Nursing Handoffs and Clinical Judgments Regarding Patient Risk of Deterioration:

A Mixed-Methods Study

Running title: Nursing Handoffs and Clinical Judgments

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The authors have no conflict of interest to declare.

Author contributions
All authors conceived and designed the study. PL was responsible for implementing the research protocol including recruitment, data collection, and data management with the assistance of LC, LZ, and ED. PL analyzed the data with the assistance of LC. PL drafted the manuscript including tables and figures. All authors reviewed the manuscript, provided comments, and approved the final version.

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ABSTRACT

Aims and objectives: To explore how change-of-shift handoffs relate to nurses' clinical judgments regarding patient risk of deterioration.

Background: The transfer of responsibility for patients' care comes with an exchange of information about their condition during change-of-shift handoff. However, it is unclear how this exchange affects nurses' clinical judgments regarding patient risk of deterioration.

Design: A sequential explanatory mixed-methods study reported according to the STROBE and COREQ guidelines.

Methods: Over four months, 62 nurses from one surgical and two medical units at a single Canadian hospital recorded their handoffs at change-of-shift. After each handoff, the two nurses involved each rated the patient's risk of experiencing cardiac arrest or being transferred to an intensive care unit in the next 24 hours separately. The information shared in handoffs was subjected to content analysis; code frequencies were contrasted per nurses' ratings of patient risk to identify characteristics of information that facilitated or hindered nurses' agreement.

Results: Out of 444 recorded handoffs, there were 125 in which at least one nurse judged that a patient was at risk of deterioration; nurses agreed in 32 cases (25.6%) and disagreed in 93 (74.4%). These handoffs generally included information on abnormal vital signs, breathing problems, chest pain, alteration of mental status, or neurological symptoms. However, the quantity and seriousness of clinical cues, recent transfers from intensive care units, pain without a clear cause, signs of delirium, and nurses' knowledge of patient were found to affect nurses' agreement.

Conclusions: Nurses exchanged more information regarding known indicators of deterioration in handoffs when they judged that patients were at risk. Disagreements most often involved incoming nurses rating patient risk as higher.

Relevance to clinical practice: This study suggests a need to sensitize nurses to the impact of certain cues at report on their colleagues' subsequent clinical judgments. Low levels of agreement between nurses underscore the importance of exchanging impressions regarding the likely evolution of a patient's situation to promote continuity of care.

Keywords: handoff, clinical judgment, patient deterioration, mixed-methods research, nursing assessment

INTRODUCTION

Care on most inpatient hospital units is delivered by nurses who work shifts of 8- to 12-hour duration. Therefore, each hospitalized patient's nursing care is transferred from one nurse to another at least two or three times every 24 hours. Assignment of responsibility to a new nurse is accompanied by an exchange of information in a process known as 'handoff' (Cohen & Hilligoss, 2010). Typically, a nurse finishing a shift presents details regarding one or more patients to a colleague coming in to oversee those patients' care on the following shift. Although nursing handoffs can fulfill social and educational functions, their primary purpose is informational; they are meant for nurses to form a shared understanding of a patient's situation in order to plan, prioritize, and ensure continuity of care (Staggers & Blaz, 2013).

Handoffs and other forms of communication at transitions of care have been recognized for their potential to contribute to health care errors, and so addressing them has become a leading patient safety priority (Eggins & Slade, 2015). Most nursing handoffs relay incomplete or even inaccurate information regarding patients' conditions; moreover, information is lost each time a handoff occurs (Nagpal et al., 2010; Pothier, Monteiro, Mooktiar, & Shaw, 2005; Richard, 1988; Sexton et al., 2004). In 2006, the organization in the United States that became the Joint Commission endorsed a new National Patient Safety Goal stipulating standardization of handoffs and creation of explicit opportunities for allowing receiving clinicians to ask questions.

The goal of standardizing handoffs is reducing omissions of important information in exchanges between professionals. Systematic reviews suggest that standardized handoffs are associated primarily with positive outcomes, including an increase in data points communicated, reductions in omitted tasks, and decreases in adverse events (Foster & Manser, 2012; Keebler et al., 2016). However, a recent meta-analysis also identified a number of negative effects of standardized handoffs, such as lengthened time required for handoffs and increased omissions because individuals conveyed only the types of data explicitly included in handoff protocols (Keebler et al., 2016).

It is assumed that providing more complete and accurate information to nurses assuming responsibility for a patient allows them to plan and manage care more effectively. However, at least one study found that nurses' recall of information received during handoffs was minimal (Dowding, 2001), which raises questions if not doubts about how handoffs ultimately affect the clinical judgments that are such an important part of nursing care.

BACKGROUND

Clinical Judgments

Handoff consists of an exchange of information between nurses so that they establish a shared mental model and where the nurse taking over forms clinical judgments regarding a patient's situation. According to (Tanner, 2006), clinical judgment refers to a nurse's understanding or conclusion about a patient's health, needs, or concerns. The process leading to a clinical judgment involves the integrated thinking about a patient and begins when a nurse notices something about a patient's situation that demands attention. To make sense of what he or she notices, the nurse employs a variety of reasoning patterns (from intuitive to analytic) to process and integrate information, form judgments, and decide on a course of action.

