

# Challenges to nurses' efforts of retrieving, documenting, and communicating patient care information

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## ABSTRACT

**Objective** To examine information flow, a vital component of a patient's care and outcomes, in a sample of multiple hospital nursing units to uncover potential sources of error and opportunities for systematic improvement.

**Design** This was a qualitative study of a sample of eight medical—surgical nursing units from four diverse hospitals in one US state. We conducted direct work observations of nursing staff's communication patterns for entire shifts (8 or 12 h) for a total of 200 h and gathered related documentation artifacts for analyses. Data were coded using qualitative content analysis procedures and then synthesized and organized thematically to characterize current practices.

**Results** Three major themes emerged from the analyses, which represent serious vulnerabilities in the flow of patient care information during nurse hand-offs and to the entire interdisciplinary team across time and settings. The three themes are: (1) variation in nurse documentation and communication; (2) the absence of a centralized care overview in the patient's electronic health record, ie, easily accessible by the entire care team; and (3) rarity of interdisciplinary communication.

**Conclusion** The care information flow vulnerabilities are a catalyst for multiple types of serious and undetectable clinical errors. We have two major recommendations to address the gaps: (1) to standardize the format, content, and words used to document core information, such as the plan of care, and make this easily accessible to all team members; (2) to conduct extensive usability testing to ensure that tools in the electronic health record help the disconnected interdisciplinary team members to maintain a shared understanding of the patient's plan.

## INTRODUCTION

In the USA, approximately 98 000 deaths are attributed to errors in healthcare each year, more deaths per year than from breast cancer, AIDS, or motor vehicle collisions.<sup>1</sup> With over 60% of these errors attributed to failures of communication and information flow,<sup>2</sup> the importance of understanding and improving these processes cannot be overstated. Although new technologies are being introduced in healthcare settings to improve quality and safety, they most often tend to target direct patient care processes, such as computer-supported medication order and administration systems,<sup>3</sup> or smart IV pumps,<sup>4</sup> when in fact systems to improve information management and

information flow are needed most. Although there are a number of work-flow single-site studies reported in the literature, we found an absence of studies that contrasted information flow in multiple organizations. To date, there is poor understanding of hospital information flow practices and a dearth of evidence-based tools to support information management. In a high-pressure environment such as healthcare, where any information mishandling can potentially lead to devastating consequences, this requires immediate attention.

## BACKGROUND

Even in its most streamlined form, the delivery of the vast majority of acute healthcare services involves interdependent work by individuals representing several disciplines executing specific activities asynchronously. Compounding the challenges of this interdependent asynchronous work is the fact that healthcare delivery is inherently non-linear and unpredictable.<sup>5</sup> Well-designed and uniformly used patient care information systems have the potential to decrease complexity and support clinicians in their efforts to manage information and overall flow among all disciplines.<sup>6</sup> The success of these systems depends largely on how well they can support care planning, documentation and information management, and flow within acceptable workflow practices.<sup>7</sup> In order to design systems that can improve information management and communication and are applicable beyond a single setting, it is important to understand current workflow practices in a representative sample of multiple settings.

Nurses routinely coordinate, deliver, and monitor patient care at the front line on behalf of all involved disciplines and thus are central to ensuring effective information management and flow. This study was an initial step in a larger study to implement and test a web-deployed big picture summary tool designed to support the nurse in carrying out the role of central integrator of information for the entire healthcare team. With this in mind, the purpose of this study was to describe existing nursing practices that affect information management and flow. To accomplish this goal, we completed a series of observations primarily focused on nurses' existing inter- and intra-disciplinary patterns of written, electronic, and oral communication and information management.

**METHODS**

We used ethnographic observation for this study which included direct observation of nursing documentation, communication practices, and care planning processes. In addition, we examined nurse-designed communication artifacts on eight diverse hospital units.

