IDS Solutions for Transferring Medication Information Across Patient Care Settings

Volume I: Final Report

SUBMITTED TO:

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RTI Project Number 07897.004

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RTI INTERNATIONAL

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Executive Summary

An important part of ensuring patient safety is the effective transmission of medication information across care settings. Inaccurate or incomplete information is a leading cause of medical error. This research project focuses on information exchange between ambulatory care and acute care settings. This is the type of domain the Institute of Medicine (IOM) has identified as prone to error (IOM, 1999). Further, this is an area in which several of the partner integrated delivery systems (IDS) in the Research Triangle Institute IDS Research Network share an ongoing interest in identifying solutions to enhance patient safety by minimizing the likelihood that adverse medical events will ever take place.

The purpose of this study is to gain an in-depth understanding of the medication information transfer process and identify likely process failures, which can be practically addressed. This qualitative study uses various data collection approaches to improve our understanding of the medication information transfer process. A series of focus groups with clinicians at Providence Health System provided the basic foundation of information for creating a generic care process model. Analysis of these data also informed the development of the key informant guide used during in-depth, case studies at Intermountain Health Care and UNC Health Care. From this, we developed a generalized framework for evaluating quality improvement initiatives, using a failure mode and effect analysis (FMEA) approach. We applied this strategy in evaluating the implementation of a select information technology solution for improved medication list transfer at Providence Health System. Finally, we added a series of focus groups at UNC Health Care to explore identified issues related to the patient role in complete and accurate medication information transfer.

We present our cumulative work efforts in studying the problem of medication information transfer as a series of three phases. Phase 1 of our study is a cross-IDS comparison of current "best practices" and issues faced by IDS staff related to transmission of medication information. In so doing, we explore how issues of clinician working conditions influence completeness of information transmission across care settings. This cross-IDS exploration of current best practices informs the generalized evaluation of an information technology solution at Providence Health System. Our developed evaluation framework (in Phase 2) generically applies to multiple types of information transfer solutions since there is not a single mechanism to ensure proper information transmission. The final phase of our work (Phase 3) provides for an evaluation of the implementation and diffusion of the select technology solution aimed at bridging the information transfer between acute and ambulatory care settings at Providence Health System.

Task Order Objectives

1.1 Need for Task Order

An important part of ensuring patient safety is the effective transmission of information between care settings. Inaccurate or incomplete information can be a key cause of medical error. The current research project focuses on information exchange between two complex systems: ambulatory care and acute care. This is the type of domain identified by the Institute of Medicine (IOM) as prone to error (IOM, 1999). A series of short vignettes, taken from actual practice within participating study sites, will be used to illustrate the issues involved. Names have been changed to protect confidentiality.

Case Study: Emily Pearson

Mrs. Pearson was brought to the Emergency Department from a local Skilled Nursing Facility. Staff at that facility, performing a routine assessment, had found Mrs. Pearson to have a very slow heart rate. Emergency physicians and on-duty hospitalists discussed what to do, and the possibility of a medication-related cause seemed plausible. A handwritten medication list that came with Mrs. Pearson to the ED did show that she was being given digoxin, but it did not show the dosage. Treatment was delayed while the ED and hospitalist worked to get a more detailed medication administration record from the nursing home. When finally obtained, the MAR showed a low dosage of digoxin, enabling physicians to rule out that cause and focus on other issues for Mrs. Pearson.

Information about a patient's medications is clearly a vital piece of the information exchange within our complex system of care. Successful transmission of medication information from a patient's ambulatory medical record into the hospital gives attending physicians important knowledge about which drugs to use and which to avoid during the acute episode. Likewise, successful transfer of discharge medications to the ambulatory medical record gives primary care providers key information about how to manage the post-acute phases of care.

There is no universal solution to the problem of transferring information quickly and accurately between care settings. Indeed, every health care system has developed its own unique way to deal with the issue. However, many of these techniques are imprecise, unreliable, and poorly executed. Rubak and Mainz (2000), for example, have found significant variability in the quality of discharge information received by physicians after a patient has been released from the hospital. Similarly, Liesenfeld et al. (1996) found quality problems in discharge summaries sent to physicians of diabetic patients. In a recent report issued by the Institute for Healthcare Improvement (IHI), one hospital characterized its efforts to unravel drug information at admission as "a nightmare" (IHI, 2001).

When information is not transferred in an accurate or timely manner, the potential for medical errors is increased. The problem is exacerbated both by working conditions and the increasing complexity of acute and ambulatory health care systems. Multiple providers work in multiple settings, using multiple systems of documentation to provide a patient's care. Patient stays are shorter than ever, increasing the time pressure for information transfer. Working conditions with high patient acuity, high workloads, and long hours accentuate the difficulties. As health care increases in complexity, mobility of information becomes an increasingly vital part of providing patients with safe, high-quality, error-free health care.

Case Study: Clarence Boston

Mr. Boston is a patient with end-stage renal disease (ESRD). He receives both primary care and nephrology care. Mr. Boston became quite ill at one point and had a brief stay in the hospital Intensive Care Unit (ICU). He was discharged from the ICU and the hospital. While appropriate medicines were prescribed for Mr. Boston, the medications unfortunately required prior authorization from his health insurance plan. Despite the primary care physician's best efforts, Mr. Boston could not obtain the prescriptions in prompt fashion, had continuing difficulties, and had to be readmitted.

Of particular prominence from a safety perspective is the transfer of a patient's medication list. This is especially true for older or chronically ill patients, who may have an extensive and frequently changing medication regimen. Patients are often simply asked to bring in their pills or submit to interviews by multiple providers. However, patients might not know the names and doses of all their medications, and some might find it difficult to accurately report the information while they are acutely ill. Having records on hand allows for a more thorough determination of the patient's medication regimen and reduces the likelihood of medication errors caused by unanticipated interactions, allergies, or inappropriate dosing.

Case Study: Florence Anderson

Ms. Anderson was a 56-year-old female, suffering from acute rheumatoid arthritis. Her primary care physician had worked for many months of treatment, using both the newest arthritis medications (Methotrexate, Remicade) together with chronic pain medications. One day while her primary care doctor was on vacation, Ms. Anderson was found comatose at home, and was rushed to the local hospital. She was then transferred to a tertiary center ICU with an intracerebral hemorrhage. She was in a coma for 48 hours, but, surprisingly, quickly began to recover and was discharged from the ICU to the rehabilitation unit. As her stay continued, however, staff struggled with pain control. It was not until her primary doctor returned from vacation that he was able to reinforce with staff that her arthritis medications should be restarted to control her pain.

Research evidence suggests that physicians do not consistently receive medication data across settings. Munday et al. (1997) surveyed physicians and found that although 96 percent want to receive such data when a patient is discharged, the majority often do not receive it. Rasmussen et al. (1991) found that information about medications was the item most often missing from discharge summaries sent to primary care providers. Finally, Adhiyaman et al. (2000) found that general practitioners regularly received incorrect information about a patient's diagnosis or medications from discharge summaries.

The lack of consistent transfer between acute and ambulatory settings is especially disturbing considering the focus of current quality initiatives based on discharge medications (Joint Commission on Accreditation of Health Care Organizations, 2000). The IOM's *Crossing the Quality Chasm* (2001) decries the inadequate prescription of beta-blockers, aspirin, and other discharge medicines. The extent of this quality problem is probably understated, however, because medications prescribed at discharge are not always followed up in the ambulatory care setting.

Researchers have studied a variety of techniques for improving the quality of admission and discharge summaries. These techniques include videotaped summaries (Brunham et al., 1992), handwritten, faxed summaries (Paterson & Allega, 1999), having patients take the discharge summary to their primary care provider (Colledge, Smith, & Lewis, 1992), and standardized discharge forms (Van Walraven et al., 1998). Luther Midelfort Hospital and Clinic has undertaken an extensive "medication reconciliation" process (IHI, 2001). Other research has looked at the effect of automated information systems on improving information management. Van Walraven et al. (1999) compared dictated and computerized summaries in a randomized trial, finding that the computerized summaries were communicated faster and were preferred by the in-house staff. Likewise, Archibold et al. (1998) found that general practitioners preferred a computerized summary to one that had been dictated because of the greater clarity and better access to information in the document.

Information technology would seem a natural solution to the problems of information transfer. However, IT solutions typically are not embraced if they pose an additional time burden on staff already working under stressful time constraints. Technology also poses problems of its own. A medication list from an electronic medical record may be outdated or inaccurate, and patients may suffer adverse consequences when hospital staff assume that all listed medications are active and attempt to administer them. It is imperative to verify electronic data, particularly because such data are increasingly subjected to algorithms, auto-flags, and other methods of clinical decision support (Pestotnik et al., 1996).

Case Study: Francis Morgan

Mrs. Morgan was last seen by her primary care physician in March. Her diabetes mellitus was not being managed well, and she was diagnosed early in the year with ovarian cancer. Most of her care has been delivered by her gynecologist and oncologist. Between them, they had discontinued hormones, administered pain medicine and started chemotherapy. However, her current admission cause was a failure in her diabetes management. Her primary care physician was contacted and supplied his version of her medication list from his electronic medical record system. However, none of the gynecology or oncology medications were reflected in this list. Fortunately, Mrs. Morgan's daughter was able to furnish a medication list she had been keeping for her mother, so that hospital physicians could assess the array of medications and plan for the diabetes treatment.

In summary, there is promising research but little systematic understanding of the best method to transfer medication information between health care settings. Few tools are available for health care systems to evaluate the effectiveness of their particular approach. Technology has the potential to solve many information transfer problems, but not enough work has been done to evaluate its strengths and weaknesses. Compared to the volume of work on prescribing patterns and systems for inpatient care, this area has received too little attention.

This task order was designed to fill the research gap by (1) gaining a systematic understanding of how different integrated delivery systems handle the transfer of medication lists between settings, (2) developing an evaluation framework to assess these various approaches, and (3) using that framework to evaluate the usefulness of certain technological advances in overcoming problems around information transfer.

1.2 Participating Integrated Delivery Systems

Three of the integrated delivery system (IDS) members of the RTI-UNC Integrated Delivery System Research Network (IDSRN) have participated in this Task Order. These systems were chosen because they represent a spectrum in the use of information technology (IT) within health care. A previous Task Order studied the use of IT within each system, providing a valuable foundation for understanding how they use technology to promote patient safety.

Providence Health System (PHS): A large, mature IDS operating in the Pacific Northwest, Alaska, and California. Working closely with RTI researchers, this IDS took the lead in describing current practice with regard to medication information transfer. The PHS study team is based in Providence's Center for Outcomes Research and Education (CORE), which provides health services research and evaluation services to this IDS. CORE's staff of 20 researchers and analysts assists the IDS with scientific studies and rigorous evaluation of programs and services. CORE is part of the PHS, but because it is removed from operations, it can evaluate systems and make objective recommendations.

Intermountain Health Care (IHC): Perhaps the prototypical example of a fully integrated regional health system, IHC serves small and moderately sized cities and rural areas in Utah and Idaho. IHC researchers have published extensively on patient safety issues, and this IDS is considered a forerunner in the use of IT solutions for patient safety.

UNC Health Care: An IDS in the formative stages of development, serving small and medium-sized cities and rural areas throughout North Carolina. Information systems are being added and linked to serve the geographically dispersed and real-time information demands of physicians. For example, UNC Hospitals is the major tertiary care provider for the entire state, and UNC and local physicians in dispersed rural clinics often follow up patients who receive sophisticated tertiary care at UNC Hospitals. Therefore, providing patient data housed at UNC Hospitals to physicians at geographically dispersed clinics becomes a special challenge.

1.3 Collaborative Research Process

We distinguish a collaborative research process from a traditional health services research study process. In this way, interim results are presented to relevant committees in participating IDSs in order to provide periodic feedback and seek expert clinical guidance in conducting targeted, applied research. This interactive process allows for applied IDSRN work to have maximal operational utility and be responsive to evolving, real-world issues. Findings are communicated by the IDSRN awardee(s) as contractually obligated final reports; these may also be supplemented by presentations at national meetings and publication in peer-reviewed journals. In contract, traditional health services research is traditionally completed before it is presented at a national meeting and/or published in the peer-reviewed

literature for research community commentary. In **Chapter 3** of this report, we discuss the collaborative research process at PHS within the context of our current study.

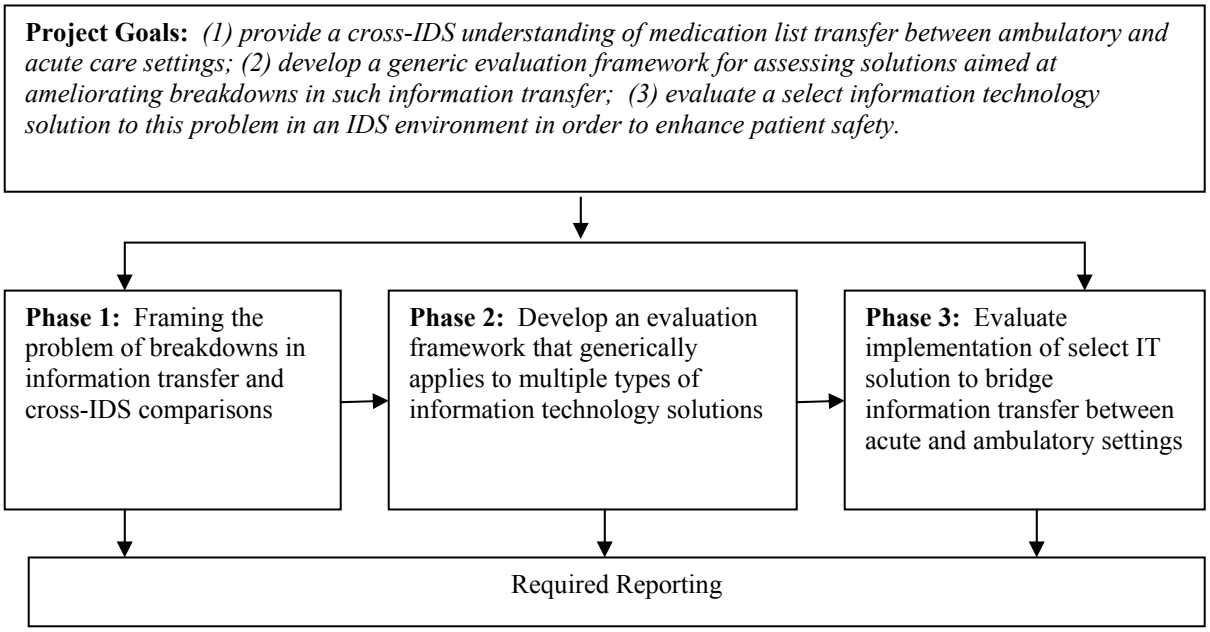
The following chapters describe our technical approach, results, dissemination plans, and indicated next steps. **Chapter 2** explains the technical approach to the various tasks and subtasks required to complete this project together with the results from this work. **Chapter 3** describes the impact of this work on IDS partners, **Chapter 4** discusses our plans for dissemination, and **Chapter 5** describes indicated recommendations for future research.

Technical Approach

2.1 Overall Objectives

This research has three objectives: (1) to systematically understand how integrated delivery systems currently manage the problem of information transfer with a focus on medications; (2) to develop an evaluation framework and a set of specific measurements that can be used to assess such systems; and (3) to use the above tools to evaluate the usefulness of one technological solution to the problem of information transfer. Thus, our research consists of three phases, each corresponding to one objective (see **Exhibit 1** below).

Exhibit 1. Project Goals and Phases



In ***Phase 1***, a series of focus groups with health care professionals in hospital and ambulatory care settings were conducted. These professionals included nurses, pharmacists, care managers, physicians, hospitalists, and emergency room doctors. The purpose of these initial focus groups was to determine how clinicians in a variety of settings currently receive medication information about patients and what types of workplace conditions affect their ability to do so. With this information, a clearer picture emerged regarding how different integrated delivery systems handle the transfer of medication information. This was documented in a generic care process map. Next, we conducted site visits at UNC Health Care and IHC, consisting of focus groups and key informant interviews to provide more in-depth comparative information.

In ***Phase 2***, the key elements from Phase 1 were used to identify an evaluation approach for assessing the effectiveness of information transfer practices. There were two principal criteria used in identifying a suitable evaluation framework—incorporation of safety principles and capability of multiple process comparisons. First, information transfer processes were compared to established safety principles, many of which have been outlined recently by the IOM (IOM, 1999). Additionally, complex adaptive systems (CAS) theory (Plesk, 2001) served as the theoretical framework for comparing the various processes used to transfer medication information. CAS theory recommends that systems use a small number of simple rules to produce desired outcomes, rather than relying on a complex, rigidly defined structure. Thus, we anticipated that comparisons between processes and safety principles would be loose rather than rigid. CAS theory leads this research in a very specific direction: using knowledge about how different systems manage information transfer to compile a list of fundamental elements that can form the basis for organizing and evaluating systems that transfer medication information. Essentially, the goal of Phase 2 was to "boil down" the existing knowledge into a small, manageable set of basic principles. The product of this phase is a quality improvement oriented framework, which is described in detail below.

In ***Phase 3***, the evaluation approach identified in Phase 2 was applied to study the effectiveness of a specific technological innovation in transferring medication information. PHS in Oregon evaluated its technological solution to transferring medication information for the purposes of this evaluative study. PHS has begun to implement an electronic interface between the outpatient electronic medical record (EMR) and the inpatient hospital system at select locations. This interface allows a patient's record to be called up during admission, where the attending physician can easily access it and print a medication list. Likewise, the interface allows the discharging physician to automatically enter any changes that were made during a patient's hospital stay directly into that patient's ambulatory medical record. The RTI-PHS team assessed the *effectiveness* of the IT solution in addressing vulnerability points in the medication information transfer process, using the evaluation approach identified in Phase 2.

2.2 Expanded Scope of Work

As our study of medication information transfer progressed and we sought to keep our AHRQ Project Officer informed, it became clear in our discussions that several issues emerged that were important additions to our original work plan. These include:

- The need for additional data to understand how incoming and outgoing patients are treated differently in home health and long-term care facilities;
- The role of hospitalists versus primary care physicians in medication information transfer; and
- Patient perceptions of their role in the medication information transfer process.

We discuss how these issues were incorporated, expanding our original scope of work, in the following sections of this chapter.

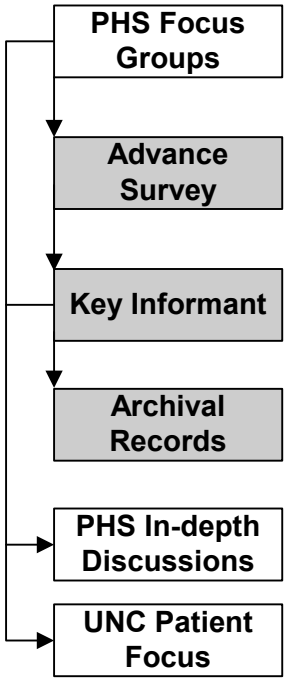
2.3 Phase 1: Describe and Understand the Medication Information Transfer Process

This initial phase of our work was intended to provide the foundation for completing subsequent phases. In the following sections (**Sections 2.3.1** and **2.3.2**), we report the methods and findings from PHS focus groups and case study site visits to IHC and UNC Health Care together with methods and results for two areas that expand our scope of work—in-depth discussions with clinical experts in long-term care and home health and patient focus groups.

2.3.1 Methods

Our assessment of the medication information transfer process is a predominantly qualitative exploration. **Exhibit 2** graphically depicts the logic flow of our data collection process.

Exhibit 2. Logic of Instrumentation Flow for Assessing IDS Solutions for Transferring Medication Data Across Patient Care Settings



PHS focus groups were conducted with clinicians at Providence Health System to inform the case study protocol and associated instrumentation as well as to develop flow diagrams.

Case study advance survey was sent to IDS consultant experts to complete prior to the site visit. This survey was used to identify key informants, strategies for in-depth investigation, and important contextual information for the site visitors.

Case study key informant interviews were conducted with a prescribed set of staff together with additional persons indicated on the advance survey.

Copies of **archival records** were requested at the time of the site visit. These include flow charts, study reports, and documentation of strategies used. We asked the IDS consultant to assist in acquiring copies of these relevant documents.

PHS in-depth discussions were completed with long-term care and home health clinical experts.

Patient focus groups were completed with UNC Health Care patients taking multiple medications discharged from medical units in the past 6 months.

We implement our iterative research process by beginning with focus groups at PHS, next conducting case study site visits at two partnering IDSs—IHC and UNC Health Care. The site visit protocol is described in **Section 2.3.1.2**, including an advance survey, key informant interviews, and review of discussed archival records (e.g., flow sheets or forms used). Based on findings from our initial effort, emergent themes suggested the need to conduct in-depth discussions to learn more about implications for long-term care and home health at both admission and discharge as well as close examination of the patient perspective.

2.3.1.1 PHS Focus Group Methodology

The focus group method was chosen as a first step in gaining a rapid overview of the medication list transfer process. While focus groups are typically convened with a homogeneous group of participants, we viewed this as an opportunity to facilitate a multidisciplinary group of physicians, non-physician clinicians, and administrators in order to understand issues and complexities associated with medication information transfer at various steps in the process. Thus, focus groups permitted participants from different disciplines to compare their perceptions of how the process works, comment on their overlapping roles, and generate multiple ideas about why and where possible breakdowns occur. These focus groups have been a productive way of getting nurses, pharmacists, physicians and managers together to discuss issues related to medication transfer across care settings.

Four focus groups were conducted at PHS facilities, involving both inpatient and primary care sites (see **Appendix A** for a generic focus group guide). On the inpatient side, a decision was made early in our study to focus our effort on specific nursing units within the hospital, rather than specific types of patients (e.g., patients with congestive heart failure or CHF). This reduced some of the variability in process due to stage or type of care (e.g., intensive care, critical care, and step-down units), allowing us to find a small number of key informants who were expert on the process and identify similar settings in all three IDSs—PHS, IHC, and UNC Health Care. We chose general medical units that deal with chronic cardiac, pulmonary, or respiratory disease. In these units, patients are often on multiple medications, and medication management is integral to their care, pre- and post-hospital stay.

The major PHS hospitals in Portland each have four such units, each with approximately 30 beds. A nurse manager typically oversees two units; and, thus, there is much commonality in the way they are run. A primary nurse model is used, which means that the same nurse admits and discharges the patient as much as schedules permit.

Recruitment. Two focus groups were conducted within Providence Portland Medical Center (PPMC), and one at Providence St. Vincent Medical Center (PSVMC). Nursing and pharmacy managers from each medical unit were given a brief overview of the study, and asked to nominate front-line staff who were knowledgeable about the medication information flow. Both managers and potential participants were given a sample of the questions to be used in the focus groups. The meetings were held during the lunch hour in a hospital conference room with lunch provided.

Physicians were not included in the inpatient focus groups in order to permit easier discussion among staff. Our experience has been that non-physician clinicians tend to defer to physicians in a focus

group, based on their historical roles in the hospital. (Exceptions are when the various disciplines have established a close working relationship or unique culture within a smaller clinic.)

One focus group was conducted within a primary care medical office of providers employed by PHS. The primary care office chosen is one in which Logician™ is used as the EMR. It was not a clinic currently piloting the use of Logician for electronic medication transfer, but still afforded the opportunity to ask about how Logician was currently used (or not used) in transferring medication information across care sites. The patients from this medical office are hospitalized at PPMC. Participation of two physicians and two medical assistants was arranged by the clinic manager. The meeting was held in the clinic conference room during the lunch hour with lunch provided. This group differed from the others by the presence of physicians. Care was taken to solicit opinions from non-physicians during the course of the group so that the resulting discussion was balanced between physician and non-physician perspectives.

Logistics. The meetings began with introductions of the study staff and the purpose of the study, including its origins and funding. Each of the participants introduced themselves and their staff position. The facilitator followed an established protocol (see **Appendix A** for generic version). The same protocol was used for the two inpatient groups and the primary care group protocol was altered to reflect the perspective of primary care providers.

Data Capture & Analysis. Each focus group lasted 1 to 2 hours. Notes of the meeting were transcribed and summarized for common themes and questions. Notes from the focus groups were sent to participants for confirmation and possible additions. (None were received.) Forms/documentation mentioned during the groups (e.g., the Clinical Admission Data form) were collected from participants after the meeting. Key ideas were coded from notes and themes emerged when ideas were mentioned in at least two of the focus groups.

2.3.1.2 Case Study Site Visits

Case studies were conducted at UNC Health Care in April and IHC in May of 2002. The purpose of these case studies was to gain in-depth knowledge of the medication information process in other regions of the country and IDS settings. We focused our discussion on the generalizability of information gleaned from the PHS focus groups and the identification of best practices at participating IDSs. Our structured case study protocol has been developed and refined based on several studies conducted by Dr. Savitz, including several IDSRN funded task orders. First, we identified a key contact at each IDS to serve as a project liaison. This person was sent an advance survey to complete at least 2 weeks prior to our visit.

Recruitment. Information from the advance survey was used to identify key informants as well as potential participants in a nursing focus group if appropriate. Once we received a completed advance survey, the research team set up a site visit interview schedule.

Data Capture. An open-ended, key informant interview guide was used together with a companion Microsoft Access database to facilitate real-time data entry at the time of interview by the two-person interview team. The advance survey and key informant interview guide are provided in

Appendix B. These data collection tools were tailored for each IDS visited with a maximum of 9 key informants per IDS. In particular, we were sensitive to OMB policies related to data collection burden and as such ensured that the number and types of key informant interviews were in compliance with relevant policies.

Data Analysis. A replication logic was used when conducting the case studies, whereby we viewed each case study (i.e., IDS visited) as a single "experiment" and focused on the confirmation or rejection of emergent or predicted cross-case comparisons (Yin, 1994; Patton, 2002). We used both inductive and deductive analytic approaches. The inductive approach involves the identification of themes through a close reading of the data for each case study (i.e., IDS site visited). Emergent themes from IDSs visited served as deductive, working hypotheses that were subsequently tested against the data from review of additional case studies and findings from the focus groups (Yin, 1994; Miles & Huberman, 1994; Patton, 2002).