Tanner's (2006) Clinical Judgment Model suggests that the processes and outcomes of nurses' judgments are more strongly influenced by both individual (e.g., the nurse's experience, knowledge, and values) and contextual factors (e.g., culture and specialty of the unit) than by actual patient data. However, another body of research from cognitive psychology indicates that characteristics of the data being processed are also influential. In the probabilistic functionalist approach (Brunswick, 1955; Cooksey, 1996), any judgment can be thought of as resulting from the interaction between an individual and the environment. The environment contains data about a current state of affairs available for the individual to perceive and process to reach an understanding of 'what is going on' and decide how to respond appropriately. An individual's perception of the information can never be perfectly reliable as it is always modulated by one's perceptive capacities and by characteristics of the data (e.g., complexity, ambiguity, quantity). A corollary of this proposition is that cues—or information as perceived by the individual—are only partially representative of the data actually present in the environment. This first level of uncertainty is further complicated by the imperfect relationship between cues and individual responses, both in terms of judgments and decisions. The accuracy of any clinical judgment thus depends on the extent to which a nurse notices and relies on certain cues, and the extent to which these cues are representative of the actual state of affairs in the environment. This was demonstrated in a number of studies where different nurses arrived at different judgments when presented with the same information (Anders Ericsson, Whyte, & Ward, 2007; Stamp, 2012; Thompson, Aitken, Doran, & Dowding, 2013; Thompson et al., 2007) and in studies that showed that characteristics of the information, such as complexity, affected nurses' judgments (Corcoran, 1986; Hughes & Young, 1990).

Patient Deterioration

One example of a clinical judgment that nurses are expected to make on a continuous basis is determining whether a patient's condition is stable/improving or deteriorating. In the latter case, the outcomes of most concern are whether the patient might imminently experience cardiac arrest or require emergency transfer to an intensive care unit (ICU). Such judgments plays a critical role in how nurses adjust their monitoring of patients' conditions, initiate rescue interventions, and communicate with other professionals (Massey, Chaboyer, & Anderson, 2017). Research has shown that to identify deteriorating patients, nurses rely on vital sign abnormalities and various other cues that arouse suspicion and generate a feeling of worry or concern (Douw et al., 2015; Mok, Wang, & Liaw, 2015). These cues have been grouped into ten indicators of patient deterioration: change in breathing, change in circulation, temperature, impaired mentation, agitation, pain, failure to show signs of improvement, patient feeling unwell, subjective nurse observations, and knowing without a rationale (Douw et al., 2015). Studies have suggested that some of these indicators may surface before any vital sign abnormalities appear (Hodgetts, Kenward, Vlachonikolis, Payne, & Castle, 2002) and demonstrated associations with mortality and ICU admissions (Buist et al., 2002; Jacques, Harrison, McLaws, & Kilborn, 2006). Although previous research has shown that nurses use these types of data in presenting evidence of patient deterioration to physicians and other health professionals (Andrews & Waterman, 2005; Donohue & Endacott, 2010; Endacott, Kidd, Chaboyer, & Edington, 2007), we are unaware of prior research examining use of data other than vital signs in the context of communication about patient stability or risk in nurse-to-nurse, change-of-shift handoffs.

It is essential that in giving handoffs, nurses communicate any suspicions that a patient is at high risk for deterioration to their incoming colleagues to ensure that proper monitoring and appropriate actions are undertaken. Yet, communication and judgments regarding risk in the context of handoff are complex. The outgoing nurse selects and presents information that he or she

deems key for the incoming nurse to understand the patient's situation (Birmingham, Buffum, Blegen, & Lyndon, 2015). The incoming nurse, with his or her own ways of appraising and understanding clinical cues, must rely on the outgoing nurse's description of the patient's situation to get data to form his or her own judgments. Thus, the data that the outgoing nurse chooses to present during handoff—and how it is presented—have profound implications for how the incoming nurse will understand a patient situation and prioritize care. Furthermore, which data are deemed pertinent varies across units, making it essential to grasp the specific content and structure of handoffs of the particular unit where an exchange occurs (Welsh, Flanagan, & Ebright, 2010). However, little research has examined how this phenomenon unfolds in practice.

METHODS

This paper reports one set of analyses from a larger sequential explanatory mixed-methods study (Creswell & Plano Clark, 2011), which explored how change-of-shift handoffs relate to nurses' clinical judgments regarding patient deterioration and is reported according to Strengthening The Reporting of OBservational Studies in Epidemiology (STROBE; von Elm et al., 2008) and COnsolidated criteria for REporting Qualitative research (COREQ; Tong, Sainsbury, & Craig, 2007) guidelines (supplementary files 1 and 2). The feasibility and acceptability of the protocol were described previously (Lavoie et al., 2018).

In this study, we focussed on the information exchanged between nurses during handoffs, which lends itself better to qualitative methods. To sharpen our focus and analyse the impact of this information on nurses' judgments, we chose a mixed-methods design, which allowed to base our analysis of handoff information content on nurses' assessment of patient risk deterioration (in the form of quantitative ratings). The research questions addressed in this study are:

1. What was the structure and content of handoffs on one surgical and two medical units in an acute care hospital?

2. How did the handoff information content differ if the outgoing nurse judged a patient to be at low or high risk of deterioration?
3. What characteristics of information exchanged during handoff facilitated or hindered nurses' agreement in their judgments that a patient was at high risk of deterioration?