**Sample**

Convenience sampling with maximum variation strategies at the hospital, unit, and nurse level was used to support generalizability. At the hospital level, a convenience sample of four diverse hospital types was selected: a large university teaching hospital, two large community hospital systems, and one small community hospital. The hospital sizes ranged from 82 to 865 inpatient beds and 95 611 to 1 521 824 outpatient visits/year. At the unit level, to further enhance generalizability, we selected a subset of eight sample units representative of a wide range of adult patient population types and unit characteristics (table 1). Selected units were required to meet the following nurse administrator-perceived criteria at baseline: (1) adequate staffing; (2) low turnover; (3) willingness to participate in the study; and (4) nurse manager commitment to support the future study intervention. At the nurse level, maximum variation strategy was used to include at least one novice (0–3 years of experience) and one expert (4 or more years of experience) nurse per unit. Benner’s five categories of expertise<sup>8</sup> were collapsed (novice=beginner, advanced beginner, competent; expert = proficient and expert) to ensure balanced experience across subjects while accommodating the small sample size. Total nurse subjects included 20 nurses (nine novices with 7 months to 3 years’ experience, and 11 experts with 6–45 years’ experience) who were shadowed for 200 total hours (~25 h per unit). All nurses who were invited to participate agreed to do so.

**Procedure**

In preparation for observations, nurse managers for each of the eight study units were interviewed and asked to explain the processes, forms, and electronic tools used in nursing documentation and communication. Next, nurses were identified who would be working on the shifts that research assistants were scheduled to observe. Initially, nurses were selected randomly and invited to participate. As the study progressed, nurses were selected to ensure maximum variation in Benner’s novice to expert categories. We conducted observations for every shift (7:00–15:00, 15:00–23:00, 23:00–7:00, or 7:00–19:00 and 19:00–7:00) on every unit.

To conduct the observations, a trained nurse research assistant not employed by the hospital shadowed each nurse participant for an entire shift. Each potential subject was contacted ahead to explain the study and determine willingness to be shadowed for an upcoming shift. Observations began at the beginning of the

shift during the oncoming hand-off and ended with an interview that followed the nurse’s hand-offs at the end of the shift. This produced a minimum of 24 h of observations on each of the eight units. Standardized protocol observation forms developed in an earlier pilot study<sup>9</sup> were used to guide the systematic collection of all the data gathered in this study by nurse research assistants (table 2).

The research assistants recorded all communication activities (oral and written) using the structured observation protocol. Specifically, they observed data entry and retrieval, including recorded duplications for data entry (eg, documentation of information into a paper chart form and also into the electronic health record (EHR)), data retrieval (from an electronic database to a working paper document, eg, scrap or a patient summary sheet), and oral communication patterns between various healthcare team members. The research assistants took detailed notes describing these activities and collected related written artifacts (eg, printouts, forms, and scraps) created throughout the observation session. After observation sessions, all communication and documentation activities were entered into spreadsheets by the research assistants. The spreadsheets were used to organize the observation data made by the research assistant during the shadowing. In addition, a narrative was created describing the observed information flow for each observation session.

**Protection of human subjects**

The research was approved by institutional review boards at all hospitals. All nurses participated in an informed consent process and signed a written consent form before observation. Nurse identities were kept confidential throughout the data collection process. To maintain patient confidentiality, no patient names were recorded during the observation sessions, and there was no documentation of nurse–patient communication. If patient names appeared on the written artifacts, the research assistant blacked out the names with a permanent marker before leaving the unit.

**Data analysis**

The observed and written artifactual data were coded independently by one of the principal investigators (EY) using the observation protocol and directed content analysis procedures<sup>10</sup> to develop the initial coding categories. Any data that could not be coded within these categories were coded inductively with new codes derived from the data.<sup>10</sup> In this way, the initial coding categories were revised and refined to best fit the emerging data. Coding decisions were reviewed by the other principal investigator (GK), and consensus was developed between the two investigators. Their decisions were revised iteratively throughout the data collection and analysis period, and then synthesized into three descriptive themes.

**Table 1** Characteristics of hospital units included in the observation study

Hospital* unit	Type of hospital	Patient population type	Beds per unit	Total RNs employed on unit	Patients per nurse
A-1	University	Neurological	32	60	5–6
A-2	University	Cardiac	60	120	5
B-1	Large community	Gerontology	42	48	5–6
B-2	Large community	Medical–surgical	42	79	5
B-3	Large community	Medical ICU	10	36	2
C-1	Large community	Medical–surgical	22	32	5
C-2	Large community	Gerontology	23	22	6
D-1	Small community	Medical–surgical	22	26	5–6

\*A, university hospital; B and C, large community hospitals; D, small community hospital. ICU, intensive care unit; RN, registered nurse.