2.3.1.3 PHS In-Depth Discussions: Long-Term Care and Home Health Services

In-depth discussions with clinical experts from PHS were used to more fully understand process variation in information transfer when home services (n=2) or long-term care (n=3) is the patient's admission source or discharge destination. In each case, a pair of PHS researchers spoke for one hour with representatives from Home Services and Long Term Care within PHS. The long-term care discussions included representatives from Providence's combined skilled nursing facility (SNF) and intermediate care facility (ICF).

Following the discussions, typed notes from the session were sent back to participants for further clarification and accuracy confirmation. Home services themes and long-term care themes were summarized for this report. To accurately represent the strength of a theme, a matrix was used to note themes mentioned by more than one participant (as distinct from multiple mentions by the same participant). Ubiquitous themes are emphasized in our results section.

2.3.1.4 UNC Health Care Patient Focus Groups

The purpose of the patient focus groups was to follow up on emergent themes identified from the PHS focus groups and case studies. Based on established working relationships at UNC Health Care, the research team was able to collaborate with the Marketing Department at UNC Health Care to jointly fund the focus groups, which were conducted by Jennings and Associates, a private marketing research company located in Chapel Hill and the sole UNC outsource contractor for such services.

Recruitment. We recruited inpatient participants for two, one-hour focus groups. Recruited participants were patients admitted to a UNC Health Care medical unit within the past 6 months. A list of eligible patients was provided by a UNC Health Care marketing analyst to Jennings & Associates staff. Participants were randomly selected with replacement from this list.

Logistics. Former patients (or their proxies) were recruited by telephone and offered $50 to participate in one of two focus groups on September 18—6:30pm or 8pm—at the Sienna Hotel. Nine participants were recruited to participate in each focus group.

Data Capture & Analysis. RTI research team members observed the focus groups via closed circuit television and were able to prompt the focus group moderator. The proceedings were videotaped and RTI researchers took notes. As with the in-depth discussions, thematic matrices were constructed to identify key themes. Themes mentioned by more than one participant (as distinct from multiple mentions by the same participant) were noted for analytic purposes. Ubiquitous themes are emphasized in our results section. A list of focus group questions is provided in **Appendix C**.

2.3.2 Findings

2.3.2.1 Key Findings from PHS Focus Groups

Themes were identified by reviewing focus group summary notes and coding items that were repeated in at least two of the completed focus groups. Key findings from PHS focus groups that were examined in greater depth during subsequent data collection are summarized as five main findings:

1. Breakdowns in medication information transfer are a problem that concerns clinicians, who believe that these breakdowns are definitely a source of adverse medical events;
2. Medication information transfer is not a single process, but rather a complex set of overlapping processes that—
    a. engage multiple caregivers;
    b. depend on source of admission and discharge destination;
3. Clinicians expect that patients and their family members will serve as a reliable source of information;
4. Due to heavy workloads and competing priorities, medication information education with patients/family is often limited to new medications (versus a comprehensive review of all prescribed medications); and
5. Information technology as a solution for enhancing medication information transfer has both an up- and a down-side.

In-depth discussion of findings related to these themes are organized into four areas:

- Process Steps and Variation,
- Areas of Potential Error,
- Systems Issues, and
- Potential Remedies.

The admission process and discharge process are discussed separately. Very little time was spent on medication administration within the hospital because this was not the focus of the present study.

Recruitment of focus group participants was described in **Section 2.3.1.1**. The composition of the groups is summarized below:

Exhibit 3. Composition and Timing of PHS Focus Groups

Attributes	Focus Group 1 (inpatient)	Focus Group 2 (inpatient)	Focus Group 3 (primary care)	Focus Group 4 (inpatient)	TOTAL
Date Held	10/31/01	1/04/02	2/08/02	3/05/02	
Nurse	4	3	0	3	12
Pharmacist	2	2	0	2	6
Manager	1	0	1	2	4
Physician	0	0	2	0	2
Other	0	0	2	0	2
TOTAL	7	5	5	7	24

In addition to the facilitator, two study staff members attended each group as note-takers.

Focus Group Logistics & Data Capture. The meetings began with introductions of the study staff and the purpose of the study, including its origins and funding. Each of the participants introduced themselves and their staff position. The facilitator followed an established protocol (see **Appendix A** for generic version). The same protocol was used for the two inpatient groups and the primary care group protocol was altered to reflect the perspective of primary care providers. Each focus group lasted 1 to 2 hours. Notes of the meeting were transcribed and summarized for common themes and questions. Notes from the focus groups were sent to participants for confirmation and possible additions. Forms/documentation mentioned during the groups (e.g., the Clinical Admission Data form or CAD) were collected from participants after the meeting.

Process Steps and Variation

Admission

1. On admission, nurses gather information from patients about their current medication use. They record this on a paper nursing admission form in some facilities called a Clinical Admission Data form or CAD. There are additional sources for obtaining medication information on patient medications, depending on how the patient was admitted. The variability could be described in a table as below.

Exhibit 4. Multiple Data Capture Points Varying by Source of Admission

	Admission Source			
Data Source	Doctor Office	SNF, ICF	Foster Care	ED
Patient				
Family				
Past Hospital Record				
Primary Care Record				
Pre-admit Forms				
EMS Providers				
Dictated H&P				
SNF or ICF M.A.R				
Bag of Pill Bottles				

While quantifying the volume for each source was beyond the scope of this study, the above framework may be useful for future inquiry.

2. Physicians usually repeat the nurse's initial interview, sometimes working from the patient's written list, sometimes from a list furnished by the SNF, and sometimes referring to the nursing admission form. According to focus group participants, the physician interview is often seen by the patient as a second independent interview, which is annoying and may not add to the accuracy (i.e., versus being introduced to the patient as a double-check).

3. Faced with the difficulty of securing accurate information, nurses and doctors simply do the best they can in the limited time they have.

    a. There is reportedly more effort expended on some particular types of patients—e.g., those with multiple medications;

    b. There is reportedly more effort expended on some particular types of medications—anticoagulants were used as an example;

    c. The main focus is on getting the correct information for medication administration rather than getting a comprehensive history (lack of information on the patient's current medications is usually not perceived as a roadblock to making a decision on what to administer in the hospital from the physician's perspective);

    d. From the nursing perspective, the potential for inconsistencies (omissions, duplications, or drug interactions) between ambulatory and hospital medications is exacerbated by some physicians—orders may be written, "Patient may take medications as at home" without any specific listing of what those are;

    e. Pharmacy personnel are not routinely involved in developing the medication history. Their assistance is sometimes requested by nursing.

4. Physician variability:

    a. Some specialties (e.g., orthopedics) were singled out as better than others (likely a local variation); and

    b. Some groups were singled out as better than others. At Providence, hospital care for Kaiser Permanente patients is provided by Permanente hospitalists, who have access to an EMR system. This is considered by some nurses and pharmacists to be a best practice.

5. Nursing and physician data gathering are not always coordinated.

    a. In some cases pharmacists feel a need to reconcile the information from both sources before they can establish a medication information record; and

    b. In most cases, the nursing interview is just a back-up piece of data gathering because the physician order is the true directive for the medication administration record (MAR).

6. There is also facility and unit variability in the way that medication information is gathered and documented.

Discharge

1. There are three different processes for listing medications at discharge:

    a. Discharge Instruction Form: this includes the suggested regimen (e.g., limited activity) on the top half of the form. The bottom half is an actual prescription which can be filled. The physician completes and signs this form.

    b. Discharge Summary or Discharge Letter: dictated summary which may or may not include medications, and which may or may not be available by the time the patient is discharged. It was estimated that this is available 30 to 40 percent of the time at discharge. Nursing can sometimes speed this up by calling for a fax copy or letting transcription know it is STAT; but timely receipt is sometimes at the mercy of the physician giving it a priority rating among competing obligations.

    c. Transfer orders: a set of orders transmitted to nursing facilities

2. The physician role in discharge medications and patient instruction is highly variable. Some are very thorough and use multiple means (e.g., phone calls, notes) to communicate to patients and ambulatory providers. Others are not as involved, and may not make much use of the hospital's discharge instruction forms. Sometimes a physician will later write additional medications for the patient on a prescription pad, and these are not necessarily recorded in the record. Further variation is due to the type of physician involved: hospitalist, teaching staff, Kaiser physician.

3. Nurses are keenly aware of the need to educate patients on their discharge medications. They believe that better education would make patients feel like their needs are being met better. Nurse have received feedback via patient satisfaction surveys indicating that: patients feel like they haven't received good information about their medications, no one takes time to explain their medications, they get inaccurate information, they are confused, and they are wondering about allergies.

a. If nurses feel that patients are confused or have many medications to take, they will draw a chart or table that shows what is to be taken each day, at each time of day. One person indicated she would usually do this if the patient was to take more than two medications.

b. Nurses will also print out medication information (i.e., how to take the medicine, possible side effects) for the patient to take home, particularly if the patient has questions.

c. Nurses are not particularly concerned with getting medication information sent to the primary care physician.

4. At discharge, pharmacy assistance is requested infrequently by nursing.

a. This is likely to be for complex patients or those with many medications, those taking a new medication, or one with a complex regimen (e.g., tapering steroid use).

b. If the patient is not going to be able to fill an outpatient prescription (e.g., is going to a nursing home), the pharmacist sometimes fills a 3-day supply of medicines for the patient to take home. This process is being discontinued as there is no reimbursement for it.

c. There is some division of labor – the nurse talks to the patient and family, the pharmacist makes calls to get information from outside the hospital.

5. Medication information is included in transfer orders that go to nursing homes. The perception is that this acute care-to-SNF information transfer is reliable.

6. Nurses sometimes fax a copy of discharge orders to home health as well, to help home health understand what the patient needs.

7. The medication chart (referred to above) is included in the packet that goes home with the patient and a copy is placed into the chart. But this is not usually faxed to anyone because it is duplicate of the physician orders in language the patient can understand. The chart may not include all drugs if the nurse didn't know of other drugs the patient is supposed to take.

Areas of Potential Error

Admission

1. The nursing and physician data collection process has many sources of error:

a. Patient memory or knowledge problems.

b. Lack of family knowledge of medications.

c. Omission of over-the-counter (OTC) or herbal remedies during patient self-report. An OTC example might be Tylenol, which might affect the dosing of inpatient medicines containing Tylenol.

d. Past records are used which have not been updated. For example, some medication lists (e.g., from Logician) may contain all medications ever taken not just the current ones.

e. Primary doctors may not be available to answer questions, covering physician may not know the case.

f. SNF fails to send medication administration record.

g. Doctors and nurses may simply not be as concerned about medications for certain types of patients (e.g., surgeries) and not spend time probing or clarifying frequencies and doses.

h. The doctor is likely only giving medication information relevant to admit orders but not history.

i. History and physical (H&P) information doesn't get to the unit for at least 24 hours if it is dictated.

2. Dose and frequency information is likely to be worse than the information on the identity of the medications. It is usually difficult to determine when a medication was last taken.

3. There are important medications given in the Emergency Department (ED) or Intensive Care Unit (ICU) that need to be continued on the floor, but the timing is not always known. Differing documentation systems contribute to this problem. There is variability in expectations between units (e.g., "ER used to do one page of the CAD form and they've kind of given that up;" "All the medication orders are rewritten when the patient is transferred from ICU to 2R but sometimes they forget some things.").

Discharge

1. An ideal process for ensuring appropriate discharge medications would factor in the following:

   a. Pre-hospital medications,

   b. Changes to medications made during the hospitalization, and

   c. Changes that should occur with the transition out of the hospital.

2. Most problems occur in "a" and "c" above…

   a. "a" is hampered by the problems in the admission process,

   b. information on "b" was not identified in focus groups as a problem, and

   c. appears complicated—the discharging physician may be too brief and not completely review all medications ("take medications as at home…"), the discharging physician may be a resident, hospitalist, or specialist (usually not the patient's primary physician) not technically responsible for post-hospital follow-up; in fact, it is not always clear which physician **is** responsible for post-hospital follow-up (PCP, admitting physician, specialist).

3. There are problems with physician discharge instructions:

   a. Illegible handwriting.

   b. Incomplete forms.

   c. No signature.

   d. There may be discrepancies between what the discharging physician writes and what the primary care doctor wants—most often, the patient wants to do what their primary care doctor wants; the nurse sometimes has to mediate this disagreement.

   e. Discharge instructions may include medicines that the hospital can give but are not covered by the patient's insurance on an outpatient basis. The patient gets in the middle of this formulary discrepancy.

f. Narcotics need to be written separately from other medications and are sometimes not done so in that way.

4. Focus group participants reported the following specific situations in which there is the potential for patient harm due to poor medication information.

a. There can be conflicting and incomplete information on patient allergies to medications.

b. Some patients are in a rush to leave the hospital without really understanding the medications.

c. With the many herbal medications out there, patients often mix medications dangerously.

d. Cardiac drugs can be problematic. There have been instances where patients were about to take two of the same drug because they had different names.

e. There was a case where the physician prescribed a drug, the patient also had some at home, and the patient was going to take both.

f. Some patients do not finish their antibiotics doses.

g. Some patients stop taking medications because they don't seem like they are helping.

h. Drugs with similar names have a potential for problems.

Systems Issues

It was clear from focus group discussions that problems in the transfer of medication information are built on a foundation of difficult system issues. Two stood out from the participants' perspectives:

1. Subsystem Interface

a. The hospital care system and the ambulatory care system operate as distinct subsystems with a focus on efficiency *within* settings not across them. Ambulatory physicians must make efficient use of their time and can spend limited time on cases in the hospital. (The hospitalist movement is one form of this efficiency).

b. Nurses and hospital physicians must be efficient in the care for patients in inpatient beds. There are fewer staff to care for sicker patients. Pharmacists are in short supply. Each discipline is under great pressure to be efficient with their time in their limited scope of responsibility.

c. The transition points of hospital admission and discharge are transitions in responsibility for care. The primary doctor is often not available to answer questions about medications or to be brought into the loop for follow-up care. Hospital staff play a limited role once the patient has left the hospital. Often, reliance is placed on the *patient* to furnish the required continuity of care. The transfer of medication information is only one piece of this continuity problem.

2. Multiple Providers

In both inpatient and ambulatory settings, there are multiple doctors (primary care and specialists) involved, who may be prescribing different medications and not know what the others are prescribing. For complex patients, there may be many doctors and many medications. This trend has been spurred in recent years by the lessening of managed care restrictions on patient visits to both primary care and specialty physicians. The insurance system is less and less expecting a primary coordinator of care. It is also amplified by the extreme sub specialization of many health disciplines.

To a lesser extent, focus group participants mentioned other systems issues:

3. Health Insurance Coverage

Insurance plans may not cover medications prescribed at discharge or they may require prior authorization. Inpatient covering physicians are not always aware or attuned to these requirements.

4. Working Conditions

Volume and time constraints are constant pressures which limit the ability of health care providers to gather and transmit information. On evening and night shifts, staffing is lighter and people are even less accessible to be consulted.

5. Motivation/Incentives

   a. Nurses believe that the form they complete at admission may not be utilized by physicians, pharmacists or others so they are not motivated to do an accurate and thorough job.

   b. Physicians do not believe they can bill for a review and update of patient medications, so they may focus more time on review of systems and other billable work-up elements.

6. Roles

Nursing/physician roles and dynamics are part of the process at both admission and discharge. For example, the physician may not refer to the nurse's patient interview at admission or the nurse at discharge may not want to rewrite all patient medications if the physician has said "continue all medications" because writing them individually would seem like prescribing them.

Potential Remedies

Focus group participants were asked for suggestions on how to improve the process, and were encouraged to think broadly about solutions. Their suggestions are listed below.

1. Provide Electronic Access to Information

   a. Have physicians use Logician forms to provide the admission H&P and the discharge instructions.

   b. Make it possible for nurses and pharmacists to access a patient profile, in the same way that a physician can view Logician or Kaiser's EMR.

   c. Have ED physicians access Logician for any patient from a Logician-based clinic.

   d. Have a comprehensive EMR – inpatient, outpatient, etc.

2. Improve Forms, Procedures, and Documentation

   a. Establish a hospital deadline that when a patient is admitted we get a current H&P that included certain elements.

   b. Make sure doctors have knowledge of procedures, e.g., narcotics need separate signed forms.

c. Until we get the herbal medication information online, it would be good for the nurses to get the already published book describing the interactions of prescription drugs with herbal medications.

d. Improve discharge forms for patients discharged to foster care facilities to make sure they meet foster care regulations.

3. Staffing Suggestions

a. Have a hospitalist present on site. Be able to call an internist who looks at labs, etc and makes a plan – a surrogate PCP on staff who will take accountability.

b. Have a person who would coordinate all care, including medication list information. Could be a nurse or a pharmacist. A dedicated person to follow through. "Like case manager but with more power. Can write orders."

c. Require that the primary physician manage the whole patient visit.

d. Have hospitalists available after hours.

e. Have an inpatient pharmacist involved at admit and discharge for all patients. Nurses likened this to nutrition consultation. Ideally it would be done for all patients.

4. Help Patients Maintain Responsibility

a. Keep the information with the patient. Have patients receive a wallet-sized card from the primary care provider that had information about current medications based upon physician visit on a specific date. "Have it on a disk (or a chip in their ear!), something that every time a patient sees a doctor that information is added."

b. Give the patients information in writing and verbally. There are some patients that don't read well or have vision problems so they need more counseling.

c. Make sure doctor communication to patient is appropriate. Doctors sometimes tell patients that they will go home with medications when they are really only giving the patient a prescription to be filled.

d. Provide medication information in languages other than English and Spanish. Romanian, Russian, Vietnamese would be helpful. We could do a survey to find out exactly which languages need to be addressed.

e. The patient can play a key role at both admission and discharge, by knowing the medications at admission, and by asking about changes at discharge. Same with family!

f. Establish a contract between the patient and the physician for narcotics.

5. Improve Communication Among Providers

a. Better communication between nurses and doctors would help. Nurses would like better information from doctors at the time of discharge.

b. Have more teaching service involvement. It is easier because they are at the hospital more.

c. Ask ancillary pharmacies to help. However, some ancillary pharmacies request a patient signature to give information so it is not always easy to get information due to patient confidentiality issues.

d. Would like doctors to type medication orders so they could read them.

e. It would be helpful if the pharmacies communicated between each other (e.g., Walgreen's, Fred Meyer).

f. I'd like patients go to one pharmacy to get all their medications or all the pharmacies have to communicate. Then I would like to get communication from that pharmacy of what was filled every six months.

6. Strengthen Current Process Controls, including:

a. At admission, nurses can compare the physician order to CAD and call the physician if there are discrepancies.

b. Admitting nurse can flag the CAD for Pharmacy review.

c. Nurse-to-nurse coordination between shifts.

d. Admit nurse to call PCP to fax the medication list.

e. Have the admitting physician and specialist communicate about medications.

f. Enforce P&T policy – no "resume meds" orders.

g. Ensure that patients get timely physician follow-up visits post-discharge.

h. Ensure nurses coordinate discharge plan with PCP and specialist.

i. If high-risk patient, have pharmacist or nurse to contact the PCP or patient's pharmacy.

7. Other

a. Make sure that medication lists in physician offices are updated regularly.

Process Flow

Based on focus group information, we constructed a set of detailed flow diagrams or care process maps showing the steps in the medication information transfer process, focusing on admission and discharge. These diagrams are provided as **Exhibits 5-8.** There is one overview map (**Exhibit 5**) that is presented together with detailed sub-process diagrams (**Exhibits 6-8**).

Key steps in the *admission* process include the physician order, the nursing initiation of an admission form based on a patient/family interview, and the MAR established by the pharmacy. Nursing and physicians work in parallel on obtaining medication information with the essentials coming together at the pharmacy.

Within this process, a number of key decision-points are also apparent:

1. Does the patient know their medications or should further research be done by the nurse?
2. Does the patient have an allergy that should be flagged for pharmacy?
3. Is the patient information consistent with the physician orders? If not, how much effort should be spent on reconciliation?
4. Can an appropriate MAR be developed with the information at hand?

The overall process is depicted in **Exhibit 5**. The process of gathering information on medications is so extensive, at times, that the process is detailed in a sub-process diagram (**Exhibit 6**). The detailed sub-

process diagram illustrates an important point: the nurse makes decisions about how much data gathering to do based on: (a) the availability of information and (b) the patient's condition.

Primary steps in the *discharge* process include the discharge orders (physician), the discussion of medications with the patient (nursing), and the transmission of new medications to subsequent providers (nursing, physician, and medical records). Key handoffs include both the discharge order, which signals the nurse to prepare the patient for discharge, and the discharge instructions, which furnish the basis for patient education on medications. A critical decision is whether either nursing or the physician communicates with subsequent providers on medication issues. If not, this is left to the transmission of a dictated discharge summary through the hospital medical records system.

Exhibit 7 shows the difference in the process flow when the ambulatory medical record system, Logician, is used at Providence. The steps are basically the same, but instead of a dictated discharge summary, the physician types a brief summary and, importantly; updates the Logician medication list.

Many patients are admitted through the ED so the process has been given a separate sub-process diagram (**Exhibit 8**). Many of the key steps are the same with slight variations. The encounter is brief and focused. Allowance is made in the flow chart for steps that are specific to the Providence System, where ED physicians have access to Logician and also to the Kaiser Permanente Epicare system. For the most part, the process of medication information transfer on the nursing floor is the same whether or not the patient has been in the ED. A nursing interview is still conducted. Patient medications documented in the ED are not thought to be completely reliable, given the time constraints and pressures on the ED and the typical absence of the patient's regular physician until an admission is indicated.

Exhibit 5. Medication Information Process Overview

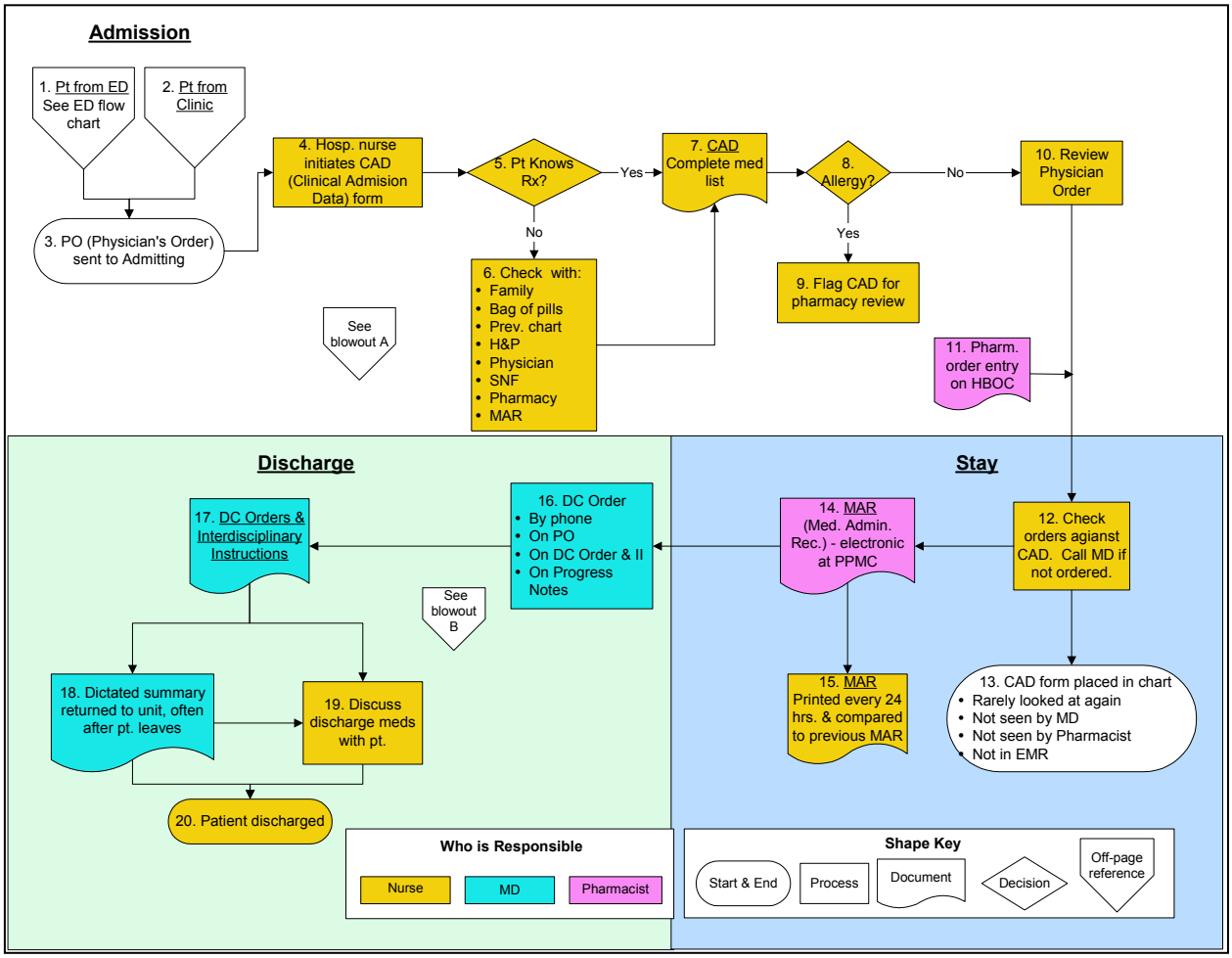


Exhibit 6. Medication Information Transfer Admission Process: Information Gathering