Setting

The study was conducted from September to December 2017 in one surgical unit (A) and two medical units (B and C) at a single tertiary acute care bilingual (English and French) university-affiliated hospital in Montreal, Canada. Each of the units had a capacity of 32 beds. Unit A specialized in gastroenterological and gynecological surgery, Unit B in internal medicine, and Unit C in hematology-oncology. In 2016-2017, the units received 884, 805, and 888 admissions annually, and the mean lengths of stay were 8.2, 14.2, and 12.3 days, respectively.

At the time of the study, no standardized handoff tool (such as the SBAR [Situation, Background, Assessment, and Recommendation]) had been formally implemented on any of the three units. At the change of shift, nurses sat at the nursing station and proceeded with face-to-face handoff. On Unit A, handoffs occurred three times a day because nurses worked 8-hour shifts; nurses on units B and C mostly worked 12-hour shifts and patients were handed off between twice and three times a day.

Participants and recruitment

The study was approved by the hospital's Research Ethics Committee (CODIM-MBM-17-096). Participants were registered nurses who worked at least twice during the data collection period and occupied a role where they provided/received handoffs on included units. A convenience sample was formed based on expected samples required to identify trends rather than *a priori* sample size calculations. Recruitment proceeded by presenting the study to all nurses who met inclusion criteria (n=108) in short sessions during regular work hours; nurses were asked to

provide their contact information if they were interested in participating. Enrollment was voluntary and written informed consent was obtained from all participants. As a token of appreciation, participants received a $10 gift card for the hospital coffee shop.

Study Procedure

Upon enrollment, participants completed a sociodemographic questionnaire collecting age, gender, experience, and education. On each unit, four consecutive weeks of data collection were scheduled. Over that period, the unit's schedules were examined to select the 10 days when most enrolled participants worked. On those days, nurse-to-patient assignments were examined to identify patients whose care was to be handed off between two study participants. When one or multiple handoffs were eligible (both nurses had provided consent for the study), research assistants handed a mobile device and two individual questionnaires to the nurse participants.

Nurses recorded their interactions using the mobile device. Of note, they could handoff multiple patients during a single interaction. Immediately afterwards, they completed the questionnaires separately: each nurse answered a question about his or her individual judgment of the patient risk of deterioration using the Patient Acuity Rating (PAR; Edelson et al., 2011) and prior knowledge of the patient. Upon completion of the questionnaires, research assistants collected the mobile devices and questionnaires, and participants resumed their usual care activities.

After the data collection period, information on the numbers of cardiac arrests, ICU transfers, and deaths on the designated units during the data collection period was acquired from the hospital's information management service. In addition, all "code blue" calls were retrieved from the hospital paging system records. Of note, at the time of the study the hospital did not have a rapid response team in place and therefore a "code blue" team responded to all medical emergencies, even those not involving cardiac arrests.

For patients handed off during the study, the hospital's information management service provided admission diagnoses, discharge diagnoses, age, gender, and trajectory through the hospital (transfers to and from units during the current hospitalization). For patients who had deteriorated (as evidenced by code blue calls, cardiac arrests, deaths or ICU transfers) and whose handoffs had been recorded during the study, a chart review was performed for the 24 hours preceding deterioration in order to identify the events leading to the event. All patient data was anonymized.

Instrument

The questionnaire comprised two questions for each patient handed off during the nurses' interaction: the Patient Acuity Rating (PAR; Edelson et al., 2011) and the nurse's prior knowledge of the patient. The PAR is a 7-point Likert-type scale developed to help clinicians share their judgments of patient stability. Respondents indicate the likelihood that a patient will be transferred to an ICU or experience a cardiac arrest in the next 24 hours (from 1-extremely unlikely to 7-extremely likely; 4-neither likely nor unlikely). In a previous study with 1663 patients (Edelson et al., 2011), the PAR showed good accuracy in predicting ICU transfers and cardiac arrests (area under the receiver operating characteristic curve: 0.69-0.85) and moderate inter-rater reliability (weighted kappa: 0.32-0.43).

The question about the nurse's prior knowledge of the patient was taken from a previous study of nursing handoffs (Carroll, Williams, & Gallivan, 2012). Respondents indicate whether they have cared for this patient before and if so, was it in the past 24 hours, three days, or seven days, or during a previous admission.

Of note, every patient from the participating hospital is routinely assigned a 'level of intervention', which dictates actions to be undertaken in the event of a situation requiring life-sustaining interventions (such as cardiopulmonary resuscitation or admission to an ICU). For the

purpose of the study—which focussed on deterioration risk rather than on the complexities of acute care at the end of life—nurses were asked to rate risk of deterioration for each patient assuming that maximal interventions were a consideration ('full code', including cardiopulmonary resuscitation and transfer to an ICU) regardless of any special orders that might be in place. However, nurses were instructed to use the ordered/recorded level of intervention intensity to guide their clinical actions over any information received or judgments formed when participating in the study's data collection.

Data Sampling

Handoffs were sampled for analysis based on nurses' judgments of patient risk of deterioration on the PAR: the patients who were the focus of the analyses here were those judged at high risk of deterioration (PAR ≥ 5) at least once during the study. All handoffs for these patients were transcribed verbatim and stripped of nominal information. Data was managed with MAXQDA2018 (VERBI Gmbh).