**Table 2** Standardized observation protocol forms used to guide collection of data

Form section	Content
Study equipment checklist	List of five items needed for data collection (eg, forms, stopwatch)
Unit information	Eight information items to be gathered to characterize unit (eg, number of beds, number of nurses employed)
Nurse manager description of baseline documentation and communication practices	Two open-ended questions for assessing the unit's baseline documentation and communication policies, processes, and forms
Nurse profile	Seven interview items to assess nurse characteristics (eg, sex, race, education)
Shift report	Seven items gathered to characterize the hand-offs observed at start and end of shift (eg, start and stop time, narrative, number of nurses present)
Shift observations	Sheet to record and organize six items about each documentation and communication encounter (eg, start and stop time, narrative, copy of actual written documentation)
Post-shift interview	Seven interview questions for clarifying observations
Health information portability and accountability act identifiers	Eighteen identifiers to be removed from all copies of documentation before leaving observation site

We used standard approaches of qualitative research to ensure analytic rigor, including peer debriefing and prolonged engagement.<sup>11</sup> Peer debriefing sessions consisted of several 2–3 h sessions between the first two authors and the research assistants to review the coding decisions. In cases where we disagreed about coding decisions, we discussed and clarified decisions until we achieved consensus. In addition, a thick narrative description of the information flow on each unit was synthesized from all the units' observations, and representative descriptions were provided to establish the context for transferability.<sup>11</sup> While nurse managers' descriptions of communication practices were collected to orient the researchers to the expected practices, these descriptions often differed from actual practice. Thus only observed practices and artifacts were considered part of the coding dataset. Finally, an audit trail consisting of raw data, field notes, and initial and final coding decisions was maintained to confirm that the findings were grounded in the data.

## RESULTS

Overall, on all the study units, nursing information work consisted of recording and retrieving information from paper and electronic sources, and talking to other healthcare personnel. Nurses devoted 31–37% of their time retrieving information, orally communicating, and documenting on seven of the eight study units (table 3).<sup>1</sup> While similar activities occurred on all units, they differed by location, technology involved, and documentation practices. These differences affected the pace of work and flow of information. Overall, we identified three common themes that characterize the challenges we observed in nurses' efforts to retrieve, document, and communicate patient care information in all units: (1) variation in documentation and communication practices; (2) absence of a current centralized care overview in the patient's electronic record; (3) rarity of interdisciplinary communication (table 4).

### Theme 1: variation in documentation and communication practices

We observed a wide variety in nurse documentation and communication practices particularly in the (1) use of paper, (2)

balance of paper versus electronic documentation, and (3) RN hand-off practices across the study units. Electronic systems included EHRs, medication administration applications, and online physician order entry systems.

### Use of paper

In the presence of electronic systems, nurses still used paper forms to support their use of these systems. The number of forms on the eight study units ranged from seven to 24, although in our observation significantly fewer were actually used. Many of these paper forms were outputs of the electronic systems, such as medicine administration records, flow sheets, physician order forms, and plans of care.

In addition to paper forms, 'scraps' of paper which nurses kept in their pockets during work were in evidence in all of the units, similarly to findings of others.<sup>12</sup> Nurses regularly highlighted, wrote on, crossed out, and put 'post-it' notes on their scraps. One nurse at site D personalized her information through organization, stapling different forms together to create a single long sheet. Nurses at site A made the most use of scraps, but even at site D where the Excel sheet was designed to replace scraps, we observed one of the nurses carried around a piece of paper with what she deemed essential information for her patients. At site A, scraps were also often passed along at reports, but on the other units the scraps were most often thrown out at the end of the shift.

### Balance of paper versus electronic documentation

The balance of electronic versus paper documentation varied across units. All sites used some paper to augment information flow beyond the patients' health records. Interestingly, site B, the hospital with the most extensive amount of electronic documentation, had the most forms, whereas site A, the hospital with the least electronic documentation, had the fewest forms. The following narrative descriptions of two units demonstrate the wide variation in documentation systems used to accomplish similar tasks.