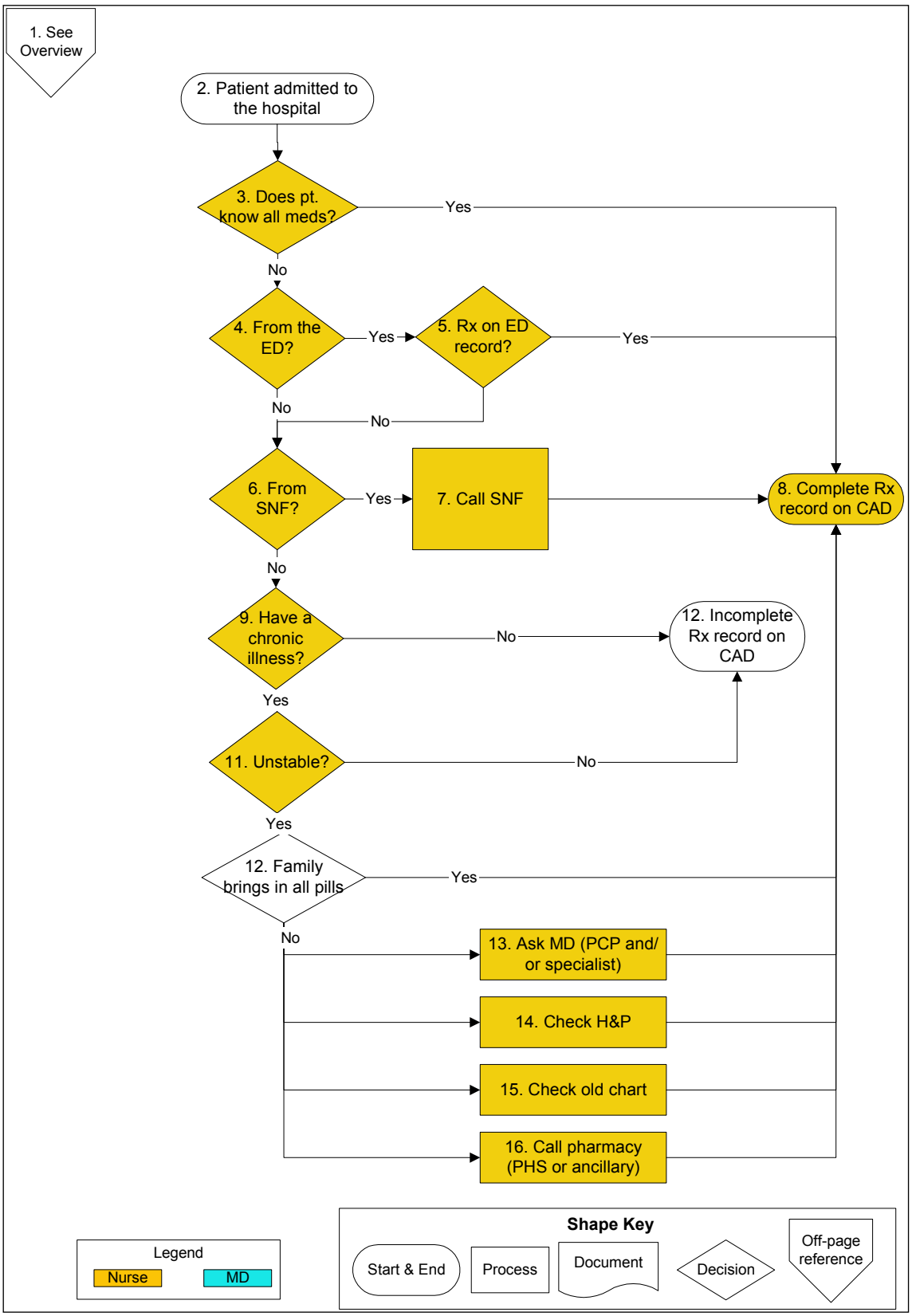


Exhibit 7. Medication Information Transfer Discharge Process with Logician

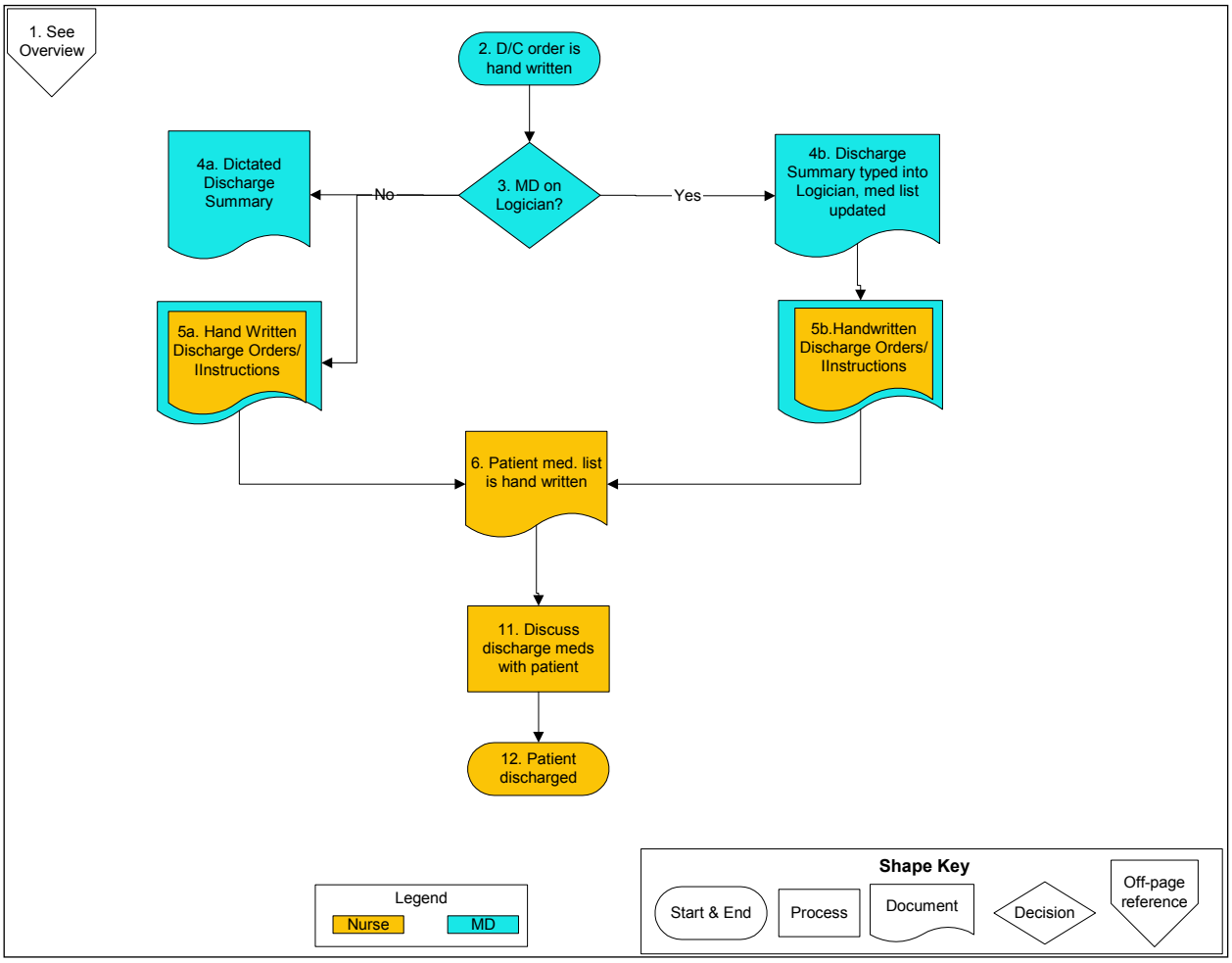
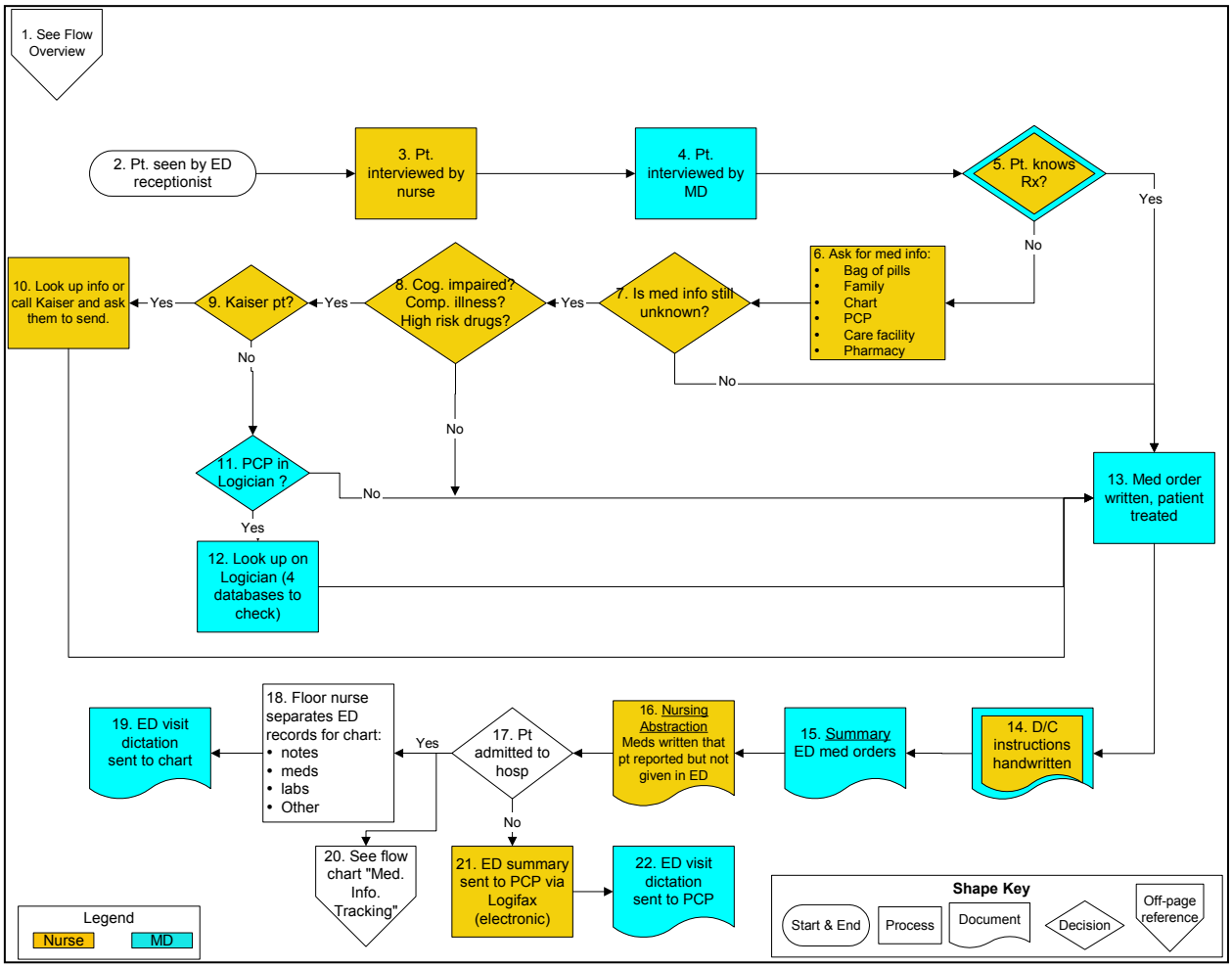


Exhibit 8. Medication Information Transfer ED to Hospital Admission



2.3.2.2 Case Study Site Visit Summary

We conducted two case studies, one at UNC Health Care in April and one at IHC in May of 2002. Site visits were completed at IHC and UNC Health Care as follows:

IDS	Facility Site	Brief Description:
IHC	McKay-Dee Hospital	Mid-size, community hospital
	LDS Hospital	Large, urban teaching hospital
UNC	NC Memorial	Mid-size, tertiary care, teaching hospital

Our case studies included nine key informants at each site as depicted in **Exhibit 9** below.

Exhibit 9. Number and Type of Clinicians Interviewed at Site Visit

Type of Clinician	Number at UNC	Number at IHC
Nurses	3	7
Pharmacists	2	1
Social Workers	2	0
Case Managers	0	1
Primary Care Physicians	1	0
Administrators	1	0

We were also able to conduct a focus group with 12 nurses, representing six units across the IDS at UNC Health Care. In that focus group, we sought to confirm findings elicited in the PHS focus groups.

Best Practices. Surprisingly, we found best practices across IDSs to be fairly consistent with information technology solutions related to medication ordering and supply through off-the-shelf vendor offerings. There was also a high degree (almost exclusively so) of standardization in the medication information transfer process across inpatient units. Key informants reported that the source of admission and place of discharge influenced the quality of medication information with higher quality information coming from and going to SNFs and home health services (largely due to regulatory requirements).

Facilitating Factors. The top five factors that facilitate effective medication information transfer include (in descending order from most to least):

1. Good information obtained from patient or family member(s);
2. Computer system (for ordering and inventorying, e.g., Pyxis);
3. Good communications (i.e., doctor to nurse and clinician to patient);
4. Pharmacists on the care team; and
5. Multiple checking systems.

We do note, however, that the inclusion of social workers as part of the care team, rounding with physicians and pharmacists, was an important facilitating factor at UNC Health Care. This aspect of the care process assured that affordable and accessible medications were prescribed for discharged patients.

Barriers. The top five themes (in descending order from most to least) noted in analyzing barriers to effective medication information transfer were:

1. Incomplete information obtained from/provided by patient or family member.
2. Inadequate communications (i.e., doctor to nurse and clinician to patient);
3. Nursing work load (FTE reductions combined with decreased length of stay and increased paperwork demands);
4. Computer system delays (data entry, information processing, cross-checking, and inventory dispensing); and
5. Patient access to medications post-discharge.

Other barriers noted included the timing at which medications were dispensed through the electronic dispensing protocol and pharmacist overload and lack of sufficient pharmacy staff on the floor to efficiently verify and dispense needed medications. We also note that electronic systems that offer automatic notes to be sent to the primary care physician at discharge require that the patient properly identify the physician; and these systems are often limited to a single automatic send selection when there may be more than one physician involved in a patient's care. Further, we note that PCP expectations for comprehensive medication updating prior to discharge and clinical staff expectations of the patient role as broker of accurate medication information are frequently incorrect. The paradox here is that patients are expected by clinicians to know this information while clinicians are often too busy to provide complete information and answer patient questions.

2.3.2.3 Transitions from Hospital to Long-Term Care and Home Services

Discussions with staff at nursing homes and home services elucidated the process differences for patients discharged to long-term care facilities and home health services. The discussions also revealed a number of potential failures with regard to medication information transfer. We have organized these findings into three subsections for each destination type: process of information transfer, potential medication information failure(s), and resources for addressing medication issues.

Long-Term Care (LTC)

1. Process of Information Transfer to LTC

   a. Discharge information from hospitals varies by hospital and often has gaps. If there is an H&P, it typically contains the patient's pre-hospital medication list. Discussants was estimated that the SNF receives the H&P about 70 percent of the time. The last few days' hospital MAR may also be included.

   b. Often, the first physician orders from the hospital arrive before the patient does. Although the initial physician orders are helpful in terms of preparing for the patient, the discharge orders often differ from the initial orders. Discussants confirmed data from earlier interviews that a physician who barely knows the patient may write these orders.

c. Physicians do not always have a good sense of what medications their patients are taking at a given time. During the hospitalization, some medications may have changed. It is likely that a current medication list does not exist; it is the responsibility of the nursing facility to create one.

d. Pharmacists within the LTC facility start preparing medications based on the faxed physician orders, but may need to make changes once the physician's discharge orders arrive. The pharmacist often identifies discrepancies in the medication list, and typically contacts the nurse/residential care manager (RCM) to resolve the issue with the physician. Sometimes the pharmacist works directly with the discharging hospital physician.

e. The unit assistant transcribes the orders and lists them on a new MAR; the RCM confirms that the MAR matches the orders and that the orders make sense (dosages, medications, frequency, no contraindications, etc.). If the unit assistant and/or RCM is not available (neither position is staffed 24/7), the charge nurse does this.

f. Some hospitals are good at forwarding the necessary information to nursing facilities but others are not. In order to make this determination if it is not otherwise clear, the nursing facility RCM/nurse must look in several places. These include the hospital H&P, the hospital admission note, the nursing facility's family interview regarding medication lists, and potentially elsewhere.

g. For both the SNF and ICU units, ideally, the RCM will compare *all* medication list sources (hospital, physician, family, etc.), and will contact the primary care physician if there is any discrepancy. However, it was noted that the primary care physician is not always involved in the hospitalization. Securing complete information can be extremely time-consuming.

h. It is important to note that more admissions occur in the late afternoon (evening shift) when the staffing level is lower than it is for the day shift.

i. For patients from LTC who are admitted to the hospital due to a crisis, copies of current medication and treatment sheets are included. However, the other information on the transfer form is written by hand (at a time when the nurse is focused on managing an individual in crisis). Ideally, this information includes details about when each medication was last given to the patient. However, this process can be an avenue for missing information.

2. Potential Medication Information Failures During Transition to LTC

a. LTC facilities have an essential need to know the medication history for psychotropic medications, due to regulatory issues regarding chemical restraints. Nursing homes are not allowed to use restraints (chemical or physical). A patient with a history of a psychotropic medication prior to hospitalization can continue with the medication, because (presumably) it's not being used as a chemical restraint. Someone with new use of psychotropics (that is, use was started during hospitalization) probably has the medication as a chemical restraint. The nursing home then has the obligation to explore other ways to achieve behavior management with the goal of reducing or eliminating the medication.

b. It is common to receive incomplete information, for example, a specific medication but without a dose. It is also easy to miss a medication because it was not included on the hospital (or other) transfer orders. Oversights regarding contraindications occur. Discussants believed it is far more common to have *missing* information than *wrong* information.

c. The level of challenge is much greater when hospital's discharging physician is less accurate or complete with the medication list. On-call physicians tend to be less thorough than physicians who have a long-standing relationship with the patient.

d. Orthopedic surgeons often make temporary changes (such as with hypertension medications) but do not make it clear whether to revert back to the previous medication regime. This results in a time-consuming process for the nursing facility to resolve any discrepancies.

e. Another challenge is surgeons who do procedures without taking a complete medical history. This results in a medication list that differs greatly from the primary care physician's medication list. Again, the nursing facility is responsible for resolving the discrepancy.

f. Families usually know about a patient's home medication regime. They usually do not know about the new, post-hospital medication regime. There are challenges if there was a medication change during the hospital; an example might be a change in hypertension medication but the family is not informed about why the change is made. The nursing facility keeps things as they currently are until they learn otherwise.

g. Patients may get the wrong medication or the wrong dose of the right medication. Doses may be missed. Unclear directions result in incorrect dispensing. These issues are attributable to human error, the MAR system, and the ergonomics and other challenges of 40-year old medication cards that are not designed to dispense medications in the way that they are received from the pharmacy.

h. A small source of error is transcribing information provided by the hospital into the nursing facility's system.

i. It is common for the nursing facility to receive an order "resume all medications" from the hospital discharging physician. This is particularly an issue for patients of orthopedic surgeons. The nursing facility then needs to track down the correct information and get a physician order for the newly resumed medications. The nursing facility can get caught between the primary care physician and the orthopedic surgeon who are "passing the buck." Resolving such issues can be very time consuming. It can impact whether patients receive the right medications in the right doses at the right time.

j. There is a systems error in that the pharmacist is often unable to prepare medications until 6pm. However, a patient admitted in the morning may have missed medications. This can be a particularly important issue for pain medications.

k. Families often bring the patient's medications to the nursing facility days or weeks after the admission. In an ideal world, this would occur the day of admission.

l. One interviewee noted that the three top situations impacting orthopedic patients greatly are: (1) pain medications, (2) anti-coagulation medications, and (3) psychotropic medications.

    1. Most orthopedic patients (and many other patients) have pain medications. However, until the medication orders are completed, it is not possible to dispense medications. As a result, pain gets out of control.

    2. The issue with anticoagulation medications is dosing. Information about where they were in the hospital is not always provided. There are lots of critical INRs. The nursing facility needs to do more extensive blood level monitoring for patients with these medications, even if it means daily pro times.

    3. As noted earlier, the nursing facility has the obligation to minimize the use of psychotropic medications. It is essential to know whether the psychotropic medication was initially prescribed during the hospitalization, or whether it is a medication the patient has used for a long period of time. In the former case, it is likely that the medication was given for post-operative delirium and both can and should be tapered.

m. Another situation is medications that appear to contradict each other. For example, it is not uncommon for a patient to receive Ritalin and Respiridol simultaneously but without an explanation of why either medication is prescribed.

3. Resources for Addressing Medication Information Issues in LTC Settings

a. Family information is critical to completing the list of current medications, particularly if a medication was stopped prior to surgery. Families often bring a "grocery sack" of medications. Families have a huge role in identifying the current medication list. They might have important insights about what led to a change in the patient's condition.

b. Physicians who do not complete the discharge orders completely and accurately often must provide the information directly to the nursing facility when the nurse/RCM contacts them (by phone or fax) for clarification.

Home Health Care

1. Process of Information Transfer from Acute Care to Home Services

The emphasis in these discussions was on home health as a discharge destination, although there was some discussion of admission to the hospital after home health had already been involved.

a. The first medication information after a hospital discharge comes to home health by fax. Since most home health patients come directly from the hospital, the fax typically comes from the hospital.

b. The content of this first fax can vary, but is often a summary of the hospital MAR. Significantly, it typically occurs *prior* to hospital discharge (which is necessary for home health so they can start planning and assign the appropriate clinician). At hospital discharge, however, a physician often changes medications and/or dosages. The discharge medication list is sometimes, but not always, faxed to home health (if it is, it simply "updates" the previous information). The discharge information does go home with the patient, who often, but not always, shares the information with the home health nurse or other clinician.

c. A medication list is compiled at the first home health visit by whichever clinician is involved. home health providers compile the medication list "empirically." That is, they ask patients to find all of their medications (including over the counter and complementary medications) from around the house, and then go through the bottles one by one. This list is then compared to orders received from the hospital or other health care providers.

d. Home health staff contact physicians to clarify discrepancies between the orders and the newly compiled medication list. The referral identifies which physician to contact. Typically, the physician following the patient in home health is *not* the discharging hospital physician. Often, the primary care physician follows the patient in home health. Sometimes a surgeon or other specialist follows the patient.

e. From the primary care physician's perspective any medication information is provided for signature only. There is not a systematic process to compare the new medication list with previous medication lists in the medical record. It would be unusual to enter the new medication list into the medical record.

f. Similarly, home health typically does not transfer medication information when they discharge a patient. In part, this is because there is no one designated to transfer the information to.

2. Potential Failures in the Transition from Acute Care to Home Services

Each entity across the continuum of care has its own formats and forms to store medication information. Even within the same type of provider (physician, hospital, etc.), each has a unique system. Accordingly, significant time is spent transcribing information; such a process if ripe for errors. Significant time is wasted for a subsequent provider who must collect previously-gathered information into a unique format.

a. The current system was likened to "traveling through Europe, where each region speaks its own language so information must be translated at each country border." Medication information must be repeated with each transfer across the continuum of care. There does not exist a "lingua Franca" for medication information.

b. Medications and other current treatments often change between the initial hospital fax and the discharge orders, which are not sent to home health. As a result, there could be 2 different "official" medication lists from the hospital. To compound the challenge, each hospital uses different forms; some provide computer printouts, some a handwritten list. In general, home health's process is consistent regardless of who referred the patient to home health services.

c. Typed hospital discharge summaries can take up to a week to arrive, so are not as useful to home health as they could be.

d. There are many opportunities for errors in this process: there may be other physicians involved, there may or may not have been clinical changes that make medication changes appropriate, the possibility of paper/transcription errors, etc.

e. The fact that results of home health's "examination of the pills" are not systematically shared with PCPs (or others) is a lost opportunity.

2.3.2.4 Patient Focus Groups

We conducted two focus groups, each with nine participants recruited from four counties. The focus groups were held on September 18, 2002 in Chapel Hill, North Carolina. Participants in focus group one were 43 years of age on average (ranging from 24 to 73) with two males and seven females. Participants in focus group two were 42 years of age on average (ranging from 23 to 68) with two males and seven females. We attempted to balance racial-ethnic and income diversity of the focus groups. Participants were paid $50 and refreshments were provided.

Key themes identified from these focus groups included:

- Patients learn from experience that they must be the broker of their health information;
- Patients believe it is essential to have a family member or friend with them at all times to oversee their care;
- None of the patients could identify a single health care provider that was aware of all their medication information;
- Improved communication across various clinicians and departments treating a patient during their stay is necessary;
- Patients who clearly understand their medications are often confused when admitted because the hospital pharmacy substitutes other brands or generics so the medications don't appear to be the same;

- Nurses and doctors are often frustrated when patients and/or family members ask questions because they are too busy;
- Printed materials on new medications are typically provided at discharge but little discussion of these new medications together with previously prescribed medications that should be continued is typically offered;
- There are often delays in receiving medications that don't make sense and can have adverse effects;
- Doctors should listen to patients and their family members; and
- Specialty units have a better quality of care with respect to medication information transfer and patient education than do medical units with diverse patient populations.

Appendix C includes quoted responses from focus group participants to the question: If you were the CEO of UNC Hospitals, what two or three things would you do to improve safety and quality of care? Key themes are confirmed in these responses.

2.4 Phase 2: Develop an Evaluation Framework

2.4.1 Methods

2.4.1.1 Using a Framework Based on Safety Principles

The study began with the premise that the information transfer processes would operate under a set of safety principles. The purpose of our focus groups and discussions were to document how these principles were applied within each IDS.

To our surprise, only a few safety principles are adhered to in this process. **Exhibit 10**, below, typifies what we found across all three sites, in focus groups and key informant interviews. The safety principles, as listed in our work plan, are adopted from the IOM Report, *To Err is Human* (1999).