Data Analysis

Nurses' sociodemographic data and patients' characteristics were summarized with descriptive statistics: means and standard deviations (SD) for continuous variables, and counts/frequencies and percentages for categorical variables. Handoff transcripts were analyzed using directed content analysis, a qualitative research technique where coding categories are predefined based on existing theories or prior research (Hsieh & Shannon, 2005). The analysis aimed to describe the information exchanged by nurses during handoffs. The initial coding scheme was based on a previous methodological study that examined the clinical content of nursing handoffs (Abraham et al., 2016) that was adapted during analysis in the present study to reflect the

content of the transcripts (see Table 1 for the final coding scheme). Coding was performed and disagreements discussed by two researchers until 90% agreement was reached.

To answer the first research question, code frequencies and positions were examined to characterize the content and structure of handoffs on each unit. Code frequencies were computed using the proportion of handoffs containing each code. Code positions were calculated by ranking codes according to the order in which they appeared in each handoff (1^{st} code, 2^{nd} code, etc.). Since the number of codes varied from one handoff to another, the ranks were standardized to ensure comparability—ranks were divided by the total number of codes in their own handoff (e.g., 3^{rd} code/17 codes in total). Using standardized ranks, mean code positions were then calculated at the unit level, and then for all handoffs across units.

To address the second research question, we divided handoffs in two groups depending on whether the outgoing nurse judged the patient to be at low (PAR ≤ 4) or high (PAR ≥ 5) risk of deterioration. The frequencies of codes between high- and low-risk patients were compared; between-group differences larger than 10% were considered noteworthy. Next, handoffs from the high-risk group were examined to identify the data elements that could explain why the outgoing nurses judged that patients were at risk of deterioration. Attention was paid to information that reflected cues that nurses use to recognize deteriorating patients (abnormal vital signs and indicators of deterioration) and codes for which the between-group difference in frequency was superior to 10%.

To answer the third research question, all handoffs for patients who were judged at risk of deterioration at least once over the study were examined in chronological order. We proceeded by comparing handoffs where the patient was judged at risk with handoffs where the same patient was not judged at risk in order to identify how the information diverged. The analysis was based on our

understanding of the typical structure and content of handoffs on each unit (first research question) and on the information exchanged when the outgoing nurse judged the patient to be at risk (second research question). Excerpts that contained information that could explain why one or both nurses judged the patient to be at risk were extracted and compiled in double-entry tables (crossing the nature of information with nurses' agreement/disagreement over the patient risk of deterioration—see Table 2 for an example). Comparing the excerpts provided an opportunity to identify differences in the presentation of information that could explain agreement and disagreement between nurses. Potential explanations for agreement/disagreement were compared across patients on each unit to identify themes—i.e., commonalities and contrasts in the nature and characteristics of information that facilitated or hindered nurses' agreement in their judgments of patients' risk of deterioration. Patterns were also examined between units.

Throughout the analysis, an exhaustive audit trail was conducted. Credibility of the results was achieved through comparisons at multiple stages of the analysis: between analysts (coding), between handoffs (for a single patient), between patients, and between the three units.

RESULTS

In total, 62 out of 108 eligible nurses agreed to participate in the study and carried out 444 handoffs for 158 patients. Nurses (*n*=62) had a mean age of 30.8 years old (SD 6.7) and a mean of 4.7 years of work experience (SD 4.1). They were mostly female (*n*=50; 80.6%), worked full-time (*n*=34; 54.8%), and held a bachelor's degree (*n*=42; 67.7%). Patient characteristics are presented in Table 3. Over the course of the study, only one patient experienced a significant clinical event as defined in the study protocol (i.e., "code blue" call, cardiac arrest, ICU transfer, or death in the 24 hours following a recorded handoff). This patient was transferred to the ICU after presenting signs of sepsis.

There were 125 handoffs (28.2% of 444 handoffs) in which at least one or the two nurses involved judged that the patient was at high risk of deterioration (PAR ≥ 5; *n*=53, 43, and 29 on Units A, B, and C, respectively). These 125 handoffs involved 66 patients. For the 66 patients, 240 handoffs were recorded across the entire study of which 101, 87, and 52 originated on the three units, respectively.

Structure and Content of Handoffs

The mean duration of handoffs, per patient, was 155 sec. (SD 105 sec.) on unit A, 204 sec. (SD 94 sec.) on unit B, and 155 sec. (SD 116 sec.) on unit C. The analysis suggested that there were generally three sections to the handoffs: 1) introduction of the patient, 2) review of the patient's clinical status, and 3) discussion of care needs.

Outgoing nurses began their handoff with the introduction of the patient, which included: 1) name and room number (*n*=234; 97.5%), 2) age and gender (*n*=120; 50.0%), and 3) a question: "Do you know this patient" or "Did you care for this patient before?" (*n*=68; 28.3%). If the incoming nurse did not know the patient, handoffs continued with further presentation of the patient's background: 4) reason for admission (*n*=120; 50.0%), 5) surgery during current hospitalization (only on unit A: *n*=39/101; 38.6%), 6) level of care (mostly on units B [n=58/87; 66.7%] and C [n=22/52; 42.3%]; unit A: n=9/101; 8.9%), and 7) health history (n=49; 20.4%). If the incoming nurse knew the patient, these elements of the presentation were usually skipped or truncated.

After introducing the patient, handoffs continued with current assessment of the patient's status and care; the relative frequency of data points presented in this section of handoffs is presented in Table 1. This information was often presented in technical language relating to interventions, rather than as an assessment (e.g., "oxygen at 2L by nasal cannula" instead of

descriptors of the qualities of a patient's breathing). The sequence in which the information was presented was quite similar across units (the first column in Table 1 presents the relative order of the data points across the whole sample). The most striking differences were related to the placement of information within the interactions regarding mental status (2nd on units A and C, 17th on unit B) and social context (19th, 7th, and 1st on unit A, B, and C, respectively).