► On the gerontology unit (hospital B, unit 1), computers were located at the front desk, nurses did a substantial amount of paper organizing at the beginning of each shift, creating a folder for each patient with a preprinted care summary sheet for note writing (to be later entered into a computer). Laboratory results and medications were printed out for review and transcribed on to the sheet that also contained physicians' orders and medication information. Nurses wrote notes on this sheet throughout the shift and based their hand-off reports on these notes. There was also a master overview sheet, which resided at the front desk, that was

<sup>1</sup>The small community hospital (site D) displayed a different picture, which included several interruptions (training a float nurse, attending to a combative patient, and locating a physician) and resulted in remarkably time-consuming communication. Given the nature of hospital work, we suspect that time-consuming interruptions occur occasionally on all units, but were unable to validate in this study. Nonetheless, smaller community hospitals may routinely experience greater numbers of time-consuming interruptions for reasons unique to these settings. It is also natural to expect the 8 h shift (the standard for site D) to have a higher percentage of communication time than the 12 h shift, as similar communication expectations are spread across the two different time periods.

**Table 3** Percentage of shift time that registered nurse spent managing, documenting, and orally communicating about patient care information

	Organization			
	A	B	C	D
Number of units in study	2	3	2	1
Shifts/nurses observed	5	7	5	3
Oral communication between RNs (excluding shift report) (%)	2	3	4	13
Oral communication between RNs (shift report) (%)	8	7	5	8
Oral communication with MD (%)	2	1	1	5
Oral communication with other unit staff (not RN or MD) (%)	1	1	4	3
Oral communication with other (non-unit) (%)	1	2	1	7
Total % of RN shift time spent orally communicating	14	14	15	36
Documentation (data entry) (%)	7	13	11	32
Information retrieval (%)	10	6	11	12
Total % of RN shift time spent documenting and retrieving	17	19	22	44
Total % of RN shift time spent managing, documenting, and orally communicating about patient care information	31	33	37	80

A, university hospital; B and C, large community hospitals; D, small community hospital. MD, medical doctor; RN, registered nurse.

a high-level unit summary done in pencil to allow changes throughout a patient's stay. Nurses mostly used the overview at shifts' beginnings and ends to transfer information to their personal copies and back. Both nurses and physicians used a neurological assessment form that guided nurses through specific daily activities and gave physicians an overview of patients, aiding in interdisciplinary communication. Unlike the local EHR, this form also contained graphics that provided a visualization of patients' progress.

- ▶ On the progressive care unit (site C, unit 1), computers were dispersed and were placed in between patient rooms.

Although access to computers was easier, nurses still relied heavily on paper documentation which varied from formal recordkeeping systems (such as a Kardex with an overview of each patient) to very informal temporary records (such as individually devised scraps, which nurses referred to as an 'organization sheet'). There were also two additional important documentation systems on this unit: a form to facilitate interdisciplinary communication and a medication management system. The first form was designed for interdisciplinary communication and was kept in a special section of the paper chart and was reported to promote interaction. The