Exhibit 10. Evaluating Medication Information Transfer Against Common Safety Principles

Safety Principle	Early Findings
Simplify the process, reduce variation	The process varies by admission source, admission unit, discharge destination and treating physician. Staff may spend a lot of time or no time at all in reconciling medication information, depending on workload, training, and perception of patient risk.
Make things visible	Medication lists and allergies are not always easy to find within inpatient chart.
Standardize layouts and information displays	Structured forms are available; they may or may not be completed.
"Affordance" and mappings	There is little standardization in appearance of medication lists and allergies in acute and ambulatory settings.
Written protocols for high-risk medications	There are few written protocols for ensuring that pre-existing high-risk medications are asked about and documented (although there are many protocols for *administering* high-risk medications).
Pharmaceutical decision-support	Pharmacy is only sometimes involved in admission and discharge.
Involve patients	Patients are interviewed about medications, and are used as a corroborating source by both nurses and physicians. They are educated about discharge medications, although this may be limited to the new medications written in the discharge instructions.
Improve patient knowledge	Some attempts are made to rewrite instructions to make them simpler to understand (e.g., write out abbreviations, create daily dosing tables).
Incorporate feedback	Feedback is difficult – medication information at different times and from different sources may be different for good reason.
Constraints and forcing functions	Medication allergies are not a required field during the admission process.
Include possibilities for recovery	Few checks and balances are built into the process. Reconciliation is at the discretion of staff – they will call attention to discrepancies if they have time and believe they can acquire a definitive response from another source.

Adapted from *To Err is Human*, IOM, 1999.

In addition, performance measures for this process are few and far between. That is, none of the IDSs routinely collect data on the accuracy of information transfer with regard to medications.

2.4.1.2 Using a Framework Based on Complex Adaptive Systems

A second evaluation framework considered for the study is that of complex adaptive systems (Plesk, 2001). We believed that staff within our systems would need to act in adaptive ways to deal with the difficulties of medication information transfer. In complex environments, a few simple rules might cover a wide range of behavior that is needed to cover the myriad of situations encountered (Plesk, 2001). Plesk describes these rules to be of three kinds:

1. overall direction-setting
2. prohibitions
3. resources and permissions

For the medication information transfer process, we proposed the "rules" listed in **Exhibit 11**.

Exhibit 11. Simple Rules for the Problem of Medication Transfer

I. Overall Direction: Quickly develop a "good list" of medications
- A "good list" includes all medications to be stopped, started, or continued during the hospital stay, plus those with possible significant interaction with hospital treatment.
- A guiding factor in developing this list is the condition being treated (diagnosis) and any related secondary diagnoses.
- There should be a focus on high-risk patients and medications

II. Prohibitions: Don't rely on any single source of information

III. Resources and Permissions: Use any or all of the following information sources and tools to aid the process:
- records of past hospitalizations
- ambulatory chart list
- interview with patient
- interview with family
- results of vital signs or diagnostic tests
- checklists of high-risk medications
- pharmacy consult
- physician consult

Complex adaptive systems (CAS) theory would seem to be particularly applicable to the medication information transfer issues under study, as they fit with Plesk's reference to the need to operate in a "zone of complexity" (Stacey, 1996). This zone is characterized by a fairly low degree of certainty about the situation at hand, coupled with a lack of agreement about the situation and what should be done. The current study topic certainly fits here:

- there is a lack of certainty about what medications a patient is currently taking, and whether current information is good enough to proceed without further research, and
- a lack of agreement among data sources and even different provider disciplines about the importance of knowing about and continuing previously taken medications.

CAS theory led us to seek knowledge about how different systems manage information transfer, and to compile a list of fundamental elements that could form the basis for organizing and evaluating systems that transfer medication information. Essentially, the goal of Phase 2 was to "boil down" the existing knowledge into a small, manageable set of basic principles.

This is why the collective learning of three different IDSs was thought to be crucial to the project. The systems provide a range of sophistication with regard to information technology, different work environments and approaches to handling issues on working conditions, and different challenges in formally linking primary and acute care. From this variety we expected to find a rich set of solutions to information transfer, and from our work distill a small set of rules to guide them.

However, as our work progressed, we found that focus group participants and key informants expressed much more discomfort about the current process than we imagined they would. There was almost universal agreement that there was wide variation in practice, potential for error, and a lack of good systems for addressing transfer issues. Staff appears to be diligent, responsible, and adaptive, but the resulting system for transferring medication is not "good enough" by their own standards.

We did find examples of providers optimizing the use of their time and expertise within their system of care (their micro-system). However, the transfer issues we encountered were not handled well by this type of optimization. Adapting well within the micro-system did not optimize care for a patient moving across the continuum. The basics of CAS theory were not sufficient for us to elucidate and evaluate in depth the transition issues we encountered (although CAS theory suggests some approaches to tackle the underlying issues, a topic which will be discussed later in our report).

We, therefore, sought a method of assessing the risks and potential improvement opportunities that could span the subsystems of care. Moreover, we searched for a *proactive* risk assessment tool that would help us assess the inherent risks in the current process, guide further data collection, and provide participating IDSs with priorities for action.

2.4.1.3 Potential Use of FMEA

Contacts with national experts in patient safety found that FMEA was a promising proactive risk assessment strategy for health care, having been promoted by the Joint Commission on Accreditation of Healthcare Organizations (JCAHO) and adapted for nationwide use within the Veterans Administration (VA) Health System by their National Center for Patient Safety.

Trained PHS staff were included in the research project, informing the team of JCAHO and VHA approaches. A literature review on the technique was conducted. A bibliography of this review is included in **Appendix D**. In addition, the study team assessed the fit of the method to the data collected from Phase 1. We determined that much of the rich detail on the medication information transfer process, its breakdowns, and its potential impact could be captured within an FMEA framework.

A literature review on the FMEA approach was conducted, using the following databases: Medline, HealthStar, and CINAHL (Nursing & Allied Health), using text word searches on "FMEA", "failure mode$" ($=wildcard), and "effect$ analysis." The NASA technical reports database was

searched using the term "FMEA," as was the U.S. Patent Office database. The main purpose of the literature review was to ensure proper use of the technique, and to answer initial questions about the basis for the ratings used in this approach. Twenty-two articles were obtained from this review, from the health care and engineering literature. Brief abstracts of these articles as well as material from Internet searches are provided in **Appendix D**.

In brief, the FMEA tool provides an approach for listing the steps in the process, the potential failures at each step, the causes of these failures, and the resulting effect on the patient. Each failure is rated as to its likelihood of occurrence, the severity of its effects, and the likelihood that it will be detected prior to causing harm.

For our study, the care process map was already completed. The discussions had revealed the breakdowns or "failures" in the process as well as some of the causes and effects of these failures. The FMEA tool could, therefore, be readily applied to the problem of medication information transfer by the study team, incorporating the focus group and key informant material.

2.5 Phase 3: Evaluate an IT Solution at PHS

2.5.1 Applying FMEA in the Current Study

2.5.1.1 Listing All Potential Failures

We culled information from focus groups and key informants that dealt with failures and errors. We *added* some things we didn't hear about in focus groups, for the sake of completeness. These additions are important because of the reticence of focus group participants and key informants to mention things that are considered substandard care. An example would be a nursing admission form that is left blank. This is a known possibility but was not mentioned in focus groups. In the results section below we distinguish between those failures mentioned in focus groups and those we added.

We emphasized the things that carried the theme of information transfer — a failure based on not knowing historical medication information. At times, we included transition issues such as failures to send or receive information. Less emphasis was put on transcription errors or slips and lapses within a particular setting. Along with administration errors, these were thought to be beyond the scope of the current study.

We listed failures associated with each process step. In so doing, we tried to avoid repeating the error later if it was built on an earlier failure. For example, the discharging physician could be reasonably expected to review the hospital H&P in developing discharge instructions. If a failure had occurred and the H&P was incomplete, it was not considered an *additional* failure for the discharging physician not to research and correct it. Similarly, pharmacists were expected to fill prescriptions based on the information given them and to use available tools for consistency checking. They were not expected to do an independent study of a patient's past medication and allergy history.

These assumptions were made for the purpose of associating risks with each step. We *do* believe that staff at later steps should check the work of staff performing earlier steps, where possible.

2.5.1.2 Prioritizing the Failures for Further Scrutiny

In most FMEA situations, a group decides on which of the many possible failures to focus. The VA has suggested using a "decision tree" to guide this work (DeRosier et al., 2002). Within the current project, the research team screened potential failures to determine which to focus on more closely. We utilized a decision matrix to identify the most important failures for the FMEA, using the same criteria as the VA's HFMEA process. The detailed tool is provided as **Appendix F**. In brief, we eliminated:

- failures that were outside the scope of the study (e.g., patient memory loss),
- failures that we could potentially imagine but seemed remote and were never mentioned in interviews (e.g., the physician wrote orders for the wrong patient), and
- failures that would be easily detected and stop the process from proceeding (such as the complete absence of a physician admitting order).

Minimal pre-screening of the failure modes was done, as we believed that the FMEA process is itself a screening and prioritization process. We did attempt to concentrate on failures that were:

- most often mentioned as important problems in the interviews;
- most related to not having the historical prescription information;
- failures unlikely to be immediately detected; and
- failures under staff control (e.g., not "patient lied to us")

2.5.1.3 Rating Assumptions and Methods

As noted in the literature review, there are many approaches to a failure mode and effect analysis. Clear assumptions and rater guidelines are critical to effective use of the tool. Our important assumptions are stated below, to make it clear how our approach might differ from those used in other settings.

Patient case mix

The type of patient rated is critical to the ratings. An error for a low-risk patient will not have the same effect as the same error for a high-risk patient. A missed medication can make a great deal of difference within one patient and very little difference in another. Some medications are more important than others.

For this reason we considered having two failure modes at each step, one for low-risk and one for high-risk patients. This approach has been advocated (Haviland, web site; JCAHO's Croteau, personal communication).

However, the purpose of the FMEA in our study was to (a) compare and prioritize failure modes within this process, and (b) compare the current process to one facilitated by an IT solution. The patient risk level doesn't change these comparisons as long as the assumptions are the same within each aspect of the FMEA. We therefore simplified the rating task and assumed that all patients were high risk. That is, they were patients where the frequency, dose, and presence of medications were important.

The single drawback of this approach is that the resulting FMEA scores may not be comparable to scores from FMEAs on other processes where the assumptions are different (e.g., for the "typical" patient). We comment further on this issue in **Section 2.5.2** below.

Rating the ED Process Separately

We addressed the process in the Emergency Department separately, for the following reasons:

- Two-thirds of medical patients in these hospitals come through ED (it is an important process).
- The conditions differ in some ways:
  - Patients are in more critical condition;
  - Time pressure is greater;
  - There is less knowledge of the patient;
  - It is less likely that the patient has brought medication information;

  - Stays are shorter and it may be more important to stabilize the patient than to resume home medications.
- For the above reasons, ratings of frequency, severity, and detectability differ.
- Causes of failures may be different.
- Solutions/actions may be different.

Framing the "IT Solution"

The Logician IT solution was rated as designed to show the risk reduction potential of this approach. In effect, we rated the ideal. We didn't include any failures such as "physician doesn't use Logician." In a separate part of the study, we describe how Logician is currently used, including barriers to using it as designed for this purpose.

More specifically for the ratings, "Logician as designed" means that the Logician medication list is included as part of the hospital admission H&P, and referenced by the admitting physician when making up the hospital medication orders. It is used as a reference guide for a patient interview. The discharge summary is developed using Logician form components, which allow the physician to update the ambulatory medication list simultaneous with the discharge summary. This process step is performed in advance of the discharge instructions, enabling the instructions, summary, and ambulatory medication list to be identical.

Wording of Failures

The team worked diligently to make sure that each failure mode was clearly worded for rating. This was not a simple task, and many revisions were done. Of particular difficulty was distinguishing between failures, causes, and effects. As noted by other researchers (Bedford & Cooke, 2001; McDermott, 1996), this is an area of potential confusion within the FMEA tool.

An example illustrates these difficulties. Two alternatives are shown below for the failure, "physician (MD) orders a duplicate medication."

Exhibit 12. Example Implications of Alternative Failures

	One Way to Fail	Another Way to Fail
Root Cause	ED has little time to assess the threat	MD doesn't review ambulatory data or call PCP
Cause	MD doesn't review ambulatory data or call PCP	MD doesn't know home medications
Failure	MD doesn't know home medications; orders duplicate	Patient receives wrong medication, dose or frequency
Effect	Patient receives wrong medication, dose or frequency	Patient harm level - ADE, death, extended stay, etc.
Severity	Patient harm level - ADE, death, extended stay, etc.	

We used the strategy on the left in our assessment.

Effects

Effects were worded in terms of what potentially could happen if the failure occurred. Examples would be that a patient received a wrong medication. Effects were not worded in terms of harm (e.g., adverse drug reaction), because patient harm is included within the severity ratings.

Severity Ratings

The severity of every failure-effect combination was rated, and there was usually more than one. The rating scales were phrased in terms of patient harm, i.e., "Would this failure-effect combination cause death, disability, discomfort, dissatisfaction, or..?"

Generally, the amount of *time* a patient was at risk was *not* taken into consideration by the rater, simply because it would make the ratings too complex. However, it is acknowledged that different failures create different "exposure windows" – the amount of time when the patient is taking the wrong dose, drug, etc. and harm could be occurring. Examples are delays in information transmission. A delay in transmittal of a discharge summary extends the time when a patient is taking the wrong medications before the follow-up physician can take notice.

A further step for the FMEA would be to add this dimension, based on the time between a failure and its detection. The exposure window would be an additional means of prioritizing failure modes for action.

Occurrence (Frequency or Probability) Ratings

The failure-effect combination, that is, the frequency that both the failure and its effect would occur, was rated. For example, we rated the frequency that a physician does not write a comprehensive prescription list *and therefore* the patient doesn't take proper medications. If the physician doesn't write a comprehensive list about 50 percent of the time, and of these patients, maybe 50 percent would therefore take the wrong medication, then the rating would be 25 percent or 1 of every 4 patients.

List of Detection Methods

This list was brainstormed as background to the detection rating, and was not exhaustive.

Detectability Ratings of Failure Mode

We rated the detectability of the failure, not the cause. All of the detection methods together were taken as a group. In essence, this results in ratings based on the best detection method available.

List of Causes

Both direct and root causes were listed, although the emphasis was on the immediate.

List of Potential Controls and/or Actions to Reduce Failure Mode

Actions can decrease failures, address causes, or improve detection mechanisms. A list of actions to address these issues is only partially begun. It will likely be generated by teams within each IDS.

Other

There are small differences between the listing of failures and the FMEA form. The listing of failures is stated generally, whereas the FMEA form is more specific in its wording, to guide the rater. This rating task is not easy, and it is important that the rating element be clearly held in mind as the rating is given. In addition, words like "critical medication" or "high-risk" were used to remind the rater of the class of patients and medications being rated.

Raters

As alluded to above, the study team used data from focus groups and key informant interviews in developing ratings, rather than using a group meeting. The actual task of assigning ratings was nevertheless an interdisciplinary process, as our nurse-expert took one pass at the ratings, then reviewed them with one other nurse and a pharmacist before coming to a final rating number. In addition, clinician input was sought during multiple meetings at PHS including:

- PHS Patient Safety Committee on 3/21/02 with representation from physicians, nurses, and administrators;
- PSVMC Quality Committee on 2/21/02 and 8/22/02 with representation from physicians, quality improvement staff, nurses, and administrators;
- PHS ED Medical Directors and Administrators Meeting on 4/15/02;
- Project Physician Advisor meeting on 5/2/02;
- PHS Family Practice Residency meeting on 9/11/02;
- A series of individual meetings with physicians and hospitalists on 5/22/02, 7/22/02, 8/13/02, 9/14/02, and 9/16/02 to discuss specific points in our ratings.

2.5.2 Extending the FMEA Tool

In the process of using the FMEA, the subjectivity of the ratings used within the tool became apparent. One key rating involves the frequency of a failure's occurrence. Various forms have ways to anchor the ratings so that participants know how to assess frequency (DeRosier et al., 2002). As noted above, JCAHO uses a scale from 1-10:

1 = "very infrequently, on the order of once in a hundred years" and

10 = "likely to occur with high frequency, on the order of one or more times a day."

The VA's process uses a scale from 1-4:

1 = "remote – may happen sometime in 5 to 30 years" and

4 = "frequent – may happen several times in 1 year."

In either scheme, the ratings of probability are all quite subjective. Typically they are done by group consensus, which has been shown to be an unreliable technique (Eddy, 1996).

A second key rating involves the severity of effects of the failure. The severity scales are anchored in similar fashion. However, in many processes within health care, the severity of effects of a failure is very dependent on the type of patient being treated, as mentioned above.

The subjective features of the FMEA are due to its intended use as an aid to brainstorming and rapid prioritization of action steps by health care staff. For research and evaluation purposes, we believed that the approach could be extended to include supplementary data from other sources.

Appendix E presents a listing of all failures with the study team's assessment of potential sources of actual data. **Exhibit 13** illustrates our approach:

Exhibit 13. RTI-PHS Approach Used to Quantify FMEA Ratings

Method to Gather Data for FMEA	Example of Quantifiable Data
Chart review to estimate probability of failure	Percentage of charts with notation, "resume home meds"
Transaction data to understand patient case mix, for severity ratings	Percentage of patients receiving a high-risk medication (insulin, coumadin) during stay
Survey to quantify potential causes of failure	Percentage of patients who can report current medications
Observation to understand detection methods	Percentage of ED physicians who call patient's primary MD to verify admission medications
Formal comparative study	Percentage of charts with appropriate correspondence among ambulatory, admitting, and discharge medication lists

These methods do not yield precise estimates, but could represent a vast improvement over a group rating process. We have, therefore, assembled a small stand-alone "toolkit" of methods that can be used with the rating-based FMEA to make it more data-driven. This toolkit is included as **Appendix F**. We believe this type of toolkit will be indispensable to researchers wanting to use the FMEA for evaluation purposes. Examples are given for how chart reviews, surveys, observational studies, transaction data, and formal comparative research can add value to a data-driven FMEA.

For example, we explored the benefits of conducting a small chart review study. A chart abstraction tool was developed using the data needed to inform the FMEA (**Appendix G**). A random sample of 90 charts was drawn from the hospital record system of Providence Portland Medical Center for patients discharged from the medical units we studied. A trained nurse chart-reviewer reviewed the records of these patients and documented cases of "failures" that could be ascertained from the charts. These data were then analyzed to determine how they might provide a means of refining the FMEA.

2.5.3 Results of Evaluation

2.5.3.1 FMEA Literature Review Summary

FMEA was developed by the U.S. military in the 1940s, adopted by the American auto industry in the late 1980s, and eventually adapted for health care in the 1990s. There has, thus, been over a decade of experience with FMEA in the medical community, enough time for the adopters of FMEA to influence the JCAHO to adopt FMEA within its standards. The FMEA approach has the advantage of being proactive in nature, making it useful for evaluating a process before errors occur.

The bulk of experience in FMEA comes from engineering and manufacturing. This work indicates that FMEA has matured beyond the point of validation to become a standard of operation. As a result, there is not an emphasis in the literature in proving that FMEA works. Instead, the literature shows concern with improvement and innovation of the process, including patents for systems to facilitate FMEA. Several books on the topic have been published, including an excellent primer by the consulting group Productivity, Inc.

One notable exposition on the use of FMEA in health care comes from the Veteran's Affairs (VA) National Center for Patient Safety. The VA has adapted the FMEA approach to include decision checkpoints based on whether the failure represents a single weakness, whether existing controls are in place, or whether further analysis is needed. They have also modified the rating scales and altered some of the terminology. Their approach is termed HFMEA, for Healthcare FMEA.

Other adaptations for health care come from consulting groups like VHA, as well as the JCAHO. These groups have kept some of the auto industry rating scales but altered other aspects of the ratings. To illustrate the differences among FMEA approaches, five representative descriptions are portrayed in **Exhibit 14**. This exhibit shows how the FMEA details differ in each approach, including a summary column to indicate whether there is general consensus, and a column showing the decision of our study team as to appropriate method for our study.

2.5.3.2 Failure Modes

Three exhibits describe the failure modes we encountered during the course of the study. These are included as **Exhibits 15-17** at the end of this subsection.

Listing of Failure Modes. Exhibit 15 is a table describing all failure modes. The listing gives the failure modes with some details, either examples or causes, in order to provide context. Those failures listed below were added by the study researchers, based on the logic or the process flow, or in some cases based on event reporting within the hospitals studied. These include:

- No medication orders
- Blank nursing admission form
- Chart note refers to patient medication list, doesn't attach it
- Failures in communication within pharmacy

- Slips, lapses, and other errors by physician, nurse, or pharmacy
- Faxes sent to wrong locations
- Pages or sections of discharge summary missing

All other failure modes were mentioned within focus groups or key informant discussions.

Close scrutiny of this failure list will reveal that the study team had decisions to make regarding the granularity of failure modes. For example, a broad term like "wrong medication" could cover a host of failures. However, we chose to distinguish the failure "too many medications" from the failure "missed a medication" because the frequency of occurrence, severity, and often the causes of these failures differed. In this particular example, ordering too many medications would be caused by using an old medication list, whereas missing a medication would be caused by not having a medication list at all.

Screening of Failure Modes. Exhibit 16 shows how these failures are evaluated against our screening criteria.

A number of potential failures surfaced during our focus groups and discussions, but are not addressed in our work, as they did not meet the screening criteria. Each of these is discussed below.

a. The patient is not taking medications as prescribed.

It is a commonly held opinion among focus group participants and key informants that patients do not take their medications as prescribed. We consider this is a separate problem for study. Of relevance to the current study, however, is the fact that almost no printed medication list is trusted as a source of what the patient is taking. The exceptions would be the hospital MAR and the MAR from a skilled nursing facility, which are considered to be reliable records of what was given to the patient, and when.

b. The patient is not taking medications as reported.

The problem of under- or mis-reporting medications was also mentioned during our discussions. Several discussants believe that patients might reveal different things to nurses and physicians, for example. Again, however, this is a separate problem which deserves study, and the failures we examined were only associated with the ability of staff to make it conducive for patients to report accurately and reliably.

c. The patient is not asked about medications.

This failure was considered so remote as to not merit further exploration. Patient survey data might be needed to assess this possibility, as participants would not state that this ever happened.

d. The pharmacist is working off an inappropriate physician order (incomplete, wrong, etc.) and simply fills it.

Upon closer examination, this particular failure occurs at an earlier step, the physician order, and is accounted for already.

e. The pharmacist introduces errors of his/her own (transcription/entry errors, wrong substitutions, wrong choice of route, etc.).

This particular issue has been studied elsewhere and was not the focus of the current study. Many things could possibly go wrong here, and we didn't talk to people about the order entry or prescription filling process.

Finally, several other failure modes were reported to us that were not formally rated because they were out of the scope of the present study.

- At discharge, the patient doesn't understand medication orders
- Discharge instructions are lost by the patient
- Patient doesn't fill prescription after leaving the hospital

Health system staff can play a role to minimize these errors, but cannot deal with all of their causes. The health care role in these failures is included in our tables and in the discussion below (e.g., the nurse's role in making discharge information understandable to the patient and family).

Methods of Data Gathering for Failure Modes

Exhibit 17 shows how more data on each of these failures might be gathered. Of greatest potential use appear to be chart reviews, observational studies, and surveys of staff and patients. Formal comparative studies are needed for many items, but would be less preferable because of time and expense. In addition, comparative studies to assess failures (in the form of inconsistencies) are hampered by the fact that at any two time periods, there are many good reasons for medication lists to be different. Still, transcription errors are a type of failure amenable to a comparative study of lists at two time periods.

Of least utility in assessing failure modes is institutional transaction data. Transaction data might also be used to measure the extent of drug interactions or allergic reactions, as when "rescue" medications are prescribed to counteract such effects.

The most straightforward use for transaction data is in assessing the volume of cases that might be affected by failures dealing with certain types of drugs. As mentioned above, severity ratings for failure effects are heavily dependent upon patient severity and medication risk. Transaction data could quantify the percentage of patients on high-risk drugs, the number on multiple medications, and so forth.

A small amount of transaction data was mined for this study to determine the number of patients on high-risk medications mentioned during focus groups. However, we decided in doing the FMEA *not* to split out separate failures for high- and low-risk patients, so these data were not explicitly used in the study.