In terms of content, IVs, diets, labs, vital signs, and modes of elimination were discussed in approximately 50% or more of handoffs across all units. Otherwise, there were marked differences in the content of handoffs, which appeared to reflect the major types of care liked to the units' specialties. On Unit A, handoffs focused on priorities after surgery: dressings, pain, and urine output. On Unit B, handoffs focused on care for an elderly population: mobilization, mental status, integrity of skin, stools, and how the patient took their pills (e.g., crushed or whole). On Unit C, handoffs focused on priorities for patients with hematologic disorders: temperature (febrile or not) and lab results (mostly white blood cell counts, an indicator of neutropenia). Nurses on Unit B had a tendency to confirm if a type of care was absent (e.g., "no oxygen, no blood glucose"), whereas nurses from other units mentioned only ongoing care elements at the time of the handoff; this explains why oxygen and blood glucose were mentioned more frequently on Unit B than on Units A and C. Three categories of data were coded but are not presented in Table 1 because they were present in less than 10% of handoffs across all units: trajectory (transfers to or from other units of the hospital), allergies, and either risk of falls or actual falls.

Differences in Information Content for Patients Judged at Risk of Deterioration

Table 1 highlights the differences in handoff information content depending on whether the outgoing nurse judged the patient to be at low or high risk of deterioration. On Unit A (the surgical unit), handoffs for patients judged at high risk of deterioration were significantly more likely to include the following data: vital signs (+29%), oxygen ± breathing (+28%), mental status (+19%),

modes of elimination (+18%), pain (+17%), and they were less likely to include reference to a plan (-19%). On Unit B, the information that differed for high-risk patients included: drains (+24%), stools (+18%) dressings (+11%), how the patient took their pills (-12%), and blood glucose (-13%). On Unit C, differences were found for the following data: drains (+23%), family (+21), plan (+18%), vital signs (+13%), mental status (-13%), and pain (-15%).

Information Content Related to Agreement/Disagreement between Nurses Regarding Risk

There were 32 handoffs (25.6%; n=16, 13, 3 on the respective units) where both nurses agreed that the patient was at risk of deterioration (PAR ≥ 5). In those cases, patients were described as experiencing, either separately or in combination: severe/multiple abnormalities in vital signs (low blood pressure, elevated heart rate, and/or high temperature); dyspnea and/or desaturation requiring supplementary oxygen ± abnormal breath sounds (wheezing, crackles, or a "death rattle"); chest pain with elevated troponin levels; active bleeding (from a wound, melena, or hematemesis) with hemoglobin levels between 50 and 85; severe/increased/sudden alteration of mental status (agitation, disorientation, decreased responsiveness); neurological symptoms (seizures, rigidity, ataxia, dystonia, dysarthria). When it was mentioned that a physician said that the patient might be transferred to the ICU, both nurses rated the patient at high risk of deterioration.

In 93 handoffs (74.4%), nurses made discordant ratings of patient risk of deterioration; in 29 handoffs (23.2%; *n*=11, 8, and 10), only the outgoing nurse judged the patient to be at risk and in 64 handoffs (52.2%; *n*=26, 22, and 16), it was only the incoming nurse. In most cases, information fell into the same categories as when nurses agreed on the risk of deterioration. However, the characteristics of the information differed in the following ways: a single, unexplained abnormality (e.g., "BP was low, but everything else looked fine."); an abnormal sign or symptom that was improving (e.g., "Hemoglobin was 88, which is better than 62!"); a mild

abnormality (e.g., “The pulse is in the low hundreds and the BP is borderline.”); or a severe issue that had resolved some time ago (e.g., seizures, disseminated intravascular coagulation, hemolytic anemia, or melena in the previous days/weeks). In other cases, one of the nurses involved placed an abnormal sign or symptom in the context of the patient’s baseline or “usual” parameters (e.g., “His BP was in the 70’s, but that’s his baseline. He even told me 70 is kind of high for him.”).

Some types of information were linked with disagreements of risk assessments between nurses, no matter how presented. Incoming nurses were inclined to give higher ratings than outgoing nurses to patients recently transferred from the ICU. When it was mentioned that a physician was aware of an abnormality and was not worried, outgoing nurses tended to rate patient risk of deterioration lower than incoming nurses. Nurses often made discordant ratings of risk for patients presenting with pain that did not have a clear cause, or with signs and symptoms of delirium. When it was noted by an outgoing nurse that a patient expressed a wish to die or s/he felt that the patient was deteriorating (e.g., “the patient is getting worse/not doing well/dying”) but no further data related to these statements/conclusions were provided, ratings were often discordant.

Among the 93 handoffs with discordant ratings of risk between incoming and outgoing nurses, 18 handoffs (19.3%) were practically identical in content to other handoffs where both nurses agreed that the same patients were not at risk. It appeared some nurses provided consistently higher risk ratings for specific patients for reasons that were not entirely clear (n=2, 4, and 3 from the respective units).