**Table 4** Major themes with examples by site

	Hospital A	Hospital B	Hospital C	Hospital D
▶ Theme 1: variation in documentation and communication practices				
Use of paper	<ul style="list-style-type: none"> <li>▶ Fewest forms (7)</li> <li>▶ Heavy use of personalized 'scraps' to organize nursing activities</li> </ul>	<ul style="list-style-type: none"> <li>▶ Most forms (24)</li> <li>▶ Used graphics for patient progress</li> <li>▶ Transcription of EHR data to paper (eg, labs, meds, orders)</li> <li>▶ Moderate use of personalized 'scraps' to organize nursing activities</li> </ul>	<ul style="list-style-type: none"> <li>▶ Kardex with overview of each patient</li> <li>▶ Heavy use of personalized 'scraps' to organize nursing activities</li> </ul>	<ul style="list-style-type: none"> <li>▶ Multiple forms used to organize care</li> <li>▶ Least use of personalized 'scraps' to organize nursing activities</li> </ul>
Balance of paper versus electronic charting	Primarily used paper documentation	Maintained both paper and electronic records (site with greatest amount of electronic documentation)	<ul style="list-style-type: none"> <li>▶ Relied more fully on computers (C2 in particular)</li> <li>▶ Easy access to computers</li> </ul>	<ul style="list-style-type: none"> <li>▶ Maintained both paper and electronic records</li> </ul>
RN hand-off practices	<ul style="list-style-type: none"> <li>▶ Face-to-face report on RNs assigned patients typically received from multiple RNs</li> <li>▶ Used standard worksheets and scraps—both discarded</li> </ul>	<ul style="list-style-type: none"> <li>▶ B1 used audio-taped report on all unit patients</li> <li>▶ Focused on tasks to be completed</li> <li>▶ Most consistent hand-off (format and content) among all eight study units</li> </ul>	<ul style="list-style-type: none"> <li>▶ Individual face-to-face hand-offs at computer stations outside patients' rooms</li> <li>▶ Shortest hand-offs</li> <li>▶ Utilized paper Kardex, computer MAR, paper flow sheet, and scraps</li> </ul>	<ul style="list-style-type: none"> <li>▶ Individual face-to-face hand-off at nursing station</li> <li>▶ Oncoming RNs viewed paper forms before hand-off</li> <li>▶ Focus was on completed and future tasks</li> </ul>
Theme 2: absence of a centralized care overview in the patient's EHR				
Patient overview forms homegrown and not part of the patient's record	<ul style="list-style-type: none"> <li>▶ Standard hospital paper worksheets used to gather broad patient overview</li> </ul>	<ul style="list-style-type: none"> <li>▶ Patient overview on a report sheet</li> <li>▶ Master copy of overviews on all unit patients at front desk, updated throughout patient stay</li> </ul>	<ul style="list-style-type: none"> <li>▶ RN individualized 'organization sheets' with patient overview developed for each assigned patient</li> </ul>	<ul style="list-style-type: none"> <li>▶ RNs collaboratively designed an Excel spreadsheet to provide overview of all patients on the unit</li> </ul>
Theme 3: rarity of interdisciplinary communication				
Across sites				
<ul style="list-style-type: none"> <li>▶ Paper forms designed to facilitate interdisciplinary communication were infrequently used.</li> <li>▶ Non-nurse disciplines were rarely present on the patient care unit.</li> <li>▶ Majority of 'other' discipline communication took place by phone.</li> <li>▶ Efficiency of care was dramatically affected when needed care team member was unavailable.</li> <li>▶ RNs frequently consolidated and interpreted information from a variety of sources and disciplines to coordinate care without seeking team validation.</li> <li>▶ Information related during interdisciplinary communication was rarely documented.</li> </ul>				

A, university hospital; B and C, large community hospitals; D, small community hospital. EHR, electronic health record; MAR, medication administration record; RN, registered nurse.



medication management system included two components: an overview of medications for each patient, from which information was transcribed by hand on to the 'organization sheet,' and the medication administration record system, which was also organized by patient and provided precise medication information.

### RN hand-off practices

Hand-off, or end-of-shift report, is a central event in health information flow from nurse to nurse and is the category of oral communication involving the most time (table 3). Despite the variability between units, we observed that nurses talked more to each other than any other member of a medical team. The following narrative descriptions illustrate the variety of practices we observed in nurse-to-nurse hand-offs in information flow.

- ▶ On the progressive care unit (site B, unit 1), nurses received a group audiorecorded report. This report consisted of pending tests, lab work, telephone calls, and other key information with a focus on tasks that need to get done during the following shift. After they were done with the report, incoming nurses themselves made patient assignment decisions.
- ▶ On the medical–surgical unit in the community hospital (site D, unit 1), hand-offs occurred face-to-face in the nursing station. Reporting began after each nurse got a colored folder with several forms and patient information to be used throughout the shift. The first 5–10 min of the report was spent looking at information and then manually copying selected additional information on all patients on to a preprinted form. After that, nurses received their patient assignments and the incoming nurses went to find outgoing nurses previously responsible for their assigned patients for the actual hand-off report. In these instances, the nurses predominantly focused on describing patient activities and tests completed in the previous shift and tasks to be carried out in the next shift.
- ▶ On the gerontology unit (site C, unit 1) reports took place at computers and documentation stations outside patients' rooms. As in unit D, incoming nurses received assignments and then sought out the off-going nurses who had cared for their patients. This process typically went smoothly, with little wait time when compared with the other units. The reporting took 3–7 min per patient. The nurses used the Kardex, the chart, the computer medication administration record, and a paper flow sheet during these sessions. The incoming nurses, however, wrote on scraps (self-designed paper 'organization sheets'), and the outgoing nurses relied primarily on their own scraps to give the report.