Exhibit 14. Comparison of FMEA Methods

	Source							
	Step	JCAHO	VA	VHA	AIAG (Auto Industry Advisory Group) via Haviland Consulting	Productivity, Inc	Summary	RTI-PHS
0	Convene Process Experts in Group Setting	Yes	Yes	Yes	Yes	Yes	Consensus	Conduct Focus Groups/ Key Informant Interviews
1	Develop a Process Map, Identify Key Steps	Yes	Yes	Yes	Yes	Yes	Consensus	Yes
2	List Failures at Each Step	Yes	Yes	Yes	Yes	Yes	Consensus	Yes
3	Screen/Prioritize Failures	No	Rate first, eliminate failures with low hazard scores or that are easily detected; but then bring back failures that would stop the whole process	No	No	No, but group failure modes together for ease in rating	Minimal screening, FMEA ratings are a priority-setting mechanism	Yes, eliminate failures that are remote, not controllable by staff, or easily detected.
4	List Effects of Failures	List in terms of *harms* (e.g., death, disability, etc.)	List in terms of *actions* (e.g., patient gets wrong dose, etc.)	List in terms of effects on patient, next user of the process, or end user (both actions and harms)	List effects that occur whenever the failure occurs; create separate failure modes for special circumstances	List effects that are definitely consequences of the failure	General emphasis is on only the effects that will definitely occur if the failure occurs.	Rate high-risk and low-risk separately. Define high-risk patient
5	Rate Occurrence Frequency (or Probability)	Failure-effect combination	Failure only	Causes	Causes that WILL result in the failure mode	Rate failures; could use data on causes to estimate	Differences on this issue	Failure-effect combination

(continued)

Exhibit 14. Comparison of FMEA Methods (continued)

	Source							
	Step	JCAHO	VA	VHA	AIAG (Auto Industry Advisory Group) via Haviland Consulting	Productivity, Inc	Summary	RTI-PHS
6	Rate Severity	Effects	Effects	Effects	Effects	Each effect rated separately	Consensus	Effects
7	List Controls/Detection Methods	Yes	Yes	Yes	Yes	Failures or effects of failures	Consensus	?
8	Rate Detectability	Rated 1-10, emphasis on detection only	Not rated, screened instead	Rated 1-10, emphasis on detection but 1 = automatic shut off; and the term "controls" is also used	Rated 1-10, emphasis on detection only	Rated 1-10 on detection of failures	Almost consensus to rate detectability of failures	1-10 on detection of failures
9	List Direct and Root Causes	Yes	Yes	Yes	Yes	No	Consensus	?
10	List Potential Actions to Reduce Failure Mode	Address Causes	Address Causes	Address failures, causes, detection mechanisms	Address failures, causes, detection mechanisms	Address failures, causes, detection mechanisms	General emphasis toward addressing all types of actions	Address failures, causes, detection mechanisms

Exhibit 15. Detailed Description of Failures

–Patient is not taking medications as *prescribed* (This type of failure is outside the scope of study)
–Patient is not taking medications as *reported* (This type of failure is outside the scope of study)
ADMISSION

1 MD writes admitting order:
- a. No medication orders are given
- b. Wrong medication, dose or frequency
  - 1 Mis-copies something from a written medication list
  - 2 Confuses this patient with another
  - 3 Doesn't know home medications; orders something that duplicates or interacts
  - 4 Slips and lapses (omissions, similarly spelled medications, etc.)
- c. Not all medications ordered
  - 1 Writes from memory and forgets something
  - 2 Medications from specialists not included
- d. Too many medications
  - 1 MD attaches complete medication list but old inactive medications are included
  - 2 Multiple MDs write admitting orders
- e. Prescription is inappropriate for this patient (e.g., MD doesn't know patient)
  - 1 Allergy
  - 2 Interaction
  - 3 Patient condition
- f. Other
  - 1 Order can't be read (e.g., handwriting not legible)
  - 2 Indicates medication list is attached, forgets to attach it

2 Nurse completes prescription history on nursing admission form
- a. CAD is blank (patient not asked)
- b. Patient is asked but documentation is not completed
  - 1 No CAD is done (forgotten, thought to be done by someone else)
  - 2 Prescription section of CAD not completed
- c. Wrong medication, dose or frequency
  - 1 No dose or frequency information is requested
  - 2 Slips and lapses (sound-alike medications, transcription errors)
- d. Not all medications listed
  - 1 Patient not given enough time or not prompted for more
  - 2 Patient not asked about herbal and OTC
  - 3 Not enough room to list all; only "important" medications listed
  - 4 Conditions not conducive (e.g., patient asked confidential medications in presence of others)
- e. Too many medications listed
  - 1 Lists medications based on old information (e.g., from previous admission)
  - 2 Assumes some medications are taken in combination, doesn't confirm
- f. No allergies listed
  - 1 Forgets to ask
- g. Other
  - 1 Illegible
  - 2 Chart note refers to patient medication list, doesn't attach it

(continued)

Exhibit 15. Detailed Description of Failures (continued)

3 MAR initiated and prescription therapy begun
- a. MAR based on faulty information within MD order
  - 1 Wrong drug listed
  - 2 Wrong dose listed
  - 3 Wrong frequency listed
  - 4 Patient has allergy to listed drug
- b. Pharmacy does not check orders before filling
  - 1 Discrepancies within one physician order
  - 2 Discrepancies across multiple physicians
- c. New errors introduced at MAR
  - 1 Failures in communication within pharmacy
  - 2 Slips, lapses, and other errors by pharmacy

DISCHARGE

4 Physician writes medication orders
- a. No medication orders
  - 1 Physician does not write medication orders
  - 2 Medication orders not written in time for discharge
  - 3 Orders written, not given to patient
- b. Medication order is not comprehensive
  - 1 Indicates only new medications, silent on others
  - 2 Doesn't reflect review of a H&P or other information
- c. Is overly general (e.g., "resume home meds")

5 Nurse, doctor or pharmacist explains medication orders
- a. Medication orders not explained at all
  - 1 Handed to patient or family without explanation
  - 2 Patient told to follow up with PCP with questions
  - 3 Patient told they will be called by following MD
- b. Inadequate explanation of medication orders
  - 1 Only listed medications explained, no reference to home medications
  - 2 Nurse is not familiar with medication, can't answer questions
  - 3 Mistakes in explanation - contradictions, omissions, etc.
  - 4 Pharmacist not available

6 Discharge information transmitted to primary care
- a. New medication orders never get to primary physician
  - 1 Not faxed or sent by nurse
  - 2 Physician plays no role in communication (may not be involved in ongoing care)
  - 3 No electronic transfer possible
- b. Errors in transmission
  - 1 Delays
  - 2 Fax illegible
  - 3 Fax sent to wrong location
  - 4 Pages or sections of discharge summary missing
  - 5 List not the same as given to patient (things added at last minute to one, not the other)

–Patient doesn't understand medication orders

–Orders lost by patient

–Patient doesn't fill prescription

Exhibit 16. Screening of Failures Against FMEA Inclusion Criteria

Failures at ADMISSION				Important Problem for This Study?			
				Out of Project Scope	Not Mentioned (Remote)	Detectable; Would Stop Process	PROBLEM FOR STUDY
–Patient is not taking medications as *prescribed*				X			
–Patient is not taking medications as *reported*				X			
1	**MD writes admitting order:**						
	a.	No medication orders			X	X	
	b.	Wrong medication, dose or frequency					**X**
		1	Mis-copies something from a written medication list				
		2	Confuses this patient with another				
		3	Orders something that duplicates or interacts				
		4	Slips and lapses (omissions, similarly spelled medications, etc.)				
	c.	Not all medications ordered					**X**
		1	Writes from memory and forgets something				
		2	Medications from specialists not included				
	d.	Too many medications					**X**
		1	MD attaches complete medication list but old inactive medications are included				
		2	Multiple MDs write admitting orders				
	e.	Prescription is inappropriate for this patient		X			
		1	Allergy				
		2	Interaction				
		3	Patient condition				
	f.	Other					**X**
		1	Order can't be read				
		2	Indicates medication list is attached, forgets to attach it				

(continued)

Exhibit 16. Screening of Failures Against FMEA Inclusion Criteria (continued)

				Important Problem for This Study?			
				Out of Project Scope	Not Mentioned (Remote)	Detectable; Would Stop Process	PROBLEM FOR STUDY
2	**Nurse completes prescription history and nursing admission form on CAD**						
	a.	Patient is not asked about medications			X		
	b.	Patient is asked but documentation is not completed					**X**
		1	No CAD is done				
		2	Prescription section of CAD not completed				
	c.	Wrong medication, dose or frequency					**X**
		1	No dose or frequency information is requested				
		2	Slips and lapses (sound-alike medications, transcription errors)				
	d.	Not all medications listed					**X**
		1	Patient not given enough time, or prompted for more				
		2	Patient not asked about herbal and OTC				
		3	Not enough room to list all; only "important" medications listed				
		4	Conditions not conducive to patient reporting				
	e.	Too many medications listed					**X**
		1	Lists medications based on old information				
		2	Assumes some medications are taken in combination, doesn't confirm				
	f.	No allergies listed					**X**
		1	Forgets to ask				
	g.	Other					**X**
		1	Illegible				
		2	Chart note refers to patient medication list, doesn't attach it				

(continued)

Exhibit 16. Screening of Failures Against FMEA Inclusion Criteria (continued)

				Important Problem for This Study?			
				Out of Project Scope	Not Mentioned (Remote)	Detectable; Would Stop Process	PROBLEM FOR STUDY
3	**MAR initiated and prescription therapy begun**						
	a.	MAR based on faulty information within MD order		X	X		
		1	Wrong drug listed				
		2	Wrong dose listed				
		3	Wrong frequency listed				
		4	Patient has allergy to listed drug				
	b.	Pharmacy does not check orders before filling					**X**
		1	discrepancies within one physician order				
		2	discrepancies across multiple physicians				
	c.	New errors introduced at MAR		X	X		
		1	failures in communication within pharmacy				
		2	slips, lapses, and other errors by pharmacy				
Failures at DISCHARGE							
4	**Physician Writes Medication Orders**						
	a.	No medication orders given to patient					**X**
		1	physician does not write medication orders				
		2	medication orders not written in time for discharge				
		3	orders written, not given to patient				
	b.	Medication order is not comprehensive					**X**
		1	indicates only new medications, silent on others				
		2	doesn't reflect review of H&P or other information				
	c.	Medication order is overly general e.g., "resume home meds"					**X**

(continued)

Exhibit 16. Screening of Failures Against FMEA Inclusion Criteria (continued)

				Important Problem for This Study?			
				Out of Project Scope	Not Mentioned (Remote)	Detectable; Would Stop Process	PROBLEM FOR STUDY
5	**Nurse, doctor or pharmacist explains medication orders**						
	a.	Medication orders not explained at all					**X**
		1	handed to patient or family without explanation				
		2	patient told to follow-up with PCP with questions				
		3	patient told they will be called by following MD				
	b.	Inadequate explanation of medication orders					**X**
		1	only listed medications explained, no reference to home medications				
		2	nurse is not familiar with medication, can't answer questions				
		3	mistakes in explanation - contradictions, omissions, etc.				
		4	pharmacist not available				
6	**Discharge information transmitted to primary care**						
	a.	New medication orders never get to primary physician					**X**
		1	Not faxed or sent by nurse				
		2	Physician plays no role in communication				
		3	No electronic transfer possible				
	b.	Errors in transmission					**X**
		1	Delays				
		2	Fax illegible				
		3	Fax sent to wrong location				
		4	Pages or sections of discharge summary missing				
		5	List not the same as given to patient				
7	**Patient doesn't understand medication orders**			**X**			
8	**Orders lost by patient**			**X**			
9	**Patient doesn't fill prescription**			**X**			

Exhibit 17. Methods of Gathering Quantitative Data on Failure Modes

Failures at ADMISSION				How Could This Failure Rate Be Studied (Quantified)?			
				Chart Review	Observation	Survey	Comparative Study
–Patient is not taking medications as *prescribed*						**X**	**X**
–Patient is not taking medications as *reported*							
1	**MD writes admitting order:**						
	a.		No medication orders given	**X**			
	b.		Wrong medication, dose or frequency				
		1	Mis-copies something from a written medication list				**X**
		2	Confuses this patient with another				**X**
		3	Orders something that duplicates or interacts				**X**
		4	Slips and lapses (omissions, similar spelled medications, etc.)				**X**
	c.		Not all medications ordered				
		1	Writes from memory and forgets something		**X**		**X**
		2	Medications from specialists not included		**X**		**X**
	d.		Too many medications				
		1	MD attaches complete medication list but old inactive medications are included	**X**	**X**		
		2	Multiple MDs write admitting orders	**X**			
	e.		Prescription is inappropriate for this patient	**X**			
		1	Allergy				
		2	Interaction				
		3	Patient condition				
	f.		Other				
		1	Illegible	**X**			
		2	Indicates medication list is attached, forgets to attach it	**X**			

(continued)

Exhibit 17. Methods of Gathering Quantitative Data on Failure Modes (continued)

				How Could This Failure Rate Be Studied (Quantified)?			
				Chart Review	Observation	Survey	Comparative Study
2	**Nurse completes prescription history on CAD**						
	a.		Patient is not asked about medications			X	
	b.		Patient is asked but documentation is not completed	X			
		1	No CAD is done (forgotten, thought to be done by someone else)	X			
		2	Prescription section of CAD not completed	X			
	c.		Wrong medication, dose or frequency				
		1	No dose or frequency information is requested	X			
		2	Slips and lapses (sound-alike medications, transcription errors)				X
	d.		Not all medications listed				
		1	Patient not given enough time, or prompted for more		X		
		2	Patient not asked about herbal and OTC		X		
		3	Not enough room to list all; only "important" medications listed		X		
		4	Conditions not conducive to patient reporting		X		
	e.		Too many medications				
		1	Lists medications based on old information		X		
		2	Assumes some medications are taken in combination, doesn't confirm		X	X	
	f.		No allergies listed				
		1	Forgets to ask		X		
	g.		Other				
		1	Illegible	X			
		2	Chart note refers to patient medication list, doesn't attach it	X			

(continued)

Exhibit 17. Methods of Gathering Quantitative Data on Failure Modes (continued)

				How Could This Failure Rate Be Studied (Quantified)?			
				Chart Review	Observation	Survey	Comparative Study
3	**MAR initiated and prescription therapy begun**						
	a.		MAR based on faulty information within MD order				
		1	Wrong drug listed				**X**
		2	Wrong dose listed				**X**
		3	Wrong frequency listed				**X**
		4	Patient has allergy to listed drug				**X**
	b.		Pharmacy does not check orders before filling				
		1	discrepancies within one physician order		**X**	**X**	
		2	discrepancies across multiple physicians		**X**	**X**	
	c.		New errors introduced at MAR				
		1	failures in communication within pharmacy				**X**
		2	slips, lapses, and other errors by pharmacy				**X**
Failures at DISCHARGE							
4	**Physician Writes Discharge Medication Orders**						
	a.		No medication orders				
		1	physician does not write medication orders	**X**			
		2	medication orders not written in time for discharge		**X**		
		3	orders written, not given to patient			**X**	
	b.		Medication order is not comprehensive				
		1	indicates only new medications, silent on others	**X**			
		2	doesn't reflect review of H&P or other information				**X**
	c.		Medication order is overly general e.g., "resume home meds"	**X**			

(continued)

Exhibit 17. Methods of Gathering Quantitative Data on Failure Modes (continued)

				How Could This Failure Rate Be Studied (Quantified)?			
				Chart Review	Observation	Survey	Comparative Study
5	**Nurse, doctor or pharmacist explains medication orders**						
	a.	Medication orders not explained at all					
		1	handed to patient or family without explanation		**X**		
		2	patient told to follow-up with PCP with questions		**X**	**X**	
		3	patient told they will be called by following MD		**X**	**X**	
	b.	Inadequate explanation of medication orders					
		1	only listed medications explained, no reference to home medications		**X**	**X**	
		2	nurse is not familiar with medication, can't answer questions		**X**	**X**	
		3	mistakes in explanation - contradictions, omissions, etc.		**X**		
		4	pharmacist not available		**X**		
6	**Discharge information transmitted to primary care**						
	a.	New medication orders never get to primary physician					
		1	Not faxed or sent by nurse		**X**		
		2	Physician plays no role in communication		**X**		
		3	No electronic transfer possible		**X**		
	b.	Errors in transmission					
		1	Delays				**X**
		2	Fax illegible		**X**		
		3	Fax sent to wrong location				**X**
		4	Pages or sections of discharge summary missing		**X**		
		5	List not the same as given to patient				**X**
7	**Patient doesn't understand medication orders**					**X**	
8	**Orders lost by patient**					**X**	
9	**Patient doesn't fill prescription**					**X**	

2.5.3.3 Narrative Discussion of Failure Modes

Focus groups, in-depth discussions, and key informant interviews documented many chances for failure within the process of medication information transfer. The FMEA approach provides a way to organize these failures, and ultimately quantify their relative risk to patients. The FMEA tables for admission and for discharge are presented as **Exhibits 18** and **19** at the end of this subsection and are briefly summarized below.

Failure Modes at Admission. There are three basic steps at admission at which failures may occur in the transfer of medication information:

1. Physician writes admitting order.
2. Documentation is prepared on the nursing floor.
3. The medication administration record (MAR) is created.

Different kinds of failures occur at these points, with different consequences. The consequences also depend on the type of patient and type of medication. Risky patients and risky medications are discussed in a later section. A parallel process occurs in the Emergency Department, which is treated separately.

1. Physician Admitting Orders

Failures at the physician admitting order are among the most serious in the admission process because physician orders carry a great deal of weight and may not be questioned by other care providers. There are six basic types of failures:

a. No medication orders are given.
b. The physician orders medications but writes the wrong medication, dose or frequency. This includes miscopying something from a written medication list, confusing one patient with another, ordering something that duplicates or interacts with current medication because s/he doesn't know the home medications, or slips and lapses (omissions, similarly spelled medications, etc.).
c. The physician doesn't order all the appropriate medications (s/he writes from memory and forgets something, doesn't know about medications from specialists, etc.)
d. Too many medications are ordered (a patient or clinic provides a complete medication list but old inactive medications are included, or multiple MDs write admitting orders).
e. The physician orders an inappropriate medication for this patient, based on the patient's allergies, other medications, or patient condition.
f. The order can't be read, or there are other transmission problems.

Of these, only four were examined more closely with the FMEA tool. Failure 1a. (no medication orders) was eliminated because it would halt the admission process. Failure 1e (inappropriate medication order) was considered outside the scope of study — not so much a lack of good information as a wrong decision on the part of the physician.

The frequency of errors in admitting orders is not easy to measure and not easy to detect by participants within the process because it is not a simple matter of consistency among sources. There are

many valid reasons for differences among ambulatory medication lists, patient-reported medications, and physician orders. At admission, the physician is adding or removing medications to deal with the patient's current health state or crisis.

Aside from simple omissions, lapses, or transcription errors, failures at this step are typically due to the fact that the admitting MD has incomplete knowledge of the patient's medication regimen and allergies, for one of two reasons:

1. The admitting MD may not be the patient's primary doctor, and may not take the time to call the patient's primary doctor.
2. The admitting MD may be the patient's primary doctor, but may have an incomplete Prescription or allergy tracking mechanism.
    a. The patient may not be taking every medication, or not as prescribed
    b. Allergies may not have been updated
    c. The patient may be taking medications from other providers, unknown to the admitting doctor.

The problem of incomplete knowledge can be remedied in two ways. The most immediate and frequent step is to interview the patient and family. Some patients bring lists of medications, or the actual pill bottles. However, patients without these aids may not be reliable about their medications, especially on the details such as dose, frequency, and when it was last taken. Factors which affect this recall include patient age, cognitive state, and number of medications taken. The family typically has less knowledge than the patient about medications.

The second remedy to a lack of knowledge is to find another source of information about the patient's medications. Sources can include past hospital records, ambulatory records, or even community pharmacies. Because of time constraints, this information-seeking is rarely done by the admitting physician unless the information source is readily available. They will leave this to the inpatient nursing staff.

Certainly, a physician who has been treating the patient can find a refresher within their own charts. Others may be able to find electronic medication information if they can access the charts of their colleagues in offices with electronic medical record systems. This approach will be discussed more fully below as we describe the potential improvements available in an IT solution to medication information transfer.

Finally, patients coming from a nursing facility (SNF, etc) will often have a medication list transferred with them. For this reason, the process of medication transfer for institutionalized patients was reported to be more reliable than the process for patients coming from the community.

In summary, errors in physician admitting orders are not easy to detect and are partly a consequence of incomplete information sharing among the various providers treating the patient. Some are consequences of patients taking different or additional (e.g., OTC, herbal) medications than

prescribed. Potential errors in admitting orders are only sometimes corrected by reconciliation with patient or family report of what the patient is actually taking.

2. Documentation by the Floor Nurse or Physician

Seven failure modes were identified during this step.

a. The admission data form is blank (patient not asked)

b. Patient is asked but documentation is not completed (no form is done - forgotten, thought to be done by someone else, or the prescription section of the form is not completed)

c. Wrong medication, dose or frequency is documented (no dose or frequency information is requested, or slips and lapses occur [sound-alike medications, transcription errors])

d. Not all medications are listed (the patient is not given enough time or not prompted for more; the patient is not asked about herbal and OTC medications, there is not enough room to list all, so only "important" medications are listed; or conditions are not conducive [e.g., patient asked confidential medications in presence of others])

e. Too many medications are listed (based on old information [e.g., from previous admission], or the assumption is made that some medications are taken in combination, doesn't confirm).

f. No allergies are listed (forgets to ask)

g. Other transmission problems occur (writing is illegible, or a note refers to patient medication list which is not attached)

The very first failure above, the possibility that a nurse would never ask a patient about their medications, was considered to be very remote, and it was combined with failure (b), the lack of documentation.

At admission, nurses complete an admitting form with information on the patient's medications. Physicians also ask patients about medications. This planned redundancy is often a source of irritation to the patient, but is thought by clinicians to be useful. Several physicians reported that patients tell them different (more) things than they tell nurses.

Theoretically, if the admitting physician is familiar with the patient's medications, is confident that the patient is taking them as prescribed, and knows what changes might be needed during this admission, the patient interview would not be necessary. However, it is rare that all these things are true, so the interview is done because of these unknowns.

Nursing documentation of the admission medications, based on patient interviews, family interviews, and other research, is the process step in medication information transfer with the highest variability. Key factors which drive this variability are:

- The degree of patient recall and nursing belief in the patient's credibility
- The probability of high-risk medications for this patient, based on reported diagnoses
- The presence or absence of an authoritative physician order
- The amount of discrepancy between patient self-report and physician order

All of these factors influence the degree to which nurses seek additional information, such as from past hospital records, primary care clinics, or even community pharmacies. They also influence the degree to which nurses will attempt to reconcile patient/family reports with physician admitting orders. Nurses reported spending more time in research and reconciliation with elderly, frail patients, who were potentially taking high-risk medications, when physician orders were not yet available or seemed discordant with patient report.

The time and effort that nurses spend discovering a patient's medications is not translated directly into an improved Medication Administration Record. Indeed, some physicians and pharmacists reported that they never see the results of the nursing interview. Instead, nurses must take the initiative to discuss with the admitting physician any doubts or discrepancies they have uncovered, so that the physician order can then be changed and transmitted to the pharmacy. The initiative involves a cost which nurses must weigh against the risks of an improper medication regimen.

3. Medication Administration Record

The third important step in the transfer of medication information at admission is the development of the medication administration record, or MAR, by the inpatient pharmacist. We focused on whether medication history information is available to the pharmacist creating the MAR. We did not delve into process failures such as transcription errors or administration of drugs against known allergies.

Pharmacists rely on the physician orders to complete the MAR. Therefore, the problem most frequently reported by pharmacists was a lack of coordination among physicians regarding the medication therapy. Multiple physicians and residents may be involved in a patient's case, and may prescribe slightly different medications, routes, or doses. These problems are resolved only by persistent follow-up and communication by the pharmacist.

Pharmacists do typically have software that flags drug-drug and drug-allergy interactions, so that when medication information is known, there are detection tools to reconcile errors made at earlier steps. These tools are not likely to detect error of drug omission.

In several sites in our study, pharmacists work with nurses to discover or reconcile medication information at admission. For example, a patient may bring in a bag of pills (instead of the pill bottles), and a pharmacist may be asked to identify them. Or, if other sources fail, the pharmacist may call a community pharmacy colleague to learn what medications the patient has been prescribed.

Three types of failures were identified:

1. The pharmacist is working off an inappropriate physician order (incomplete, wrong, etc.) and simply fills it.
2. The pharmacist has a chance to notice discrepancies, questionable doses, lack of allergy information, multiple physician orders that are not consistent, etc. and can clarify these problems. This double-checking role of pharmacy was prominently mentioned in the focus groups and discussions.

3. The pharmacist introduces errors of his/her own (transcription/entry errors, wrong substitutions, wrong choice of route, etc.).

As mentioned in an earlier section above, only failure b above continued as a focus of study.

In summary, the establishment of the medication administration record dictates what the patient is actually given during their stay, and is thus a critical final step in the process of medication information transfer. Some error checking is available at this step, but the MAR can only be as good as the information that nurses and physicians make available to it.

Failure Modes at Discharge. There are three important steps during the discharge process in which failures may occur in the transfer of medication information (corresponding **Exhibit 19** is provided at the end of this subsection). These are numbered following the steps above, for clarity within our FMEA rating tables.

4. The physician writes the discharge instructions.

5. The discharge instructions are transmitted to the patient.

6. Discharge instructions are transmitted to the PCP.

4. Discharge Instructions

The physician's discharge instructions are, among other things, a tool to indicate what medications the patient should be taking. Failures at this step are listed in the accompanying **Exhibit 19**. The most frequent failure at this step is for the discharging physician to write down only the medications relevant to the hospitalization—usually the ones that were added during the stay. Ongoing medications may be omitted entirely or covered under a phrase such as "patient can resume home meds." Two types of problems arise from this approach:

1. The patient resumes taking medications that either interact or duplicate a medication started during the stay. Cardiac drugs were mentioned as particularly problematic in this regard, as ones with different names may serve a similar function but the patient does not know not to take both.
2. The patient does not resume a medication that was discontinued during the stay. This is more likely when the ongoing medications are omitted from the discharge instructions. The patient is confused as to whether the hospitalization has changed their regimen permanently or only temporarily.

One cause of problems at this step is the failure to adequately assess medications at admission. If home medications were not recorded at admission, they will not be available to the discharging physician unless additional research is conducted. Other barriers include time pressure for discharge, differences between admitting and discharging physician, and even knowledge or responsibility limitations of inpatient physicians such as hospitalists. For many hospitalists the hospital stay is their main concern, with less attention to ongoing care post-discharge.

Other problems in the discharge instructions involve the medications themselves, including:

- medications that are too expensive or not covered under insurance
- medications that are not covered in the form prescribed (the medication, route or dose is different in the community pharmacy).

5. The Transfer of Medication Information to Patients

Nurses bear the responsibility of educating patients on their new medication regimen at the time of discharge. At times, pharmacists are involved as consultants. Several systems have used pharmacists in more systematic ways within specialty cardiac units, or for complex patients.

One set of failures at this point includes the omissions and blanket statements mentioned above, which the nurse can only transmit to the patient. Nurses reported they would not write specific medications from the admission forms on the discharge instructions if the physician had not written them, because this was thought to constitute prescribing behavior on their part.

A second set of failures involves the actual communication and education process between nurses and patients. The area of discharge instructions has been an area of concerted attention at several of the facilities taking part in the study, but it was acknowledged that difficulties still arise:

- Much information must be transmitted in a short period of time
- Patients are not always in a cognitive state ready to process instructions
- Nurses themselves are sometimes caught off guard by the order to discharge

6. The Transfer of Medication Information to Subsequent Providers

A final step in medication information transfer is the transmission of changes in the medication regimen to the providers who follow the patient post-discharge. Unfortunately, this step receives little attention, except in the case of a patient transferred to a skilled nursing facility. In the latter case, the nurses prepare transfer orders with the medication information (subject to the constraints above) they have at hand.