DISCUSSION

This study explored how the data exchanged during change-of-shift handoffs was related to nurses’ clinical judgments regarding patient risk of deterioration on medical and surgical units in an acute care hospital. In general, handoffs followed a similar structure comprising three sections: introduction of the patient, review of the patient’s clinical status, and current care

needs/plan. This structure partially mirrors one of the most common handoff tools, the SBAR—for Situation, Background, Assessment, and Recommendation. SBAR is often used to standardize handoffs and proponents feel that it favors clinicians' shared understandings of patient status and promotes patient safety (Muller et al., 2018). At the time of the study, SBAR had been discussed by nurses and others in hospital settings for many years, and some nurses at the study hospital had been exposed to it in professional development activities. Interestingly, while no handoff tool had been formally implemented on any of the units, nor were all nurses necessarily familiar with SBAR, intriguing parallels between the structure of handoffs here and SBAR were found. Of course, handoffs differed from SBAR as originally disseminated for communication in critical incidents in that the 'Situation' segment focussed on the overall history of the current health episode—instead of a specific issue. Furthermore, the 'Assessment' segment contained more technical information about the patient's care than information reflecting nurses' assessment of the patient, a finding that echoes previous studies of nursing handoffs (Johnson, Jefferies, & Nicholls, 2012; Staggers & Blaz, 2013).

Since most technical information exchanged during handoffs is readily available from other documents (e.g., care plan, patient record, pharmaceutical profile), some authors have questioned the need for nursing handoffs (Sexton et al., 2004). While our results reaffirm that nurses' exchanges include much technical information, they also suggest that the content of handoffs tended to shift towards assessment data when nurses judged that a patient was at risk of deterioration. This was more apparent from a qualitative perspective, with results showing that information reflecting nurses' assessment (e.g., abnormalities in patients' vital signs, breathing, circulation, and mental status) was often associated with agreement in nurses' judgments. Nurses tended to present more data regarding the patient's status and to omit treatment and care details when they judged a patient to be at higher risk of deterioration.

However, some data appear to contradict this interpretation. For example, the mode of elimination—rather treatment/care details—were discussed more frequently in handoffs for patients at risk on Unit A. This may be related to stomal melena or bleeding being a relatively common problem in the sample; nurses were not discussing modes of elimination as much as they were describing an elimination-related hemorrhage. Perhaps for similar reasons, drains were more frequently discussed in handoffs for high-risk patients on both medical units because a critical mass of patients experienced breathing problems that led to the insertion of pleural drains. Thus, the high relative frequency of technical data about drains, modes of elimination, or dressings appeared related to other information that aligned more closely with nurses' judgments. Nonetheless, this does not explain the low level of information-sharing regarding mental status and pain by outgoing nurses on Unit C. Apparently disparate findings across units are difficult to reconcile without further study but may also reflect the relatively smaller number of handoffs analyzed from Unit C.

With respect to handoff content, results suggest that nurses made concordant assessments of patient risk when handoffs contained information on severe or multiple abnormalities in vital signs, or abnormal findings related to breathing, circulation, or mental status. Moreover, two situations almost inevitably resulted in nurses' agreement that the patient was at risk: chest pain with elevated troponins and active bleeding. This is congruent with other findings in the literature regarding nurses' use of signs and symptoms to recognize and assess deteriorating patients (Douw et al., 2015). However, our results further show that the same cues could either result in agreement or disagreement regarding a patient's risk. In fact, the level of disagreement among nurses was perhaps one of the most striking findings of this study. Of the 125 handoffs where at least one nurse judged that a patient was at risk, there was agreement in nurses' judgments in only one out of four handoffs. This leaves 75% of handoffs (n=93) where nurses came to different conclusions regarding patient risk. In over two thirds of cases (n=64; 68.8%), the disagreement took the form

of the incoming nurse rating the patient's risk as higher, which may reflect that they maintained a high level of suspicion for patient risk until further—or their own—assessment confirmed otherwise.

Deeper analysis of handoffs where the nurses involved disagreed in their assessment of risk revealed three features of the information exchanged that may provide insights about what may have influenced the discordance: characteristics of the information exchanged, nature of the cues, and nurses' knowledge of the patient. The quantity and potential seriousness of clinical cues appeared to affect nurses' judgments. With respect to the nature of cues, the fact that a patient was recently transferred from the ICU tended to raise incoming nurses' suspicion that a patient might deteriorate, a finding that could reflect that up to 7% of patients are readmitted to the ICU after being discharged from critical care (Kramer, Higgins, & Zimmerman, 2013). Moreover, pain without a clear cause and signs of delirium were apparently not consistently weighted by all nurses or for all patients, which is consistent with multiple studies demonstrating that nurses hold varied, and sometime erroneous, beliefs regarding those conditions (e.g., Layman Young, Horton, & Davidhizar, 2006; Wells, 2012). Together these findings suggest a need for educational efforts to improve nurses' knowledge regarding pain, cognitive alterations, and related signs and symptoms, which will hopefully, increase agreement regarding their clinical significance.

In addition, nurses' knowledge of patients appeared to impact their judgments, given that some cues were linked differently with risk ratings depending on whether nurses were aware of the patient's baseline, previous state, or typical patterns of response. 'Knowledge of the patient' is a concept that is often encountered in the literature on nursing expertise and clinical judgment (e.g., Tanner, 2006; Zolnierek, 2014), as well as in studies of nurses' recognition of deteriorating patients (e.g., Gazarian, Henneman, & Chandler, 2010; Minick & Harvey, 2003). However, it is most often framed as an explanation for how knowledge of a patient's typical patterns of response (or patterns

for a group of patients with similar conditions) helps nurses notice data that require attention. On the contrary, this study showed that knowing the patient could have a dampening effect on their judgments of patients' risks. It could be argued that outgoing nurses, relying on their own assessment and knowledge of patients, adopted a more contextualised interpretation of cues that could otherwise be typical of a deterioration in status. Meanwhile, incoming nurses—who relied on outgoing nurses' depiction of the patient to form their judgments—were more likely to pick up on those cues without considering the broader patient presentation. Consequently, these cues triggered a heightened level of concern.