In summary, hand-offs varied greatly by site and unit in formats and locations. However, there were definite similarities in the content of the reports. All reports included patient sketches, medication information, and emphasis on important developments. They also involved some discussion of goals for the next shift, but there was very little discussion of long-term goals or rationale for activities.

### Theme 2: absence of a centralized care overview in the patient's EHR

A common form of information present on all eight participating units was a paper document that provided an overview of patient status and care needs. The following descriptions illustrate the variety in formats and content of the patient overview.

- ▶ At site A, nurses used standard worksheets provided by the hospital or designed by the nurse manager to gather

information at report and then plan the patient's care throughout a shift.

- ▶ Site B featured a report sheet, for which a 'pencil' master copy was kept at the front desk to make changes throughout a patient's stay and to erase a patient's information at discharge. Nurses carried personalized copies of this around.
- ▶ At site C, nurses designed their own assorted documents, 'organization sheets,' with information about patients under their care.
- ▶ Site D nurses collaboratively developed an Excel spreadsheet to manage patient information for all patients on the unit.

At sites A and C, nurses received information about their assigned patients only. At sites B and D, on the other hand, nurses had at least some overview of all patients on the unit. This global view would provide some context for the overall patients' acuity on the unit. Site D is the only one, however, that structured unit organizational memory around this document and ensured that it was central, updated, and longitudinal. Although three of the sites had a unit-based form that contained fields for information they deemed salient, there were overlaps and discrepancies among information elements. Finally, we observed practices that represented a continuum between adherence to institutional versus personal communication preferences.

### Theme 3: rarity of interdisciplinary communication

There was much less variety among the study units related to interdisciplinary communication. Despite the importance of this communication to efficient and high-quality healthcare, table 3 points to the limited amount of interdisciplinary communication in which nurses regularly engaged. Of particular note is nurse–physician communication, which takes only 1–5% of nursing time. Oral communications with other members of healthcare teams, both on and off the units, were also limited. Only 1–4% was spent on internal communications and 1–7% on external ones. Given that the other health professionals were typically not always present on the study units, it was not surprising to find that the vast majority of this rare interdisciplinary communication occurred by phone. Nurses had to consolidate and interpret information from diverse sources to coordinate and deliver patient care. At times, nurses asked for clarification from members of the medical team, but most of the time the nurses relied on their own judgments. The ultimate goal of interdisciplinary exchanges was nonetheless to seek needed information or orders and to pass this along to other members of the patient's team. Some of these exchanges were eventually documented, but most were not.

We witnessed firsthand difficulties of these interdisciplinary communications. For example, we observed nurses 'playing phone tag' (exchanging alternating voicemail messages) with a social worker. To minimize difficulty in interdisciplinary communication, site C unit 1 provided nurses with a cell phone on a shift-by-shift basis with key numbers of other healthcare team members for current patients pre-programmed into the phone. The other sites needed to rely on unit based telephones to contact team members resulting in nurses not being nearby when calls were returned.

### DISCUSSION

This study of nurse communication and documentation in a representative sample of hospital medical–surgical units presents a picture of health information flow that is wrought with problems. The three key themes gleaned from the observations suggest that hospitals are vulnerable to undetectable sources of error that can seriously jeopardize the quality of care.

The impact of wide variation in nurse documentation and communication practices is underscored when one realizes that it is possible for a patient to be cared for by six or more different nurses during a 48 h hospital stay. Since these six different nurses are never together at the same time, one must rely on the documentation and communication to ensure that the right information is carried forward. If, however, the content and format of the information conveyed varies by nurse, unit, and hospital or is not part of the permanent patient record (eg, scraps) as we found here, then it is hard to imagine how the meaning of such information can be interpreted as intended. It is no wonder that physicians, whose work flows typically cross multiple units and hospitals, do not read nursing documentation.

