



Interruptions and Pediatric Patient Safety

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This study explored interruptions in pediatric nurses' work and the systems issues related to interruptions in nursing work environments. A total of 5,325 interruptions were observed in this study, providing information on sources, types, and causes of interruptions. The nursing work being performed when interrupted and the outcomes of these interruptions are described.

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THE INSTITUTE OF Medicine report on errors in health care emphasizes that most errors are systems related, requiring a greater focus on improving the systems of care delivery (Kohn, Corrigan, & Donaldson, 2000). Leape (1997) suggests that errors often happen because of defects in the systems in which we work or because of conditions beyond the control of the individual. Systems-related issues are described as failures in the design of processes, management of the conditions of work, and in the individual training for that work (Leape). For example, a systems-related issue could be if the supply cart for a patient care unit had not been updated to reflect the supply needs of an expanded patient care population serviced by the unit. A failure in the design of processes could be when the design of the intravenous infusion pump is altered by the vendor without input from nurses or clinicians, and the new design changes impede practice or no longer reflect the requirements of the clinical setting. Limited research has been conducted in the field of nursing that examines systems issues that relate to patient safety. In contrast, most of the

work that has been conducted has focused on the lack of nursing knowledge or skill related to errors. Although knowledge and skill may be important considerations, it is imperative that we explore these in relation to work design and systems within the health care environment. This research examined the concept of interruptions in pediatric nurses' work and the systems issues related to interruptions in nursing work.

Conceptual Framework

Interruptions have been defined as “externally generated, randomly occurring, discrete events that break continuity of cognitive focus on a primary task” (Corragio, 1990). The framework for this study emerged from the management literature in the field of work redesign. Work redesign involves the analysis and redesign of work within an organization (Hackman & Oldham, 1980). The process of work redesign includes stakeholders in the planning and implementation of workplace changes. Work redesign has the potential of transforming work processes and communication patterns in an effort to produce a needed change within a system. Originally, the Hackman and Oldham conceptual

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framework was developed to test core job characteristics with their motivating and satisfying potential. They identified that staff perceptions of their work were important, and the stronger an employees "growth need," the more the core characteristics were important in the work. Given that nurses have high levels of growth need, that is, the need for professional and personal growth and development, the importance of understanding how interruptions in nursing work impact on the core job characteristics, especially in the area of completing "whole" pieces of work becomes evident. Understanding interruptions in the context of nursing work may assist employers to redesign the work and the systems nurses work in to strengthen the core job characteristics (i.e., reduce certain types of interruptions). In addition, understanding interruptions in the daily work of nurses will shed light onto the potential systems factors that may lead to unsafe situations. The work redesign framework will assist in better understanding nursing work in a complex environment, will engage nurses in the redesign process, and may ultimately guide changes that can improve weak systems, ultimately enhancing patient safety.

Context and Purpose

The importance of developing an understanding of systems factors in the work environment that may contribute to patient safety is underscored by the lack of literature that examines patient safety in relation to the nursing practice environment. Some research has identified a link between nurse staffing, nursing skill mix, and patient safety outcomes in adult acute-care settings, suggesting that higher levels of registered nurse staffing leads to improved outcomes (Aiken et al., 2001; Blegen, Goode, & Reed, 1998; McGillis Hall et al., 2001; Needleman, Buerhaus, Mattke, Stewart, & Zelevinsky, 2001). However, this research has not addressed how systems in the nursing work environment can specifically contribute to patient safety. For instance, there has been no research aimed at understanding interruptions in the nursing work environment that may contribute to patient safety incidents in pediatrics. In pediatric tertiary environments, these occurrences are more pronounced with patients having higher levels of acuity and complex treatment needs (Montgomery, 2007; Tamburro, West, Piercy, Towner, & Fang, 2004). The advanced, highly complex procedures available in tertiary-care settings, often provided over an extended period, are designed to meet the specialized needs of patients with high acuity. High complexity of care and acuity of patients have been linked to nurses' fatigue and workload. Some authors suggest that nursing fatigue and excessive workload can lead to increased error and infections in pediatric tertiary care (Montgomery).

The changing demands encountered by nurses in their work environments have been described as "complexity

compression," with nurses expected to take on additional unplanned work activities while continuing their multiple work responsibilities (Krichbaum et al., 2007). A number of factors were found to influence complexity compression including personal, environmental, practice, systems and technology, administration, and autonomy or control. Multiple stimuli that impact on nurses' concentration were identified within the environmental factor, whereas system breakdowns or failures were also noted as factors (Krichbaum et al., 2007).

A study of 57 pediatric nurses across six units found that distractions or interruptions and workload were the major reason for medication errors (Stratton, Blegen, Pepper, & Vaughn, 2004). Operational failures such as the disruptions and errors in material supplies or information encountered by hospital nurses have also been reported to interrupt the concentration of nurses while causing delays in patient care, putting patients at risk, and wasting hospital resources (Tucker, 2004). The author found that an average of 9% of nurses' time a shift was directed toward "failure resolution" activities such as follow-up with pharmacy regarding missing patient medications, locating a thermometer, and trying to find which physician was covering a specific patient (Tucker). The purpose of this research was to investigate the context of interruptions in nursing work through work sampling and focus groups with nurses in pediatric, acute-care units in a teaching hospital in Toronto, Canada.