This last point relates to yet another phenomenon seen in the great majority of handoffs here: the near-absence of recommendations regarding the next steps in the management of the patient, which is the last component of the SBAR tool. Across the three units, only 68 handoffs (28.3%) included a plan and when it was mentioned, it often took the form of an upcoming treatment, test, or discharge. Nurses provided each other very little guidance regarding how the situation of a patient might evolve, except when a physician had mentioned that the patient might experience a cardiac arrest or be transferred to the ICU. This could partly explain why there was so much disagreement between nurses. A recent study showed that the implementation of a handoff protocol including residents' impressions regarding the acuity of a patient's illness and anticipatory guidance regarding the possible evolution of their situation resulted in a significant decrease in medical errors (Starmer et al., 2014). Implementation of the same protocol with nurses resulted in a significant increase in the number of nursing handoffs containing acuity assessments; however, no data concerning anticipatory guidance were reported (Starmer et al., 2017). While the effects of such practices on nurses' judgments still remain to be clarified, it is plausible that they could result in greater agreement between nurses. Sharing impressions regarding the possible evolution of the

patient's situation could be an effective way for nurses to form a shared mental model of the patient's risk and help the incoming nurse gauge the significance of certain clinical cues.

Interpretation of this study's findings should consider a number of limitations. While three units with different specialties were involved, this was a single-center study. Since we opted to study handoffs as they naturally occurred in the context of the units, the sample of handoffs that was collected resulted from the interaction of myriad factors, including the number of participants, their schedule, and the nurse-to-patient assignment. This resulted in differences in the numbers of handoffs considered for analysis on each unit. In addition, the overall small number of handoffs precluded controlling for a number of variables, which are known to influence nurses' judgments. For example, the design selected did not allow us to account for work experience and nurses' previous knowledge of the patients. It is also worth reiterating that both the Clinical Judgment Model (Tanner, 2006) and the probabilistic functionalist approach (Brunswick, 1955; Cooksey, 1996) posit that individuals will come to different judgments when presented with a similar set of data. While we were able to draw conclusions from trends in our dataset, further studies are needed to take individual factors into account. Another limitation was the difficulty in quantifying the extent to which information characteristics facilitated or hindered nurses' agreement. This was due to two features of our dataset. First, the number of handoffs by patients varied and some patients were more represented than others. Practically speaking, this means that if a patient was the object of multiple handoffs, the cues that he or she presented would have been artificially overrepresented in our numbers. Second, the cues that some patients presented evolved throughout the handoffs that were analyzed. For example, one patient presented chest pains in one handoff and bleeding in subsequent ones. Thus, quantifying the cues of deterioration at the handoff or patient levels would have resulted in biased data. Finally, we did not examine the consequences of nurses' judgments

on their subsequent management and monitoring of the patient's condition. This would definitely require further research to gauge how nurses' judgments could affect patient care and outcomes.

CONCLUSION

This study was one of the first to examine the relationship between handoffs and nurses' judgments of patient risk of deterioration. Results show that nurses exchanged more information on abnormalities in vital signs and known indicators of deterioration in handoffs when they judged that a patient was at risk, compared to technical information regarding patient care. However, characteristics of the information, the nature of the cues, and nurses' knowledge of the patient tended to affect nurses' agreement, often resulting in incoming nurses overestimating the patient's risk. While these findings warrant validation in future studies, they suggest that focussing handoffs on nurses' assessment has the potential to improve the formation of shared mental models regarding patient risk.

RELEVANCE TO CLINICAL PRACTICE

Many efforts have been made to standardize nursing handoffs and reduce omissions in the exchange of important patient information. Findings from this study suggest that, beyond standardization, it is necessary to educate nurses on how data exchanged during handoff and the manner in which it is formulated impact their colleagues' clinical judgments, which in turn can affect planning, prioritization, and continuity of patient care. Educational programs and quality improvement efforts could aim at sensitizing nurses to the signs and symptoms that are known to heightened suspicion regarding patient deterioration and, consequently, how discussing these cues during handoff can generate a feeling of worry or concern in their peers. It also appears important to replicate and perhaps explain and address the high level of disagreement in nurses' judgments following handoffs seen here. Although it might seem desirable that incoming nurses maintain a high level of vigilance for patient risk, it is also striking to see that so many handoffs resulted in

what appear to be overestimations of patient risk by incoming nurses (compared with outgoing nurses' estimates and actual patient outcomes). Therefore, this study underscores the importance of nurses exchanging impressions with each other regarding how a patient's situation might evolve in order to ensure continuity of care for those at risk of deterioration.

What does this paper contribute to the wider global clinical community?

- Handoffs are meant for nurses to form a shared understanding of a patient's status. Yet, this study revealed that the information content of handoffs often results in disagreement between nurses regarding a patient's risk of deterioration.
- Nurses exchange more information on abnormal vital signs and known indicators of deterioration in handoffs when they judge a patient to be at risk of deterioration.
- Three factors were found to affect nurses' agreement following handoffs: characteristics of the information, the nature of cues, and nurses' prior knowledge of the patient.