Causes for further concern were our observations that none of the units studied had centrally available patient care overviews that were electronic and easily accessible to the entire interdisciplinary care team. Since we also found that the non-nursing members of the team spent little time on the care units and rarely interacted with the nurses, this suggested to us that nursing information is not being used appropriately by the other health disciplines. Although the three themes identified in our data were not completely unexpected, we were surprised by the extent of negative implications that could reasonably be expected from this combination of conditions.

First, the lack of consistency in the data elements collected, words used, and processes of documenting and communicating at hand-offs across all units offered unlimited opportunities for information to be lost or misinterpreted, which increased vulnerability to errors. This is particularly problematic in today's high-acuity hospital settings, where any errors in information transfer can potentially lead to devastating consequences. The variation also adversely influences continuity of care as patients move across settings.

Second, the wide assortment of documentation, which was often home-devised, excessive, unit-specific, and included an unpredictable mix of paper and electronic formats, contributed additional opportunities for breeches to information flow. Although EHRs were available in all settings, we observed very little technological support for interdisciplinary and hand-off communication, showing underutilization of this potential resource. It also demonstrated that the available EHRs did not support nurses' need for organized and synthesized overview of their patients' status and care needs. As a result, we believe there are likely to be many more errors caused by electronic tools than previously estimated.<sup>13</sup> Thus, in this representative sample of hospital units, the important goal of using EHRs to assist interdisciplinary healthcare teams in sharing patient care information in a meaningful way was elusive.

Third, duplication and redundancy were an accepted part of the everyday life of hospital units. Overall, information transactions across all units appeared to be more time-consuming and less effective than optimal because of the lack of systematization and standardization. This inefficiency leads to an unnecessary burden on nurses' time, which likely causes delays in care.

Fourth, although the importance of interdisciplinary communication was acknowledged on some units, similar to other studies of inadequate teamwork,<sup>14</sup> it was apparent that the non-nursing professional team members had little to no understanding of the nursing care provided across all units. Moreover, the high volume of patient information to integrate from multiple forms made it difficult for the RNs to have a complete, thorough, and centralized overview of the patients' needs and status. Therefore it is highly unlikely that members of

the interdisciplinary team had a shared understanding of the patient and that care was as adequately coordinated.

Finally, we acknowledge the limitations of this study based on the medical—surgical unit focus and the time period of the study (2005–2007). Nonetheless, we believe the results are more broadly generalizable because of our purposive sampling strategy and the fact that relevant conditions in the field have not changed dramatically since the study was conducted. We deliberately selected a wide range of medical—surgical units, as these units typically reflect the overall culture of a hospital. We drew these units from four diverse hospitals and balanced the numbers of experts and novices selected for the study to maximize the representativeness of our findings to hospital nurses. With regard to the study period, we have observed virtually no substantive changes to the major EHRs since the study that address the major deficiencies we found.

## CONCLUSIONS AND RECOMMENDATIONS

To begin to address the serious deficiencies we observed and to better support clinicians' needs, we have two major recommendations. Since the capability exists, it seems prudent to initiate a nationwide strategy to increase the level of standardization of health information in our EHRs. Specifically, we recommend that standardizing the format, content, and words used to document core information needed by the entire care team, such as the plan of care, across systems be considered a potential solution for decreasing clinician communication vulnerabilities. Meaningfully and substantively improving the consistency of core information in EHRs has the potential to dramatically reduce the variability and increase the validity and reliability of health information. In addition, by taking a nationwide approach, we can enable clinicians to seamlessly provide continuity of care wherever the patient presents.

Second, we believe that better and more extensive types of usability testing are needed to ensure that tools within the EHR help the physically disconnected interdisciplinary team to maintain a shared understanding of the patient's plan of care, team treatments, and progress toward goals. While a focus should be on testing to ensure tools work as intended before implementation, our electronic tools also need field testing capable of iterative revision as clinician workflow and information needs change. If both recommendations are implemented, we would expect to see a dramatic reduction in the errors and inefficiencies of communication, with corresponding major improvements in the continuity, safety, cost, and overall quality of care provided by the health team.

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