For the most part, nurses are focused on educating the patient, not preparing information for other providers. The failures at this step can therefore include the following:

- No information is provided to the following physician
- Discharge instructions are faxed or mailed, but include only hospital medications
- The medication information is sent to only one of the patient's treating clinicians

The causes of these failures are two-fold: the time pressure of discharge and the fact that so many patients have multiple providers. Both of these factors make it unlikely that transfer of medication information to subsequent providers will be complete.

For the reasons cited above, the transmittal of information on discharge medications is often left to the hospital medical records department, or to patients themselves. With regard to the role of hospital medical records departments, no particular problems in transmission accuracy or timeliness were mentioned or explored in this study. We do know that a host of issues surrounds timeliness of the discharge summary preparation by physicians, billing pressures on medical records departments, and getting electronic or paper-based information to all involved clinicians. Delays in dictation, transcription, and transmittal of discharge summaries intersect with the problems of timely primary care follow-up following discharge. This entire area deserves further study.

Failure Modes in the Emergency Department. Two-thirds of the patients admitted to the medical units we studied were admitted via the Emergency Department. The emergency department is therefore discussed as an important arena in information transfer, although not all patients take this route. The information transfer process occurs in a parallel way to what occurs within hospital units. However, it is discussed separately because the frequency, severity, and detection methods for failure modes are different.

Patients presenting to the Emergency Department are by definition in some sort of crisis, where stabilization must be the priority. The likelihood of compromised patient memory for medications is high, and the probability of patients bringing medication lists or bottles of pills is low. Time pressure makes it difficult for clinicians to check multiple sources for medication history.

Errors at this step are most likely to be omissions of ongoing medications that are not thought to be critical to stabilization. However, the possibility of drug-drug interactions is of great concern to emergency clinicians, as they need to quickly decide on administration of critical medications and doses. They typically use a short list of questions to elicit from patients any drugs that might interact with planned therapy. This detection device is not always reliable (see below), and families have been asked to return home to bring in all medications the patient might be taking. However, this was reported to be the exception rather than the rule.

In summary, there is little time to research a patient's medication history in the emergency department, making it likely that some ongoing medications are not given. Typically, however, emergency stays are short and the clinicians believe that the need for critical drug therapy overrides the risk of missing doses of non-critical drugs.

Discharge from the Emergency Department (to the hospital floor) suffers from similar problems.

1. Risky Patients

Key informants and focus group participants identified the following types of patients as being particularly risky when it comes to the transfer of medication information.

- Patients with multiple chronic diseases,
- Patients with complex medical issues,
- Patients with impaired cognition,

- Frail elderly,
- Patients who take five or more medications.

Within the FMEA analysis the severity scoring for failures at each step used these risky patients as a point of reference.

2. Risky Medications

Similarly, risks are greater when certain medications are involved. These include:

- Anti-coagulants,
- Anti-convulsants,
- Cardiac medications,
- Insulin,
- Medications with a narrow therapeutic range, and
- Medications with risk of adverse event.

Exhibit 18. Failure Mode and Effects Analysis at Admission without Logician

Item/ Function	Potential Failure Modes	Potential Effects of Failure (for high-risk patient)	Severity	Occurrence	Current Means of Failure Detection	Detection	RPN	Potential Causes/ Mechanisms of Failure
1. PCP/Admitting MD writes admitting medication orders	1.b. For a critical medication, MD orders wrong drug, dose or frequency	Patient receives inappropriate drug	9	7	Patient notices discrepancy in medications.	5	315	Admit MD doesn't know patient's prescription regimen. Admit MD doesn't call PCP. Doesn't confirm drug or dose with patient.
		Patient receives inappropriate dose or frequency	8	7	Nurse preparing CAD notices discrepancy to physician orders.		280	PCP has incomplete prescription tracking mechanism. Facility (SNF, etc.) didn't transfer prescription list.
		Medication interaction	8	5			200	Patient/family doesn't know medications. Multiple MDs involved in admission.
		Allergic reaction	10	3			150	Old (inactive) medication list is used for reference.
Total for this Failure Mode	Sum =	945					236	

Exhibit 18. Failure Mode and Effects Analysis at Admission without Logician (continued)

Item/ Function	Potential Failure Modes	Potential Effects of Failure (for high-risk patient)	Severity	Occurrence	Current Means of Failure Detection	Detection	RPN	Potential Causes/ Mechanisms of Failure
1. PCP/Admitting MD writes admitting medication orders	1.c. MD doesn't order a critical patient medication	Patient doesn't receive needed medications while in hospital	8	6	Patient notices discrepancy in medications.	5	240	Admit MD doesn't know patient's prescription regimen. Admit MD doesn't call PCP. Doesn't confirm drug or dose with patient.
					Nurse preparing CAD notices discrepancy.			PCP has incomplete prescription tracking mechanism. Facility (SNF, etc.) didn't transfer prescription list. Patient/family doesn't know medications. Multiple MDs involved in admission. Old (inactive) medication list is used for reference.
Total for this Failure Mode	Sum =	240					240	

Exhibit 18. Failure Mode and Effects Analysis at Admission without Logician (continued)

Item/ Function	Potential Failure Modes	Potential Effects of Failure (for high-risk patient)	Severity	Occurrence	Current Means of Failure Detection	Detection	RPN	Potential Causes/ Mechanisms of Failure
1. PCP/Admitting MD writes admitting medication orders	1.d. An additional critical medication is ordered	Patient takes drug not needed	4	4	Patient notices discrepancy in medications.	5	80	MD doesn't confirm prescription with patient. Admit MD doesn't know patient's prescription regimen. Admit MD doesn't call PCP.
		Medication duplication/overdose	8	4	Nurse preparing CAD notices discrepancy to physician orders.		160	PCP has incomplete prescription tracking mechanism. Facility (SNF, etc.) didn't transfer prescription list.
		Medication interaction	8	5	Pharmacy notices during profiling/order entry.		200	Patient/family doesn't know medications. Multiple MDs involved in admission.
		Allergic reactions	10	3			150	Old (inactive) medication list is used for reference.
Total for this Failure Mode	Sum =	590					148	

Exhibit 18. Failure Mode and Effects Analysis at Admission without Logician (continued)

Item/ Function	Potential Failure Modes	Potential Effects of Failure (for high-risk patient)	Severity	Occurrence	Current Means of Failure Detection	Detection	RPN	Potential Causes/ Mechanisms of Failure
1. PCP/Admitting MD writes admitting medication orders	1.f. Order cannot be read or interpreted	Patient receives inappropriate drug	9	7	Pharmacy notices during order entry.	4	252	Illegible
		Patient receives inappropriate dose or frequency	8	7	Patient notices discrepancy in medications.		224	Refers to attached medication list which cannot be found.
		Medication interaction	8	5	Nurse notices on transcription.		160	Contains general phrase, "continue home meds"
		Allergic reaction	10	3			120	
Total for this Failure Mode	Sum =	756					189	
Total for Step 1	Sum =	812.75					203	

Exhibit 18. Failure Mode and Effects Analysis at Admission without Logician (continued)

Item/ Function	Potential Failure Modes	Potential Effects of Failure (for high-risk patient)	Severity	Occurrence	Current Means of Failure Detection	Detection	RPN	Potential Causes/ Mechanisms of Failure
2. Nurse completes prescription history on nursing admission form	2.b. No nursing admission form is completed or prescription portion not completed	Patient receives inappropriate drug	9	2	Primary nurse notices when initiating care plan.	3	54	Thought someone else did this.
		Patient receives inappropriate dose or frequency	8	2			48	Too little time.
		Medication interaction	8	2			48	
		Allergic reaction	10	2			60	
Total for this Failure Mode	Sum =	210					52.5	

Exhibit 18. Failure Mode and Effects Analysis at Admission without Logician (continued)

Item/ Function	Potential Failure Modes	Potential Effects of Failure (for high-risk patient)	Severity	Occurrence	Current Means of Failure Detection	Detection	RPN	Potential Causes/ Mechanisms of Failure
2. Nurse completes prescription history on nursing admission form	2.c. Wrong medication, dose or frequency listed on nursing form	Patient receives inappropriate drug	9	2	Patient somehow notices error in communication with nurse	5	90	No dose or frequency information is requested.
		Patient receives inappropriate dose or frequency	8	3			120	Information source (e.g., previous hospital record) incomplete or outdated.
		Medication interaction	8	3	Nurse notices when comparing nursing form to physician order		120	Patient doesn't mention. No physician office record available. Patient/family unable to bring in drugs. Patient doesn't carry Prescription list.
		Allergic reaction	10	3			150	Slips and lapses (sound-alike medications, transcription errors)
Total for this Failure Mode	Sum =	480					120	

Exhibit 18. Failure Mode and Effects Analysis at Admission without Logician (continued)

Item/ Function	Potential Failure Modes	Potential Effects of Failure (for high-risk patient)	Severity	Occurrence	Current Means of Failure Detection	Detection	RPN	Potential Causes/ Mechanisms of Failure
2. Nurse completes prescription history on nursing admission form	2.d. A critical medication is not listed	Patient doesn't receive needed medication while in hospital	8	6	Patient notices discrepancy in medications.	5	240	Patient forgets to mention. Patient not given enough time, or prompted thoroughly.
					Nurse notices when comparing current nursing form to past forms		0	Patient not asked about herbal and OTC medications. Not enough room on form to list all medications, doses, etc.
								See also causes under 2.c. above.
Total for this Failure Mode	Sum =	240					120	

Exhibit 18. Failure Mode and Effects Analysis at Admission without Logician (continued)

Item/ Function	Potential Failure Modes	Potential Effects of Failure (for high-risk patient)	Severity	Occurrence	Current Means of Failure Detection	Detection	RPN	Potential Causes/ Mechanisms of Failure
2. Nurse completes prescription history on nursing admission form	2.e. An additional critical medication is listed on nursing form	Patient takes drug not needed	4	2	Patient notices discrepancy in medications.	5	40	Finds old information from historical source.
		Medication duplication/overdose	8	2	Nurse preparing CAD notices discrepancy to physician orders.		80	Assumes some prescription are taken, given patient's diagnosis or other medications
		Medication interaction	8	2			80	Some causes listed under 2.c. above also may operate here.
		Allergic reactions	10	2			100	
Total for this Failure Mode	Sum =	300					75	

Exhibit 18. Failure Mode and Effects Analysis at Admission without Logician (continued)

Item/ Function	Potential Failure Modes	Potential Effects of Failure (for high-risk patient)	Severity	Occurrence	Current Means of Failure Detection	Detection	RPN	Potential Causes/ Mechanisms of Failure
2. Nurse completes prescription history on nursing admission form	2.f. No allergies are listed	Patient receives a drug with known allergic reaction	10	3	Patient notices they weren't asked about allergies	8	240	Forgets.
								Too little time.
Total for this Failure Mode	Sum =	240					240	
2. Nurse completes prescription history on nursing admission form	2.g. Nursing admission form cannot be read or interpreted.	Patient receives inappropriate drug	4	2	Primary nurse notices when initiating care plan.	3	24	Illegible
		Patient receives inappropriate dose or frequency	8	2			48	Refers to attached medication list which cannot be found.
		Medication interaction	8	2			48	
		Allergic reaction	10	2			60	
Total for this Failure Mode	Sum =	180					45	
Total for Step 2	Sum =	1650					109	

Exhibit 18. Failure Mode and Effects Analysis at Admission without Logician (continued)

Item/ Function	Potential Failure Modes	Potential Effects of Failure (for high-risk patient)	Severity	Occurrence	Current Means of Failure Detection	Detection	RPN	Potential Causes/ Mechanisms of Failure
3. Pharmacy establishes medication administration record (MAR)	3.b. For a critical medication, MAR contains wrong drug, dose, frequency, or route	Patient receives inappropriate drug	10	3	Patient notices discrepancy in medications.	5	150	Inconsistencies *within* physician order (interactions, allergies, duplications, etc.) are not reconciled by pharmacy.
		Patient receives inappropriate dose or frequency	7	4	Nurse administering medications notices a problem.		140	Inconsistencies *across multiple physician* orders (interactions, allergies, duplications, etc.) are not reconciled by pharmacy.
		Medication interaction	6	2			60	Root causes: lack of coordination among multiple treating physicians.
		Allergic reaction	10	2			100	Lack of technology assist.
Total for this Failure Mode	Sum =	450					113	
Total for Step 3	Sum =	450					113	
Total for ALL Failure Modes	Sum =	4631					174	

Notes: The following failure modes were not evaluated (see screening criteria)

1.a. No physician medication order (would halt the process)

1.e. Physician orders an inappropriate medication for the patient (a different kind of error, we are not studying it)

2.a. The patient is not asked about their medications (VERY remote possibility)

3.a. The pharmacist fills a wrong order and has no way to know it was wrong

3.c. The pharmacist incorrectly fills order (we did not study this process in detail)

Exhibit 19. Failure Mode and Effects Analysis at Discharge without Logician

Item/ Function	Potential Failure Modes	Potential Effects of Failure	Severity	Occurrence	Means of Failure Detection	Detectability	RPN	Potential Causes/ Mechanisms of Failure
4. Physician writes discharge orders/instructions	4.a. No medication orders given to patient (MD doesn't write prescription orders, not written in time, or not given to patient)	Patient continues to take "old" medication no longer indicated (drug, dose, frequency)	9	3	Nurse notices no discharge orders/instructions for prescription.	4	108	Discharging MD doesn't know all prescription
		Patient misses a medication that they should be taking	9	3	Patient notices lack of discharge instruction for prescription.		108	Too difficult/too little time.
							0	Not thought important (assumes post-hospital follow-up will handle it).
Total for this Failure Mode	Sum =	216				Avg =	108	

Exhibit 19. Failure Mode and Effects Analysis at Discharge without Logician (continued)

Item/ Function	Potential Failure Modes	Potential Effects of Failure	Severity	Occurrence	Means of Failure Detection	Detectability	RPN	Potential Causes/ Mechanisms of Failure
4. Physician writes discharge orders/ instructions	4.b. Physician does not write comprehensive prescription list (may only write the medications relevant to the hospitalization)	Prescribed medications and home medications interact	6	5	Patient notices only new medications are listed	5	150	Too difficult/too little time.
		Patient takes wrong dose or frequency	8	8	Nurse notices when discharging patient		320	D/C physician doesn't know home regimen.
		Patient misses a medication that they should be taking	9	8	PCP notices during follow-up visit		360	Not thought important (assumes post-hospital follow-up will handle it).
		"Home" dosage is no longer correct	7	8			280	Insufficient home medication information (on H&P, CAD, etc.).
Total for this Failure Mode	Sum =	1110				Avg =	278	

Exhibit 19. Failure Mode and Effects Analysis at Discharge without Logician (continued)

Item/ Function	Potential Failure Modes	Potential Effects of Failure	Severity	Occurrence	Means of Failure Detection	Detectability	RPN	Potential Causes/ Mechanisms of Failure
4. Physician writes discharge orders/instructions	4.c. Order is overly general, e.g., "resume home meds" (see notes)	Prescribed medications and home medications interact	8	6	Nurse notices notation on discharge instruction sheet	4	192	Too difficult/too little time.
		Patient takes drug not needed	5	8			160	D/C physician doesn't know home regimen.
		Patient takes duplicate drug	8	6	Patient notices lack of prescription discharge instructions.		192	Not thought important (assumes post-hospital follow-up will catch).
		Patient misses a medication that they should be taking	9	6	PCP notices during follow-up visit		216	Insufficient home medication information (on H&P, CAD, etc.).
		"Home" dosage is no longer correct	6	8			192	
Total for this Failure Mode	Sum =	952				Avg =	190	
Total for Step 4	**Sum =**	**2278**				**Avg =**	**192**	

Exhibit 19. Failure Mode and Effects Analysis at Discharge without Logician (continued)

Item/ Function	Potential Failure Modes	Potential Effects of Failure	Severity	Occurrence	Means of Failure Detection	Detectability	RPN	Potential Causes/ Mechanisms of Failure
5. Nurse gives discharge instructions to patient	5.a. No prescription discharge instructions are given	Patient takes drug not needed	5	5	Nurse notices notation on discharge instruction sheet	4	100	Too difficult/too little time.
		Patient takes duplicate drug	8	6			192	
		Prescribed medications and home medications interact	8	4	Patient notices lack of prescription discharge instructions.		128	Won't write entire list if the MD hasn't provided it
		Patient misses a medication that they should be taking	9	8			288	Not thought important (assumes post-hospital follow-up will catch).
		Dosage or frequency is unclear, patient takes wrong amount	9	8			288	Insufficient home medication information (on H&P, CAD, etc.).
Total for this Failure Mode	Sum =	996				Avg =	199	

Exhibit 19. Failure Mode and Effects Analysis at Discharge without Logician (continued)

Item/ Function	Potential Failure Modes	Potential Effects of Failure	Severity	Occurrence	Means of Failure Detection	Detectability	RPN	Potential Causes/ Mechanisms of Failure
5. Nurse gives discharge instructions to patient	5.b. Incomplete information or explanation given.	Patient takes drug not needed	5	6	Nurse notices notation on discharge instruction sheet	4	120	Too difficult/too little time.
		Patient takes duplicate drug	8	6			192	
		Prescribed medications and home medications interact	8	6	Patient notices lack of discharge instruction for prescription.		192	Won't write entire list if the MD hasn't provided it
		Patient misses a medication that they should be taking	9	5			180	Not thought important (assumes post-hospital follow-up will catch).
		Dosage or frequency is unclear, patient takes wrong amount	9	6			216	Insufficient home medication information (on H&P, CAD, etc.).
Total for this Failure Mode	Sum =	900				Avg =	180	
Total for Step 5	**Sum =**	**1896**				**Avg =**	**190**	

Exhibit 19. Failure Mode and Effects Analysis at Discharge without Logician (continued)

Item/ Function	Potential Failure Modes	Potential Effects of Failure	Severity	Occurrence	Means of Failure Detection	Detectability	RPN	Potential Causes/ Mechanisms of Failure
6. Discharge information transmitted to PCP	6.a. Changes in medications never get to primary care physician	PCP unable to effectively coordinate prescription regimen and correct earlier failures	6	8	Patient visits the PCP and brings discharge medication list.	5	240	Discharge summary sent to wrong physician.
		PCP may incorrectly alter drug, dose, frequency	6	4	PCP office receives other hospital information related to visit, and notices discharge medication orders are missing.		120	Wrong fax, mailing information, etc.
					PCP office notified by Home Services, SNF, etc.			
Total for this Failure Mode	Sum =	360				Avg =	180	

Exhibit 19. Failure Mode and Effects Analysis at Discharge without Logician (continued)

Item/ Function	Potential Failure Modes	Potential Effects of Failure	Severity	Occurrence	Means of Failure Detection	Detectability	RPN	Potential Causes/ Mechanisms of Failure
6. Discharge information transmitted to PCP	6.b. Incomplete information on medications transmitted to primary care physician	PCP unable to effectively coordinate prescription regimen and correct earlier failures	6	8	Patient visits the PCP and brings discharge medication list.	5	240	Pages or sections missing.
		PCP may incorrectly alter drug, dose, frequency	6	4	PCP office receives other hospital information related to visit, and notices discharge medication orders are missing.		120	Discharge summary is incomplete re: medications.
					PCP office notified by Home Services, SNF, etc.			
Total for this Failure Mode	Sum =	360				Avg =	180	
Total for Step 6	**Sum =**	**720**				**Avg =**	**180**	
Total for Discharge	**Sum =**	**4894**				**Avg =**	**187**	

Exhibit 20. Failure Mode and Effects Analysis at Admission with Logician

Item/Step	Potential Failure Modes	Potential Effects of Failure (for high-risk patient)	Severity	Occurrence	Current Means of Failure Detection	Detection	RPN	NEW Potential Causes/ Mechanisms of Failure	OLD Potential Causes/ Mechanisms of Failure
1. PCP/Admitting MD writes admitting medication orders using Logician H&P.	1.b. For a critical medication, MD orders wrong drug, dose or frequency	Patient receives inappropriate drug	9	3	Patient notices discrepancy in medications.		108	Admit MD misreads list. Accesses wrong Logician chart. If not familiar with patient, doesn't call PCP. Doesn't confirm drug or dose with patient.	Admit MD doesn't know patient's prescription regimen. Admit MD doesn't call PCP. Doesn't confirm drug or dose with patient.
		Patient receives inappropriate dose or frequency	8	3	Nurse preparing CAD notices discrepancy to physician orders or printed Logician prescription list.	4	96	Logician medication list is not accurate (patient no longer taking prescription, can't afford, etc.). Or, inactive medications not marked as such.	PCP has incomplete prescription tracking mechanism. Facility (SNF, etc.) didn't transfer prescription list.
		Medication interaction	8	2			64	Patient/family doesn't know medications. Facility (SNF, etc.) didn't transfer prescription list. Multiple MDs involved in admission.	Patient/family doesn't know medications. Multiple MDs involved in admission.
		Allergic reaction	10	2			80		Old (inactive) medication list is used for reference.
Total for this Failure Mode	Sum =	348				Avg =	87		

(continued)

Exhibit 20. Failure Mode and Effects Analysis at Admission with Logician (continued)

Item/Step	Potential Failure Modes	Potential Effects of Failure (for high-risk patient)	Severity	Occurrence	Current Means of Failure Detection	Detection	RPN	NEW Potential Causes/ Mechanisms of Failure	OLD Potential Causes/ Mechanisms of Failure
1. PCP/Admitting MD writes admitting medication orders using Logician H&P.	1.c. MD doesn't order a critical patient medication	Patient doesn't receive needed medications while in hospital	8	3	Patient notices discrepancy in medications.	5	120	Admit MD misreads list. Accesses wrong Logician chart. If not familiar with patient, doesn't call PCP. Doesn't confirm drug or dose with patient.	Admit MD doesn't know patient's prescription regimen. Admit MD doesn't call PCP. Doesn't confirm drug or dose with patient.
					Nurse preparing CAD notices discrepancy to physician orders or printed Logician prescription list.			Logician medication list is not accurate (patient no longer taking prescription, can't afford, etc.). Or, inactive medications not marked as such.	PCP has incomplete prescription tracking mechanism. Facility (SNF, etc.) didn't transfer prescription list.
								Patient/family doesn't know medications. Facility (SNF, etc.) didn't transfer prescription list. Multiple MDs involved in admission.	Patient/family doesn't know medications. Multiple MDs involved in admission.
								Patient taking samples not on list.	Old (inactive) medication list is used for reference.
Total for this Failure Mode	Sum =	120				Avg =	120		

(continued)

Exhibit 20. Failure Mode and Effects Analysis at Admission with Logician (continued)

Item/Step	Potential Failure Modes	Potential Effects of Failure (for high-risk patient)	Severity	Occurrence	Current Means of Failure Detection	Detection	RPN	NEW Potential Causes/ Mechanisms of Failure	OLD Potential Causes/ Mechanisms of Failure
1. PCP/Admitting MD writes admitting medication orders using Logician H&P.	1.d. An additional critical medication is ordered	Patient takes drug not needed	4	2	Patient notices discrepancy in medications.		32	Admit MD misreads list. Accesses wrong Logician chart. If not familiar with patient, doesn't call PCP. Doesn't confirm drug or dose with patient.	MD doesn't confirm prescription with patient. Admit MD doesn't know patient's prescription regimen. Admit MD doesn't call PCP.
		Medication duplication/overdose	8	2	Nurse preparing CAD notices discrepancy to physician orders or printed Logician prescription list.	4	64	Logician medication list is not accurate (patient no longer taking prescription, can't afford, etc.). Or, inactive medications not marked as such.	PCP has incomplete prescription tracking mechanism. Facility (SNF, etc.) didn't transfer prescription list.
		Medication interaction	8	2	Pharmacy notices during profiling/order entry.		64	Patient/family doesn't know medications. Facility (SNF, etc.) didn't transfer prescription list. Multiple MDs involved in admission.	Patient/family doesn't know medications. Multiple MDs involved in admission.
		Allergic reactions	10	2			80	Patient taking samples not on list.	Old (inactive) medication list is used for reference.
Total for this Failure Mode	Sum =	240				Avg =	60		
1. PCP/Admitting MD writes admitting medication orders using Logician H&P.	1.f. Order cannot be read or interpreted	Patient receives inappropriate drug	9	3	Pharmacy notices during order entry.		81	Illegible	Illegible
		Patient receives inappropriate dose or frequency	8	3	Patient notices discrepancy in medications.	3	72	Refers to attached medication list which cannot be found.	Refers to attached medication list which cannot be found.
		Medication interaction	8	2	Nurse notices on transcription.		48		
		Allergic reaction	10	2			60		
Total for this Failure Mode	Sum =	261				Avg =	65.3		
Total for Step 1	Sum =	969				Avg =	83.1		

(continued)

Exhibit 20. Failure Mode and Effects Analysis at Admission with Logician (continued)