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Table 1. Content and Structure of Handoffs

			Unit A GI/GYN Surgery			Unit B Internal Medicine			Unit C Hematology/Oncology		
Sequence rank	Code	Definition	All (*n*=101)	Low risk (*n*=74)	High risk (*n*=27)	All (*n*=87)	Low risk (*n*=66)	High risk (*n*=21)	All (*n*=52)	Low risk (*n*=39)	High risk (*n*=13)
1.	Oxygen ± breathing	Dose and mode of delivery ± abnormalities in breathing	28	**20**	**48**	79	79	81	40	38	46
2.	IV	Type of access, site, and infusion	90	92	85	76	79	67	73	74	69
3.	Vital signs	"Stable" or abnormalities	49	**41**	**70**	48	47	52	67	**64**	**77**
4.	Drain	Type, location, and drainage (quantity and qualities)	33	35	26	15	**9**	**33**	13	**8**	**31**
5.	Blood glucose	Schedule (if planned)	15	15	15	57	**61**	**48**	12	10	15
6.	Diet	Type and patient tolerance	77	77	78	75	73	81	52	54	46
7.	Medication intake	How the patient takes their pills (e.g., whole, crushed)	5	5	4	47	**50**	**38**	13	15	8
8.	Modes of elimination	How the patient voids (bathroom, catheter, diaper, ostomy)	53	**49**	**67**	77	77	76	42	41	46
9.	Mental status	Alertness, orientation, other information on mental status	16	**11**	**30**	71	74	62	48	**51**	**38**
10.	Social context	Social situation outside the hospital	7	7	7	16	14	24	6	5	8
11.	Urine	Quantity and qualities	50	47	56	36	33	43	23	21	31
12.	Labs	Results or upcoming blood work	50	47	56	51	52	48	75	74	77
13.	Mobilization	How does the patient mobilize, with or without assistance	44	45	41	83	82	86	62	64	54
14.	Family	Presence or involvement of family during hospitalization	24	24	22	34	35	33	46	**41**	**62**
15.	Pain	Painkillers intake ± assessment of pain	54	**50**	**67**	33	32	38	42	**46**	**31**
16.	Dressings	Site, type, and changes during shift	66	69	59	21	**18**	**29**	10	10	8
17.	Stool	Frequency and qualities	38	39	33	57	**53**	**71**	35	36	31
18.	Plan	Upcoming exam, care, treatment, or discharge	21	**26**	**7**	37	38	33	10	**5**	**23**
19.	Skin	Pressure ulcers or edema	13	11	19	72	71	76	27	28	23

NOTE. All data are percentages. Numbers in the first column represent the mean sequence rank in which the information was presented across the 240 handoffs. **Bold** = difference > 10% between handoffs where the patient was judged to be at low or high risk of deterioration.

Table 2. Example of a double-entry table

Information	Agreement (OUT=IN)	Disagreement (OUT>IN)	Disagreement (OUT<IN)
Chest pain	"Around 11:30, he was complaining of chest pains, so I did a set of trop[onin]s. It was a little high. I did another one later and it was still high." (H397)	-	"She complained about, like, pain around her chest area? But we assessed her, when we came back, she forgot about that pain." (H015)
Low blood pressure	"His blood pressure decreased to, like, 85/56. […] So, I bolused him, first, with 500cc of NS. And then, they wanted 1L of the pressure bag bolus. So, after doing all those boluses, his blood pressure went up to, like, 101. It's not high…" (H023)	"She was around 96, her blood pressure. When she vomited, it went up to 105. She's been with low blood pressure since she came in, but she has hypertension in her past medical history…" (H379)	"Today apparently her blood pressure was low. With me, it was fine." (H069)

NOTE. OUT = Outgoing nurse's judgment of the patient risk of deterioration on the Patient Acuity Rating (PAR; Edelson et al., 2011). IN = Incoming nurse's judgment of the patient risk of deterioration on the PAR.

Table 3. Patient characteristics (*N*=158)

	Unit A GI/GYN Surgery (*n*=53)	Unit B Internal Medicine (*n*=67)	Unit C Hematology/ Oncology (*n*=38)
Age (years)[†]	66.4 (18.5)	75.4 (14.4)	65.9 (15.2)
Gender (female) [‡]	32 (60.4)	31 (46.3)	13 (34.2)
Length of stay (days)[§]	18.2 (44.8)	13.9 (23.3)	31.2 (27.7)
Outliers (*n*)	6	7	4
Post-hospitalization destination[‡]			
Home	33 (62.3)	29 (43.3)	20 (52.6)
Long-term care	10 (18.9)	20 (31.7)	3 (7.9)
Still hospitalized 2 months after study	1 (1.9)	2 (3.0)	1 (2.7)
Death	2 (3.8)	12 (17.9)	6 (15.8)
Unknown	7 (13.2)	4 (6.0)	8 (21.1)

NOTE. GI=Gastrointestinal; GYN=Gynecological. [†]Data are mean years (standard deviations). [‡]Data are numbers of participants (percentages). [§]Data are medians length of stay (interquartile range), including patient still hospitalized two months after the study and patients whose length of stay exceeded their unit's third quartile by 1.5 interquartile range.