Item/Step	Potential Failure Modes	Potential Effects of Failure (for high-risk patient)	Severity	Occurrence	Current Means of Failure Detection	Detection	RPN	NEW Potential Causes/ Mechanisms of Failure	OLD Potential Causes/ Mechanisms of Failure
2. Nurse completes prescription history on nursing admission form	2.b. No nursing admission form is completed or prescription portion not completed	Patient receives inappropriate drug	9	2			54	Thought someone else did this.	Thought someone else did this.
		Patient receives inappropriate dose or frequency	8	2	Primary nurse notices when initiating care plan.	3	48	Too little time.	Too little time.
		Medication interaction	8	2			48		
		Allergic reaction	10	2			60		
Total for this Failure Mode	Sum =	210				Avg =	52.5		
2. Nurse completes prescription history on nursing admission form	2.c. Wrong medication, dose or frequency listed on nursing form	Patient receives inappropriate drug	9	2			72	No dose or frequency information is requested.	No dose or frequency information is requested.
		Patient receives inappropriate dose or frequency	8	3	Patient somehow notices error in communicatio n with nurse	4	96	Nurse does not review Logician medication list. Information source (e.g., previous hospital record, Logician medication list) incomplete or outdated.	Information source (e.g., previous hospital record) incomplete or outdated.
		Medication interaction	8	3	Nurse notices when comparing nursing form to physician order		96	If MD doesn't print Logician list, nurse cannot access it. Patient doesn't mention a critical prescription. Patient/family unable to bring in drugs. Patient doesn't carry prescription list.	Patient doesn't mention. No physician office record available. Patient/family unable to bring in drugs. Patient doesn't carry prescription list.
		Allergic reaction	10	3			120	Slips and lapses (sound-alike medications, transcription errors)	Slips and lapses (sound-alike medications, transcription errors)
Total for this Failure Mode	Sum =	384				Avg =	96		

(continued)

Exhibit 20. Failure Mode and Effects Analysis at Admission with Logician (continued)

Item/Step	Potential Failure Modes	Potential Effects of Failure (for high-risk patient)	Severity	Occurrence	Current Means of Failure Detection	Detection	RPN	NEW Potential Causes/ Mechanisms of Failure	OLD Potential Causes/ Mechanisms of Failure
2. Nurse completes prescription history on nursing admission form	2.d. A critical medication is not listed	Patient doesn't receive needed medication while in hospital	8	6	Patient notices discrepancy in medications.	4	192	Patient forgets to mention. Patient not given enough time, or prompted thoroughly.	Patient forgets to mention. Patient not given enough time, or prompted thoroughly.
		Medication interaction			Nurse notices when comparing current nursing form to past forms or printed Logician prescription list		0	Patient not asked about herbal and OTC medications. Not enough room on form to list all medications, doses, etc.	Patient not asked about herbal and OTC medications. Not enough room on form to list all medications, doses, etc.
								See also causes under 2.c. above.	See also causes under 2.c. above.
Total for this Failure Mode	Sum =	192				Avg =	96		
2. Nurse completes prescription history on nursing admission form	2.e. An additional critical medication is listed on nursing form	Patient takes drug not needed	4	2	Patient notices discrepancy in medications.		40	Finds old information from historical source.	Finds old information from historical source.
		Medication duplication/overdose	8	2	Nurse preparing CAD notices discrepancy to physician orders.	5	80	Assumes some prescription are taken, given patient's diagnosis or other medications.	Assumes some prescription are taken, given patient's diagnosis or other medications.
		Medication interaction	8	2			80	Some causes listed under 2.c. above also may operate here.	Some causes listed under 2.c. above also may operate here.
		Allergic reactions	10	2			100		
Total for this Failure Mode	Sum =	300				Avg =	75		

(continued)

Exhibit 20. Failure Mode and Effects Analysis at Admission with Logician (continued)

Item/Step	Potential Failure Modes	Potential Effects of Failure (for high-risk patient)	Severity	Occurrence	Current Means of Failure Detection	Detection	RPN	NEW Potential Causes/ Mechanisms of Failure	OLD Potential Causes/ Mechanisms of Failure
2. Nurse completes prescription history on nursing admission form	2.f. No allergies are listed	Patient receives a drug with known allergic reaction	10	3	Patient notices they weren't asked about allergies	8	240	Forgets.	Forgets.
								Too little time.	Too little time.
Total for this Failure Mode	Sum =	240				Avg =	240		
2. Nurse completes prescription history on nursing admission form	2.g. Nursing admission form cannot be read or interpreted.	Patient receives inappropriate drug	4	2			24	Illegible	Illegible
		Patient receives inappropriate dose or frequency	8	2	Primary nurse notices when initiating care plan.	3	48	Refers to attached medication list which cannot be found.	Refers to attached medication list which cannot be found.
		Medication interaction	8	2			48		
		Allergic reaction	10	2			60		
Total for this Failure Mode	Sum =	180				Avg =	45		
Total for Step 2	Sum =	1506				Avg =	101		

(continued)

Exhibit 20. Failure Mode and Effects Analysis at Admission with Logician (continued)

Item/Step	Potential Failure Modes	Potential Effects of Failure (for high-risk patient)	Severity	Occurrence	Current Means of Failure Detection	Detection	RPN	NEW Potential Causes/ Mechanisms of Failure	OLD Potential Causes/ Mechanisms of Failure
3. Pharmacy establishes medication administration record (MAR)	3.b. For a critical medication, MAR contains wrong drug, dose, frequency, or route	Patient receives inappropriate drug	10	2	Patient notices discrepancy in medications.		80	Inconsistencies *within* physician order (interactions, allergies, duplications, etc.) are not reconciled by pharmacy.	
		Patient receives inappropriate dose or frequency	7	3	Nurse administering medications notices a problem.	4	84	Inconsistencies *across multiple physician* orders (interactions, allergies, duplications, etc.) are not reconciled by pharmacy.	
		Medication interaction	6	2	Physician reviews MAR against Logician.		48	Root causes: lack of coordination among multiple treating physicians.	
		Allergic reaction	10	2			80		
Total for this Failure Mode	Sum =	292				Avg =	73		
Total for Step 3	Sum =	292				Avg =	73		
Total for ALL Failure Modes	Sum =	2767				Avg =	91.8		

Notes: The following failure modes were not evaluated (see screening criteria).
1.a. No physician medication order (would halt the process).
1.e. Physician orders an inappropriate medication for the patient (a different kind of error, we are not studying it).
2.a. The patient is not asked about their medications (VERY remote possibility).
3.a. The pharmacist fills a wrong order and has no way to know it was wrong.
3.c. The pharmacist incorrectly fills order (we did not study this process in detail)

Exhibit 21. Failure Mode and Effects Analysis at Discharge with Logician

Item/Function	Potential Failure Modes	Potential Effects of Failure	Severity	Occurrence	Means of Failure Detection	Detectability	RPN	Potential Causes/ Mechanisms of Failure
4. Physician writes discharge orders/instructions	4.a. No medication orders given to patient (MD doesn't write prescription orders, not written in time, or not given to patient)	Patient continues to take "old" medication no longer indicated (drug, dose, frequency)	9	3	Nurse notices no discharge orders/instructions for prescription.	4	108	Discharging MD doesn't know all prescription
		Patient misses a medication that they should be taking	9	3	Patient notices lack of discharge instruction for prescription.		108	Too difficult/too little time.
								Not thought important (assumes post-hospital follow-up will handle it).
Total for this Failure Mode	Sum =	216					108	

Exhibit 21. Failure Mode and Effects Analysis at Discharge with Logician (continued)

Item/Function	Potential Failure Modes	Potential Effects of Failure	Severity	Occurrence	Means of Failure Detection	Detectability	RPN	Potential Causes/ Mechanisms of Failure
4. Physician writes discharge orders/instructions	4.b. Physician does not write comprehensive prescription list (may only write the medications relevant to the hospitalization)	Prescribed medications and home medications interact	6	3	Patient notices only new medications are listed	3	54	Too difficult/too little time.
		Patient takes wrong dose or frequency	8	3	Nurse notices when discharging patient		72	D/C physician doesn't know home regimen.
		Patient misses a medication that they should be taking	9	3	PCP notices during follow-up visit		81	Not thought important (assumes post-hospital follow-up will handle it).
		"Home" dosage is no longer correct	7	3			63	Insufficient home medication information (on H&P, CAD, etc.).
Total for this Failure Mode	Sum =	270					67.5	

Exhibit 21. Failure Mode and Effects Analysis at Discharge with Logician (continued)

Item/Function	Potential Failure Modes	Potential Effects of Failure	Severity	Occurrence	Means of Failure Detection	Detectability	RPN	Potential Causes/ Mechanisms of Failure
4. Physician writes discharge orders/instructions	4.c. Order is overly general, e.g., "resume home meds" (see notes)	Prescribed medications and home medications interact	8	3	Nurse notices notation on discharge instruction sheet	3	72	Too difficult/too little time.
		Patient takes drug not needed	5	3			45	D/C physician doesn't know home regimen.
		Patient takes duplicate drug	8	3	Patient notices lack of detailed discharge instruction for prescription.		72	Not thought important (assumes post-hospital follow-up will catch).
		Patient misses a medication that they should be taking	9	3	PCP notices during follow-up visit		81	Insufficient home medication information (on H&P, CAD, etc.).
		"Home" dosage is no longer correct	6	3			54	
Total for this Failure Mode	Sum =	324					64.8	
Total for Step 4	**Sum =**	**810**					**80.1**	

Exhibit 21. Failure Mode and Effects Analysis at Discharge with Logician (continued)

Item/Function	Potential Failure Modes	Potential Effects of Failure	Severity	Occurrence	Means of Failure Detection	Detectability	RPN	Potential Causes/ Mechanisms of Failure
5. Nurse gives discharge instructions to patient	5.a. No prescription discharge instructions are given	Patient takes drug not needed	5	2	Nurse notices notation on discharge instruction sheet	4	40	Too difficult/too little time.
		Patient takes duplicate drug	8	2			64	
		Prescribed medications and home medications interact	8	2	Patient notices lack of prescription discharge instructions.		64	Won't write entire list if the MD has provided it
		Patient misses a medication that they should be taking	9	2			72	Not thought important (assumes post-hospital follow-up will catch).
		Dosage or frequency is unclear, patient takes wrong amount	9	2			72	Insufficient home medication information (on H&P, CAD, etc.).
Total for this Failure Mode	Sum =	312					62.4	

Exhibit 21. Failure Mode and Effects Analysis at Discharge with Logician (continued)

Item/Function	Potential Failure Modes	Potential Effects of Failure	Severity	Occurrence	Means of Failure Detection	Detectability	RPN	Potential Causes/ Mechanisms of Failure
5. Nurse gives discharge instructions to patient	5.b. Incomplete information or explanation given.	Patient takes drug not needed	5	3	Nurse notices notation on discharge instruction sheet	4	60	Too difficult/too little time.
		Patient takes duplicate drug	8	3			96	
		Prescribed medications and home medications interact	8	3	Patient notices lack of prescription discharge instructions.		96	Won't write entire list if the MD has provided it
		Patient misses a medication that they should be taking	9	3			108	Not thought important (assumes post-hospital follow-up will catch).
		Dosage or frequency is unclear, patient takes wrong amount	9	3			108	Insufficient home medication information (on H&P, CAD, etc.).
Total for this Failure Mode	Sum =	468					93.6	
Total for Step 5	**Sum =**	**780**					**78**	

Exhibit 21. Failure Mode and Effects Analysis at Discharge with Logician (continued)

Item/Function	Potential Failure Modes	Potential Effects of Failure	Severity	Occurrence	Means of Failure Detection	Detectability	RPN	Potential Causes/ Mechanisms of Failure
6. Discharge information transmitted to PCP	6.a. Changes in medications never get to primary care physician	PCP unable to effectively coordinate prescription regimen and correct earlier failures	6	3	Patient visits the PCP and brings discharge medication list.	5	90	Discharge summary sent to wrong physician.
		PCP may incorrectly alter drug, dose, frequency	6	3	PCP office receives other hospital information related to visit, and notices discharge medication orders are missing.		90	Wrong fax, mailing information, etc.
					PCP office notified by Home Services, SNF, etc.			
Total for this Failure Mode	Sum =	180					90	

Exhibit 21. Failure Mode and Effects Analysis at Discharge with Logician (continued)

Item/Function	Potential Failure Modes	Potential Effects of Failure	Severity	Occurrence	Means of Failure Detection	Detectability	RPN	Potential Causes/ Mechanisms of Failure
6. Discharge information transmitted to PCP	6.b. Incomplete information on medications transmitted to primary care physician	PCP unable to effectively coordinate prescription regimen and correct earlier failures	6	3	Patient visits the PCP and brings discharge medication list.	5	90	Pages or sections missing.
		PCP may incorrectly alter drug, dose, frequency	6	3	PCP office receives other hospital information related to visit, and notices discharge medication orders are missing.		90	Discharge summary is incomplete re: medications.
					PCP office notified by Home Services, SNF, etc.			
Total for this Failure Mode	Sum =	180					90	
Total for Step 6	**Sum =**	**360**					**90**	
Total for Discharge	**Sum =**	**1950**					**82.7**	

How an IT Solution Might Affect Potential Failures. Two of the integrated delivery systems in our study have information technology (IT) solutions that can aid in the transfer of medication information. These solutions do not change the basic process flow, but they make information available at various steps, reducing the probability of errors as well as the time involved in researching the medication history. One particular IT solution studied was the use of Logician™, an ambulatory care electronic medical record system used by many clinicians within PHS. The discussion below describes how these IT systems might affect potential failures and a summary of our tables is provided in **Exhibits 20** and **21**.

Admission

The use of this system (described below) changes the frequency of occurrence of potential failures within the step of physician admitting orders, and downstream, the MAR. It does not affect the nursing interview or the Emergency Department, as currently implemented. Because of time and confidentiality constraints, neither the Emergency Department nor the inpatient nursing floor accesses Logician.

1. Physician Admitting Orders

A physician using Logician is able to access and print an electronic version of the patient's medication list. In a pilot at Providence Health System this information is being used as part of the hospital admission History and Physical (H&P). Specifically, this reduces:

- The probability that an ongoing medication will be inadvertently omitted,
- The probability that a new medication will be ordered at the hospital that interacts with an ongoing medication,
- The probability that a medication will be ordered that conflicts with a documented allergy.

One new source of error that is introduced by the use of this electronic source is the *inclusion* of medications that the patient may not be taking. Physicians acknowledged that the Logician medication list may not always be up-to-date. A particular problem was the lack of trimming older medications that may have been tried and discontinued. Even when the list has been maintained, the patient may not be taking the medications as prescribed.

Overall, however, failure rates are thought to be reduced when Logician is introduced into the admission process.

2. Medication Administration Record

Because the MAR is highly dependent on the physician admitting orders, the use of Logician by the admitting physician reduces the potential for medication omission within the MAR. As stated above, however, there is a slight chance that the use of Logician will cause discontinued medications to be added to the MAR.

Discharge

Logician forms can be used at discharge to ensure that updated medication information is available to the primary care physician. There is also benefit to the discharge process in that the use of Logician at admission may have allowed for a more complete list of medications to be available throughout the stay.

1. Physician Discharge Instructions

In the Providence pilot, physicians write the entire Discharge Summary, including the medication list, using Logician. This means that the historical medication list is available and can be updated based on changes during the hospital stay. Theoretically, discharge instructions can therefore include all medications, without omissions or the need to state, "resume home meds." However, the IT solution is currently not always used for the patient Discharge Instructions. For the IT solution to be of benefit here, the physician must access Logician prior to issuing discharge instructions for the patient, and make sure that the Discharge Instructions, Discharge Summary, and Logician Medication List are identical. In fact, some physicians feel that the discharge instructions are a nursing responsibility and they focus their attention on what is required for the Discharge Summary.

2. The Transfer of Medication Information to Patients

More complete information available on the discharge instructions makes it possible for nurses to have a more complete list to go over with the patient. However, potential failures still occur, due to time pressure and patient cognition.

3. The Transfer of Medication Information to Subsequent Providers

The use of Logician to write the discharge medications means that information in the ambulatory record will match the discharge instructions.

Solving this problem is a great step forward. However, it does not solve the problem of transmitting information to multiple providers.

2.5.3.4 FMEA Results Using Expert Ratings

Exhibits 20 and **21** show the expert ratings of each of the Steps and Failure Modes for both Admission and Discharge. An average and sum total are shown for each failure mode. The sum reflects the fact that each step may have multiple failures. The average is also shown, because the granularity of the failure listing is greater in some cases, and a review of the averages ensures that some failures are not over-weighted because of the way they are parsed. Similarly, the tables show sums and averages for:

- each step in the process,
- admission and for discharge total, and
- the process in total.

The sum takes into account modes with more failures, while the average treats all modes equally.

Failure Modes Across the Admission Process

Failure modes within the physician steps are rated higher (more risky) than failure modes within nursing. As mentioned above, this is because the physician order determines the medications given to the patient. Nursing documentation acts as a back-up data collection method.

According to these ratings, the most critical physician failures are (a) to order the wrong drug, frequency, or dose, and (b) to miss a medication. A significant nursing failure is to not list patient allergies. This risk score is particularly high because of the inability to detect it.

The failure of wrong drugs listed on the medication administration record (MAR) is also significant, because of the certainty with which this determines what is given to the patient, and the difficulties of detection.

Failure Modes Across the Discharge Process

As rated by our nurse researcher, the most critical failure at discharge is the omission of a critical medication because the physician does not review all medications and then re-establish the home medication regimen. This can be due to lack of time, lack of perceived responsibility, and also a lack of information.

The failure of "listing only hospital medications" is rated as more risky than the general notation of "resume home meds," perhaps because the former is thought to be more likely to result in patient confusion and the taking of a wrong drug or dose. Detection ratings for the failure of omitted medications are also higher (poor detection) than the failure of the notation to resume home medications. Nurses see the notation, but they don't necessarily review the H&P or MAR to see what might be missing.

A second failure mode with high risk is inadequate explanation of discharge medications by the nurse. Failures at this step appear to be difficult to detect and also quite likely to result in patients taking wrong drugs or doses.

Failures in the process of transmitting information from hospital to primary care are rated as having less immediate impact on the patient. Poor transmission of information does appear to reduce the ability of the primary care physician to provide defenses against any prescribing or administration errors occurring in the hospital. However, this failure is not rated as causing patients to take wrong medications.

Data-Supported FMEA

Appendix F contains an entire toolkit devoted to methods for collecting quantitative data for the FMEA. Examples are given of how chart reviews, patient and staff surveys, observational studies, transaction data, and formal comparative research can add data to the FMEA.

Chart Review Study

In this study, we conducted a small chart review to determine whether we could help to quantify some of the forces affecting failures in this process. The following exhibits display some of the results of this chart review. Additional tables are provided in **Appendix G**. Of note are the following findings.

Exhibit 22. Results from Preliminary Chart Review

Failure in Medication Information Transfer	Percentage of Charts with Failure
No medications listed on the CAD[(1)] form	26%[(2)]
No OTC/herbal medications on CAD form	33%
Discharge Order states, "Resume home meds"	20%

[(1)] The Clinical Admission Data form, a nursing admission form.
[(2)] This percentage includes patients who were not taking any medications.

These findings cannot be directly fitted into our FMEA tables, because we do not know the additional probability of one of these failures resulting in a wrong drug, dose, or frequency.

Review of these findings by the FMEA raters did find that the rates of these failure events were higher than expected. In the case of the nursing CAD form, it can be acknowledged that this is not the source of the MAR within the hospital. However, anecdotal evidence provided during the study suggests that physician ascertainment of OTC/herbal medications is not greater than that of nurses and is probably lower.

The "resume home meds" frequency is perhaps most disturbing although further exploration may be needed. Two situations may be occurring: (a) the physician has reviewed all the home medications via the hospital H&P or nursing admission forms and decides they are fine to continue, or (b) they don't really know the home medication regimen but believe there won't be a problem. It is also possible that the patient's medication list is so long that it will be tiresome to write it out, certainly a high-risk situation.

Three other types of findings from the chart review are of interest. First, several failure rates appear lower than expected:

Exhibit 23. Failure Rates Determined by Chart Abstraction

Failure in Medication Information Transfer	Percentage of Charts with Failure
"Resume Home Meds" notation at admission	2%
Allergies indicated as "Yes" on CAD form but not specifically listed by nurse	1%

Second, differences between data from the nursing interview (CAD admission form) and the physician order were very high. This is to be expected, since many medications are stopped during an inpatient episode. The degree of correspondence is shown below.

Exhibit 24. Degree of Correspondence Ascertained by Chart Review

Form of Document Consistency	Percentage
Had an prescription on Physician Order but not on CAD form	92%
Had an prescription on CAD but not on PO	83%
Had 3+ prescription on PO but not on CAD	55%
Had 3+ prescription on CAD but not on PO	27%
Had 6+ prescription on PO but not on CAD	9%
Had 6+ prescription on CAD but not on PO	4%

In almost all cases, there is a difference between the nursing interview result and what is ordered for the patient. In a small but significant number of cases, there are many medications not included in one place or the other. It would take clinical second-opinion to determine if any of these differences were clinically relevant. Also, these differences are without regard to medication type. Further analysis can be done to determine whether critical medications appear in either category.

Finally, there was an absence of documentation in the charts that effective defenses were being employed to prevent failures downstream. Admittedly, a limitation of this chart review was that charts were reviewed using an electronic system that accesses scanned documents from the chart. Not all documents from the inpatient stay are scanned.

Exhibit 25. The Role of Chart Review in Avoiding Adverse Medication Events

Potential Defense Against Failure	Percentage
Chart contains a medication list from the physician's office	41%
Chart contains a patient-provided medication list	2%
Chart contains a list of discharge medications developed by the nurse	26%
Chart contains a letter to the patient, explaining medications	30%
Chart contains a notation that discharge medication list was sent to PCP	0%

2.5.4 Comparative FMEA Methodology

2.5.4.1 FMEA Ratings

The FMEA tool was used to compare the risks associated with medication information transfer with and without the IT solution.

As discussed above, the process steps and potential failures appear to be the same with either system, so the rating tool was used to determine whether there were differences in *frequency* of failures and effects, *severity* of effects, or *detection*.

As with the earlier FMEA tables, a nurse-expert familiar with the process and trained in the FMEA tool provided ratings of severity, occurrence, and detection for each failure mode. These ratings were summed and averaged for each failure mode and step.

2.5.4.2 Discussions with Logician Users

Discussions with key Logician users were used to assess the extent to which the IT solution was implemented as designed. These were informal discussions of processes and barriers to implementation, not a formal assessment of the diffusion of this innovation at Providence.

In total, four discussions were held:

a. In a one-hour discussion with the Director of the Family Practice Residency where the Logician pilot was conducted.
b. At a noon resident conference in the Family Practice Residency
c. During a three-hour session with researchers shadowing two Providence hospitalists on morning rounds.
d. In a one-hour discussion with a faculty advisor and resident.

Notes from these discussions were taken by study researchers, and themes on the use of the IT solution presented below. These discussions were conducted in addition to an evaluation of the Logician pilot conducted in 2001 where hospital and ambulatory medication lists were compared for consistency.

2.5.5 Comparative FMEA Results

2.5.2.1 FMEA Tables

Exhibit 26 shows a summary of ratings, comparing the current process with the IT solution (using Logician) side-by-side. The process using Logician receives lower risk ratings for the following steps:

1. Medication Orders
2. Initiation of the MAR
3. Discharge Orders/Instructions
4. Transmission of Discharge Information to Primary Care

Exhibit 26. Comparative FMEA Rating Summary

ADMISSION			RPN Values				Avg Diff
			No Logician		Logician		
			Sum	Average	Sum	Average	
–Patient is not taking medications as *prescribed*			—	—	—	—	
–Patient is not taking medications as *reported*			—	—	—	—	
1	**MD writes admitting order:**						
	a.	No medication orders are given (not rated, would halt process)	-	-	-	-	
	b	Wrong medication, dose or frequency	945	236	348	87	149
	c	Not all medications ordered	240	240	120	120	120
	d.	Too many medications	590	148	240	60	88
	e.	Prescription is inappropriate for this patient (not rated)	—	—	—	—	
	f.	Other - illegible, etc.	756	189	261	65	124
Step 1 Total			**2531**	**203**	**969**	**83**	120
2	**Nurse completes prescription history on Admission Form**						
	a.	CAD is blank because patient not asked - (not rated)	—	—	—	—	
	b.	Patient is asked but documentation is not completed	210	52.5	210	52.5	0
	c.	Wrong medication, dose or frequency	480	120	384	96	24
	d.	Not all medications listed	240	120	192	96	24
	e.	Too many medications listed	300	75	300	75	0
	f.	No allergies listed	240	240	240	240	0
	g.	Other - illegible, etc.	180	45	180	45	0
Step 2 Total			**1650**	**109**	**1506**	**101**	8
3	**MAR initiated and prescription therapy begun**						0
	a.	MAR based on faulty information within MD order (not rated)	—	—	—	—	
	b.	Pharmacy does not check orders before filling	450	113	292	73	40
	c.	New errors introduced at MAR (not rated)	-	-	-	-	
Step 3 Total			**450**	**113**	**292**	**73**	40
Total for ADMISSION			**4631**	**141**	**2767**	**86**	56

Exhibit 26. Comparative FMEA Rating Summary (continued)

DISCHARGE			RPN Values				Avg Diff
			No Logician		Logician		
			Sum	Average	Sum	Average	
4	**Physician writes medication orders**						
	a.	No medication orders	216	108	216	108	0
	b.	Medication order is not comprehensive	1110	278	270	68	210
	c.	Is overly general, e.g., "resume home meds"	952	190	324	65	126
Step 4 Total			**2278**	**192**	**810**	**80**	112
5	**Nurse, doctor or pharmacist explains medication orders**						
	a.	Medication orders not explained at all	996	199.2	312	62	137
	b.	Inadequate explanation of medication orders	900	180	468	94	86
Step 5 Total			**1896**	**190**	**780**	**78**	112
6	**Discharge information transmitted to primary care**						
	a.	New medication orders never get to primary physician	360	180	180	90	90
	b.	Errors in transmission	360	180	180	90	90
Step 6 Total			**720**	**180**	**360**	**90**	90
7	**Patient doesn't understand medication orders (not rated)**		-	-	-	-	
8	**Orders lost by patient (not rated)**		-	-	-	-	
9	**Patient doesn't fill prescription (not rated)**		-	-	-	-	
Total for DISCHARGE			**4894**	**187**	**1950**	**83**	104
TOTAL for ALL Failure Modes			**9525**	**164**	**4717**	**84**	80

Note: In almost all cases the difference in average RPN ratings is positive, indicating a *lower* risk for Logician. The RPN is the product of Severity, Occurrence, and Detection Ratings. It has no intrinsic meaning aside from showing relative risks among the modes and steps. Lower numbers reflect lower risks.

A more detailed look within the FMEA tables shows that the lower ratings with Logician can be traced to Logician's positive influence on the *causes* of failure, as follows:

Step 1. Medication Orders

Failure Mode b. (Wrong Medication). Severity ratings are the same with and without Logician, but the frequency of occurrence is lower with Logician. Without Logician, failures of wrong drugs or doses occur because the admitting doctor might not know the patient and/or is unable to access current medication information. These are systemic problems which inject guesswork into developing the proper treatment regimen. With Logician, the causes of wrong drugs are due to less frequent or far-reaching causes: inaccurate medication lists, accessing the wrong chart, etc.

By providing at least an initial working list (to be confirmed via patient or family interview), Logician reduces the probability that this failure and its set of effects will occur.

Failure Mode c. (Medication Omission). It is much more likely for a physician not to order a critical medication if they don't have Logician data available, for some of the same reasons as above. They are relying on patient memory, what they can glean from the family, or possibly a phone conversation with the primary care physician. This is consistent with inter-hospital data sharing through IT solutions reported by First Consulting Group (2002) and the California HealthCare Foundation (2002).

Failure Mode d. (Added Medication). These ratings may be somewhat controversial. Some key informants said they thought physicians might be *more* likely to order an old medication if they are reviewing the Logician medication list than if they are just asking the patient, family, and possibly calling the PCP. The Logician medication lists are not updated regularly and often contain discontinued medications. Patient interviews, on the other hand, would likely result in more omissions than additions due to memory loss.

The ratings with Logician, however, do not reflect a higher risk for an added medication, probably for two reasons:

(a) Poor patient memory could result in naming a medication that has been discontinued.

(b) Even though an old Logician medication list might prompt a physician to consider other medications, the list is only a reminder, not an imperative to order a medication.

Certainly, more research could be conducted on this issue.

Failure Mode f. (Illegibility, etc.). It is much less likely to have patients receive wrong drugs, doses, etc. when Logician medication list is present, because it is printed and available in the chart for the pharmacist to double-check against.

Step 2. Nursing Admission Form

Logician has little influence on failure modes during the completion of the nursing admission forms, by these ratings. Specific failure modes are reviewed below.

2.b. The presence of a Logician medication list does not affect *absence* of nursing admission form.

2.c. Logician does make it somewhat less likely to get a *wrong drug or dose* due to a failure at the CAD, because nurse has the printed Logician list available as backup.

2.d. Logician will help to make sure that there are no *drugs omitted*.

2.e. Logician is rated as not encouraging a nurse to add other medication that result in patients receiving something additional they shouldn't. Not only is the presence of a long medication list from Logician not an imperative to provide a drug, but also many of the medications listed on the nursing form do not result in a listing on the MAR.

2.f. Ratings indicate that Logician doesn't alter the effects of an illegible CAD, which makes intuitive sense.

Step 3. MAR Development

Logician is rated as having a major influence on failures in developing the MAR, in terms of the pharmacist's ability to check their work and lower the chance of error. The presence of the Logician medication list also permits detection by nurses and physicians, as they furnish data for the MAR.

Step 4. Discharge Instructions

Our expert rater indicated that the frequency of occurrence for a physician to write only new medications or to make a general notation like "resume home meds" was greatly reduced with Logician. The potential causes of these failures are present in either case, but with the Logician information available, it is less likely that the discharging physician will make these errors. It is also easier for a nurse or pharmacist to detect a discrepancy between the few medications listed at discharge and the entire Logician list that appears in the chart.

Step 5. Nurse Gives Discharge Instructions to Patient

The Logician medication list substantially reduces the risk that a nurse will provide incomplete information, as assessed by our raters. However, this assumes that all information is accurately input into the system and completed in a timely manner so that it is accessible when needed by the nursing staff.

Step 6. Transmission of Medication Information to Primary Care

Logician plays a constructive role in reducing failures related to the transmission of information to primary care, as it facilitates the actual updating of ambulatory medication lists at the time of discharge. The impact on the patient is dependent upon whether this updating occurs prior to the step of Patient Discharge Instructions step. If the Discharge Instructions contain an entire revised list of medications, the likelihood of patient confusion, wrong drugs or does, and eventual harm is reduced.

3

Impact of Study on Providence Health System

The following discussion focuses on the impact this study has had within the Providence Health System. Preliminary focus group findings have been presented once to each of the PHS major hospital quality councils with follow-up presentations in August, 2002. We report here both initial reactions to the findings and anticipated actions to be considered upon viewing the final report.

3.1 Initial Reactions to Interim Reports

Initial reactions to the findings were a blend of enthusiasm for some of the solutions generated by key informants, tempered by the desire to know the costs of the process as it currently exists and whether investments in quality could reduce overall costs. For example, the Providence Portland Medical Center Quality Council acknowledged that it would be helpful to have a pharmacist involved at every discharge, but the cost would be prohibitive. The Council requested that further study effort be aimed at documenting leverage points and risk factors that could help target the use of pharmacy expertise. One suggested alternative approach was that the pharmacist could be involved with a subset of complex medical patients or when a major medication change needed to be explained in detail to a patient.

The Providence St. Vincent's Medical Center Quality Council suggested further discussions with the PHS Information Services Department, concerning development of access to Logician for hospital clinicians. Evidence from the study pointed to the low use of Logician in the Emergency Department, even though much time had been spent granting access to electronic charts from every Providence primary care clinic. ED clinicians reported to the study team that they had too little time to access Logician, particularly finding their way through an application with which they were not familiar.

Discussions with PHS Information Services have evolved to consideration of a web-based "Logician Summary" which would include medication information. This summary could be accessed remotely and not require knowledge of the Logician system to review pertinent details of a patient's history when that patient showed up in the ED. Inpatient nurses and pharmacists have also requested access to the Logician Summary when it is developed.

A second set of developments concerns the diffusion of the process whereby Logician form components are used for H&P and discharge summaries. This process was piloted at one hospital in the Portland Service Area within the Family Practice Residency Program. Diffusion to other sites has not been formally implemented, yet the practice is beginning to surface within the other Residency Programs via word of mouth and the sharing of office staff familiar with the practice. One important next step for Providence will be to facilitate the dissemination of this practice as it saves time for clinicians as well as reduces the failures examined in the present study.

Finally, the Patient Safety Team at Providence Portland Medical Center is exploring ways to implement the AHRQ patient safety guidelines via subcommittee review and recommendations concerning current hospital policy and practice. One guideline receiving more emphasis because of this study is the practice of educating patients on the importance of knowing their medications. At the same time that improvements in communication occur among the health care staff responsible for medication information, Providence believes that patients must help to safeguard their safety by knowing more about their medications. Educational materials based on the AHRQ guidelines are being promulgated throughout the Providence Health System.

We anticipate that other partner IDSs will quickly respond to project findings as they are disseminated. IHC has already noted that medication information transfer was not on its list of "top 10" adverse medical events and is conducting an internal investigation to assess the prevalence of the problem based on an interim report from this project.

3.2 Anticipated Future Impact of Findings

Study results are being used within the PHS in a number of ways. First, specific proposals have been developed as possible improvements to the problems of medication information transfer:

- An important proposal under consideration is to add a clinical "transition pharmacist" for each of the PHS Portland area hospitals. One function of the proposed pharmacist is to write the discharge medications, with Logician as the IT solution, and also to interface with ambulatory pharmacists already in place in the sponsored primary care groups.
- Another proposal has been to have the pharmacy produce a "check-off" list for the discharging physician so they can indicate "continue" or "stop" next to each medication. This would add comprehensiveness and save time.
- A third proposal would encourage the use of Logician discharge summary forms by hospitalists. At present, the only physicians with the incentives to update the ambulatory record are those who are seeing their own patients in the hospital. However, it has been proposed to alter the contracting arrangements with the hospitalists to make this part of their work.
- The development of a Logician Summary available on the web-based physician portal has been re-prioritized as a more urgent request from the PHS Information Services Department. Of particular importance is the use of the Logician information by the hospital emergency departments.

Second, the results of this project are being shared within PHS, across departments and facilities. The impact has spread to consideration of other patient history elements besides just medications. For example, Providence Seaside Hospital has taken on an improvement study to address the problem of identifying patient medication allergies. Initial investigations found many discrepancies in the documentation occurring within the admission face sheet, nursing admission form, the H&P, and MAR. An FMEA analysis was conducted in June, 2002, action plans developed, and ongoing monitoring established. Their target is to reduce the number of charts with discrepancies from 50 percent (1st Quarter, 2002) to 25 percent (4th Quarter, 2002).

Within Providence Portland Medical Center, word of the study has traveled to nursing units involved with surgical stays (even though the current study focused on the medical patient). In the surgical units, the problem of discharge medications is even more pronounced. It is not uncommon for a surgeon to write discharge medication orders prior to admission, that cover only the pain medications likely needed for surgical recovery. This in turn has led to investigation of the role and availability of primary care physicians during surgical stays to assist in medical management of the patient. In an effort to focus on a particularly problematic area, PPMC has begun development of a project to ensure identification of the diabetic patient and active management of glucose control during surgical stays. There is also a proposal to mandate greater use of pre-surgical services for the admission process with patients bringing in their home medications.

Third, the Portland Service Area is beginning to re-evaluate the voluntary reporting system for medical errors and near-misses. The system is increasingly used to identify types and categories of problems, but it does not yet have an easy means of pointing to underlying processes to be improved. In the current study, for example, it was not clear how many "unusual occurrence reports" stemmed from problems in medication information transfer. It is thought that more information will be needed on the context surrounding the unusual occurrence, in order to trace an unusual occurrence to the underlying processes involved.

Case Study

There was an example of a near-miss report brought up by nursing in which the admitting physician said, "see attached list," and attached a Logician medication list. According to this report, the list was not reviewed prior to development of the MAR. In this particular case, the medication list was confusing with *many* medications listed that had been discontinued.

Finally, PHS is grappling with the amount of variability inherent in these processes, often due to differences in physician practice. There is variability in the way a physician can discharge a patient (phone the unit, enter on DC Order & Interdisciplinary Instructions Form, on Physician Order, or place on Progress Notes). Similarly, there is variability in the number of people involved, and the timing of completion for the medication section of the Discharge Orders & Interdisciplinary Instructions. It may be filled out by a resident, it may be blank so the nurse has to search for the information, some specialists give prescriptions to patients long before discharge, and indicate on the medication section "continue home meds" or something similar, and additional prescriptions may be written on separate forms after the form the DC Orders & II form is filled out.

The question being debated is whether this variability keeps the process robust (with multiple avenues to complete the same task, in case one avenue is blocked), or whether it allows too many areas for latent error to remain, without easy detection. As the hospitals prepare for computerized physician order entry (CPOE), these processes are being reviewed and some amount of standardization is likely to follow.

In addition to such impacts at PHS, we anticipate additional impact at our partner IDSs. Presentations are being made at IHC on November 12 and UNC Health Care on November 13. We also hope that study findings have a larger reach, influencing quality improvement efforts on a larger scale beyond our IDSRN. Our dissemination plan is detailed in **Chapter 4** of this report.

Dissemination Plan

The RTI-PHS research team places great value on dissemination of research results. We additionally note the expectation expressed by study participants to receive feedback on the results of our work. Thus, we have designed a multi-faceted dissemination plan including:

- Presentations at participating IDSs;
- Slide set for sharing among participating IDSs;
- Fact sheet for distribution to study participants and possibly via the AHRQ web site;
- Interagency debriefing presentation at AHRQ;
- Manuscript submitted in a peer-reviewed publication, *Quality and Safety in Health Care*;
- Final report to AHRQ Project Officer; and
- Project summary on the AHA electronic newsletter.

We believe that this plan will afford broad-based dissemination of our study findings.

4.1 Presentations and Slide Set

We will present project findings to the Quality Councils at Providence Health System, the Medication Safety Committee at UNC Health Care, and the Quality Improvement Committee at IHC in October and November, 2002. Dr. Bayley will present at PHS and Dr. Savitz will present at UNC and IHC, taking advantage of their proximal offices to make these presentations budget neutral. We will also provide each partner IDS with a slide set to further diffuse project findings. In this way, we will cost effectively disseminate study results to study participants and interested administrators and clinicians at partner IDSs collaborating on this project.

4.2 Fact Sheet

Results of our work will also be synthesized in a fact sheet that is aimed at clinicians and health services researchers. Our fact sheet is informed by an inventory of all AHRQ fact sheets available at its web site and a generic template was derived from this assessment (see **Appendix H** for our assessment and draft fact sheets). Our intent is to provide this fact sheet to our key contact at each participating IDS for dissemination to involved and interested staff. Further, AHRQ will have this available to incorporate on its web site. We chose a fact sheet versus Research in Action summary format so that we did not jeopardize our ability to publish results from out study in the peer-reviewed literature. However, we could work with AHRQ to produce a Research in Action document once our manuscript is published.

4.3 Interagency Debriefing

We presented results from this study at a debriefing session to be held at AHRQ on October 11. A copy of our PowerPoint slide handouts are provided in **Appendix I**. The joint presentation was made by Dr. Lucy Savitz from RTI together with Dr. Bruce Bayley from PHS. Ms. Erica Brody from RTI also attended.

4.4 Manuscript

We intend to submit a manuscript to the journal, *Quality and Safety in Health Care*. We have communicated with Dr. Paul Barach, Editor, who has expressed interest in reviewing this manuscript for a forthcoming issue of the Journal. The proposed outline for this manuscript follows:

Structured Abstract

Background
- Outline of the Problem—Effective Medication Information Transfer across Care Settings
- Study Context –IDS Partners
- Description of the Funded Task by AHRQ

Assessment of the Problem
- Detail of the Comparative FMEA Approach and Justification
- IT Solutions Developed
- Measurement of the Problem
    - How was this done?
    - Who did the assessment?
    - How was it analyzed?

Results of the Assessment
- What was found?
- How were results used and put into a local context?
- Implications for improving quality of care?

Strategies for Quality Improvement/Change
- Feeding Back Information to Relevant Staff.
    - Why was this approach chosen?
    - How was this done?
    - Who was included?
    - What was their response?
- Mechanisms for Change.
    - What course of action was taken and why?
    - Was this justified by the results and context?
    - Discussion of ease of change versus likely effectiveness?
    - Who/what would be affected by change?

Lessons and Messages
- What changes occurred?
- Lessons and messages for your organization?
- Lessons and messages for other organizations?
- How can we use this work to enhance applying FMEA in health care settings?

4.5 Final Report

As required, we are submitting our final report to the AHRQ Project Officer within 2 weeks of the planned debriefing. This allowed us to incorporate comments received on this draft final report from our Project Officer as well as discussion items from our October 11 presentation.

4.6 AHA Electronic Newsletter

It is our intent to announce availability of the fact sheet and manuscript in the American Hospital Association (AHA) electronic newsletter that reaches over 22,000 subscribers. Subscriptions to *AHA News Now* is obtained free by sending an e-mail address to listserv@ahals.aha.org <mailto:listserv@ahals.aha.org> and writing in the message area: subscribe ahanewsnow. The weekly version of *AHA News* is available at the AHA web site http://www.ahanews.com. The AHA newsletter targets health care professionals in the field who may not necessarily be monitoring the peer-reviewed literature or AHRQ website.

5

Recommendations, Suggested Future Research Directions, & Outstanding Issues

5.1 Recommendations

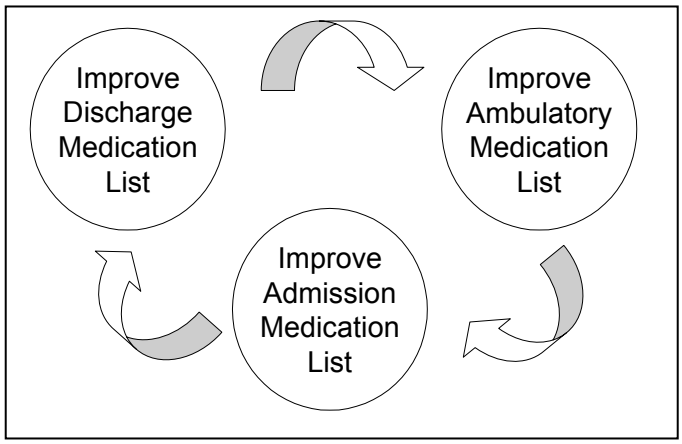
Our study has highlighted the deficiencies of current hospital practice with regard to ensuring the continuous flow of medication information from patient admission to discharge and beyond. Some general recommendations for improved clinical practice include:

- A team approach enhances effective medication information transfer even without IT support.
- Effective communications among physician and non-physician clinicians and their patients is essential at each exchange point in the process—at admission and at discharge.
- There is a need for comprehensive review and explanation of the entire (not just new) medication list together with instructions with patients and their family members at the time of discharge.
- Information transfer for non-English speaking patients poses obvious challenges to obtaining complete and accurate information and these should be anticipated.

The medication information transfer process is highly variable, available defenses against error may or may not be deployed, and each of the defenses has vulnerabilities. Expert ratings indicate that the vulnerabilities are greater at discharge with less chance of subsequent detection. Steps involving physician orders are paramount as they determine what medications the patient will receive. Problems of physician orders are exacerbated by the multiple physicians involved in care many of which are not intimately familiar with the patient.

Initiatives being considered at PHS (see **Chapter 3**) are examples of the kinds of activities that will improve hospital defenses against these failures. However, it is important to consider recommendations encompassing the broader IDS. Errors do not start and stop in the hospital. They occur because of latent conditions occurring in primary care, in nursing facilities, in specialists' offices, and in the home. A framework for generating additional recommendations is presented below.

Exhibit 27. Framework for Continuously Improving the Information Base



Our study documented the fact that information transfer processes can be either self-enhancing or self-degrading. An example of the former is the process of using an IT solution like Logician™ to update the ambulatory medical record. This improves the record for subsequent ambulatory care and also for any future hospital admissions. In turn, a more useful admission record is then used by hospital staff and discharging physicians in a reinforcing cycle. A negative cycle is certainly possible as would occur with poor discharge information, leading to unreliable ambulatory information, in turn leading to low credibility among ED and admitting physicians and lowered use of this resource.

5.1.1 Specific Steps

The following specific steps should be considered to encourage a positively reinforcing, improving the information base of medication information.

5.1.1.1. Use Information Technology

Several studies have documented the need for information technology solutions (First Consulting Group, 2002; California HealthCare Foundation, 2001). Much of the current study has been focused on the value of using an IT solution like Logician™ at admission and discharge. These steps will not be further described here except to remind that the use of this process ensures that the ambulatory record is updated and used as the source document for the admission H&P and the discharge summary. A key advantage for physicians is that they do not have to dictate, re-transcribe, or remember discharge medications and update them in their primary care office. A key barrier is the fact that few physicians actually do their own hospital care and must be motivated to update the ambulatory records of colleagues. A key disadvantage in any IT solution is that the transfer process becomes dependent upon busy clinicians using computers—a notion still in its evolution when it comes to motivation and reliability. Findings from our study suggest the importance of adequate training, issues of accessibility to the technology, processing times, and need for evaluation of the influence of the technology solution on care processes.

5.1.1.2 Improve Documentation

With or without information technology, improvements must be made in medication documentation. Three areas need improvement. First, patients need a comprehensive list of medications

at discharge. Notations to "resume home meds," "make no changes," or other general comments will lead to confusion and error. It is the physician's job to create this comprehensive list.

Pharmacists, nurses, and other staff can make the physician's job easier. A checklist system in use in certain areas at Providence Portland could be expanded within the hospital and across facilities.

Medication information collected at admission should be made available throughout the patient stay in a readily accessible form. There are currently a number of places that this information can reside, making it more difficult to access and to check for accuracy. Even patients (as revealed in focus groups) believe their vital information may not be easily found by hospital staff.

Finally, within the ambulatory care system, work is needed on keeping medication lists up-to-date. While this was not the specific focus of the current study, we recognize that information available at hospitalization is only as good as what exists in the ambulatory record. Three elements must be attended to:

1. Verifying with patients that they are taking what has been prescribed.

2. Designating older medications as inactive when they are no longer used.

3. Including the prescriptions of specialists in the primary care record, so that an overall picture of the medication regimen is available.

Again, these activities are the work of the physician, with the help of their office staff and better coordination among primary and specialty care. The challenges here are immense, given the current status of fragmented care in our ambulatory care system. However, the rewards are equally great, considering not only the upgrading of medication information for clinical decision-making but also the reduction in medication-related hospitalizations and adverse events. Further research on promising approaches is an important topic for further inquiry among such groups as AHRQ's Practice Based Research Networks.

5.1.1.3 Involve Other Disciplines in Care Teams

The proposed use of clinical pharmacists at PHS was described in **Chapter 3**. These staff hold critical knowledge not only of medications but also of hospital, ambulatory, and insurance formularies (all of which were identified as barriers to effective medication access by patients). The promise of this approach goes beyond the reconciliation of prescribed medications with historical medication use. A thorough review of medications by a pharmacist puts them in position to evaluate, simplify, and improve medications, for greater efficacy and lower cost.

For other continuity issues, social workers may be an answer. UNC Health Care is using these effectively to help discharged patients cope with the cost and complexity of obtaining appropriate medications. Home Services personnel can provide an invaluable service by communicating with primary care about what is really going on in the home. As described in our report, home services workers have access to the medicine cabinet, the medications, and the patient; and they routinely use

these sources to verify medication use. The lack of transmission of this verified information back to the physician's office is a missed opportunity.

Each member of the team—physician, nurse, pharmacist, social worker—makes a unique contribution. This team-based approach was a best practice noted in our case studies at both IHC and UNC Health Care.

5.1.1.4 Involve Patients

At every major transition in care, from ambulatory setting to hospital and back, the medication information should be reviewed with the patient and family. This will take time and a trusting relationship. It may also require that staff be able to translate medical prescription information (e.g., brand and generic names, frequency abbreviations) into lay terms so that there can be positive verification by the patient.

AHRQ has already taken steps to encourage patients to protect their safety, with publications and Fact Sheets (e.g., Five Steps to Safer Health Care). Wider use of these fact sheets as well as local variants should be encouraged. The increasing use of herbal remedies and the ongoing transition of formerly prescribed medicines to OTC are areas of special concern with regard to complete ascertainment of a patient's medications.

5.1.2 Broader Changes

The medication information transfer process is embedded in deeper system issues within our IDSs, which vary in their degree of integration. Among the most important of these is the continual pressure for productivity. As Reason (1991) indicates, there is a constant tension between forces for protection and forces for productivity within the modern organization.

Our study uncovered multiple instances where defenses were bypassed for time saving purposes, and errors and failures were simply pushed to a later process stage. This creates a reservoir of latent conditions that will lead to error with a triggering event (e.g., miscommunication, knowledgeable physician unavailable).

The tradeoff between protection and productivity is one that each organization must balance. However, two elements of our study can help in this balancing act:

1. The presence of multiple medications, frail patients, and high-risk drugs increases the need for protection and makes it advisable to operate in a safer zone—even at the expense of immediate productivity. These risky medications and risky patients have been identified earlier in our report. Such conditions make it wise to spend the time on further reconciliation, pharmacy expertise, and/or patient education.
2. Certain remedies, such as the IT solutions described, aid in both productivity and protection. These should be the highest priority for implementation. Indeed, these may be the only remedies with a chance of success in the current environment, until a sentinel event takes place and the costs of neglecting protection are magnified.

Other system factors affecting the process of accurate medication transfer have been mentioned throughout our report in specific instances, but bear repeating here:

a. shorter hospital stays with rushed discharge;
b. inadequate IT investments in clinical systems, training, and evaluation;
c. formulary issues, by setting and by insurance coverage; and
d. staffing shortages, including both nursing and pharmacy.

As outlined in the IOM report, Crossing the Quality Chasm, these environmental forces set a context that can impede changes within microsystems of care.

5.2 Suggested Future Research

There are two key areas suggested for future research. The first addresses the need to better quantify risk scores developed in conducting FMEAs. Secondly, we need to think about how we can document the cost of poor quality in making the business case for suggested improvements.

Using FMEA, we have modeled the possible failures in developing the proper information. We focused on "does the list contain the right drugs," more than we did on whether the list is visually appealing, spelled correctly, etc. (except as these may impede transmission of the list to the next provider). This analysis, largely based on qualitative data, includes our:

- Estimate for the probability of failure in having the right list;
- Estimate for the effect on the patient (and to a lesser degree on staff) of no list or the wrong list;
- Estimate for the likelihood that a failure in creating the list will be detected; and
- Postulates for potential controls that would make failure less likely or more easily detected.

Each vulnerability point identified during key informant interviews has an associated risk of failure, defined by the degree to which the current medication list does or does not incorporate changes from the previous steps (i.e., a failure is defined in terms of whether the medication information is complete).

Our ongoing project was not funded to quantify the degree of risk at each step. To date, we have:

- Mapped a generic process for three IDSs—Providence Health System, Intermountain Health Care, and UNC Health Care;
- Applied an initial FMEA, based on expert opinion; and
- Delineated the data collection steps needed to do a data-driven FMEA or other quantitative risk assessment approach.

We would like to extend this work in order to more accurately quantify risk scores using chart pulls and to assess alternative risk modeling techniques in order to make an informed recommendation to AHRQ.

Additionally, we believe that documenting the cost of poor quality is essential. IDSs will need to make the business case for proposed changes aimed at improving quality of care and minimizing the risk of adverse medical events associated with process failures such as that studied here—the medication information transfer process. Finally, we believe that a directed epidemiological study aimed at understanding the prevalence and incidence of adverse events associated with improper medication information transfer is warranted. Such a study would allow us to extrapolate cost information to assess the full magnitude of the problem.

5.3 Outstanding Issues

There are several outstanding issues that will influence progress in improving the medication information transfer process that were identified in our study. These include:

- Information sharing is critical, but what about HIPAA? How do organizations address this issue?
- FMEA is being promoted as a useful prioritization tool by JCAHO and others; but the ratings are subjective and idiosyncratic. Is there a better way?

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