Methods

Design

The study was conducted in two phases extending over 13 months, from November 2005 to November 2006. An exploratory research design was used to complete the first study phase, which involved work sampling observation of nurses on selected study units. Work sampling is a data collection process that involves observing people in their natural work environment. The objective of this phase was to observe nursing interruptions as they would be experienced on a typical nursing shift in the pediatric setting. To achieve this goal, the data collectors observed the nursing personnel on the selected units as they carried out their routine nursing work activities. Specifically, the work sampling techniques captured information related to (a) the types of interruptions that occur, (b) the source of that interruption, (c) identification of the work being performed by the nurse when interrupted, and (d) the outcome of the interruption.

One of the underpinnings of applied health services research of this nature is to engage in partnerships with clinical decision makers (Academy Health, 2008). The Child Health Services (CHS) Directors on each of the study units indicated a strong interest in participating in this study and facilitated data collection on the units. In addition, the Quality

of Nursing Work Life Committee at the study site, the Nursing Practice Council, and the Centre for Nursing deemed this study to be a priority. Phase 2 of the study involved focus groups with nurses to validate the findings from the work observation. Nursing personnel who participated in Phase 1 of the study were invited to participate in the focus groups.

Setting and Sample

Four units in a tertiary-care pediatric academic-affiliated teaching hospital participated in this study. The units sampled included medicine, surgical care, complex medical and surgical, and critical care, all of which represent the broader pediatric population in hospitals. Four units provided an adequate sample for the work sampling data collection (i.e., 32 nurses/8 per unit). Work sampling involved 32 days of work observation conducted for 12-hour work shifts, or 48 hours a week, resulting in 384 hours of work observation. Based on previous work sampling studies, a total sample of 380 hours of observation was required to be able to comment on nurses' work at 5% accuracy and 95% confidence (McGillis Hall & O'Brien-Pallas, 2000; O'Brien-Pallas, Cockerill, & Leatt, 1991). Others have reported 239 hours of work observation of 26 nurses (Tucker, 2004).

Procedure for Data Collection

Work sampling data were collected on each of the medical, surgical care, complex medical and surgical, and critical care units selected from the study site. Based on an earlier pilot study (McGillis Hall, 2003), it was found that data collection on weekday day shifts provided an accurate representation of the types, number, and scope of interruptions in nursing work environments. Therefore, data collection involved 4 days of work sampling observation each week conducted on weekday 12-hour shifts for a 2-month period. One nurse per day was observed by the data collector.

The data collector met with the nursing staff on each study unit to explain the study and the work sampling procedure. Nurses were given the opportunity to discuss and respond to any questions related to the study during these sessions. For each participating unit, during the 2-week data collection period, the CHS Director provided a list of scheduled staff to the research project manager. The staff list was stratified by level of nurse experience. The research project manager worked with the data collector to determine nurse selection for that day. All full-time or part-time unit nurses working that day were provided with the opportunity to participate in the work observation. If more than one nurse volunteered and consented to participate for that day, the research project manager randomly selected a nurse to be observed that day.

A letter of information about the study was given to all nurses, along with a consent form for them to complete. Nurses were informed of their option to opt out of the study if they chose not to participate. Receipt of the completed consent form

signified a nurse's willingness to participate in the study. Different nurses were observed on each of the study days, such that the total sample of nurses observed was eight per unit. The nurse was observed by the data collector for the duration of their worked shift, excluding breaks. The data collector observed the nurse for the day and was aware that ensuring the privacy of patients was critical. The data collector could converse with the nurse to clarify perceptions of an interruption prior to coding if unclear (i.e., conversations were nurse oriented, not focused on the patient). The data collector was to be considered an observer only and was not expected to intervene or participate in any patient care situation.

A parent information sheet was provided to parents of patients assigned to the nurse being observed each day to ensure they were aware and informed that the study was underway. The data collector recorded on the data collection sheet the types of interruptions that occurred (i.e., a telephone call, respond to patient call bell, meet with a physician, and so on), the source of that interruption, the nursing work activity being performed when interrupted, and the outcome of the interruption (i.e., late delivery of medications). Interrater reliability of the work observation was conducted throughout the study process, specifically on the first day of data collection and once weekly afterward, with the aim of achieving 80% reliability between the observers. Over a 2-hour period, the research manager and data collector would both silently complete simultaneous observations of the study nurse. A total of 192 observations comprised the interrater reliability checks. An interrater reliability score of 92% was achieved and maintained throughout the data collection period.

Nursing staff working on the participating units were asked to indicate their interest in participating in a focus group meeting to be held at a later point in the study to review and validate the preliminary findings related to interruptions in their environment. Twenty-nine nurses identified interest in participating in the focus groups, from which a third of these were randomly selected ($n = 10$) by the research team. A total of 9 nurses from the participating units attended the 1-hour focus group meeting. The focus group participants were asked to describe their perceptions of the interruptions that occur on a typical work shift in their setting.

Data Analysis and Output

The work sampling data were categorized and coded into themes and developed into a framework for categorizing nursing interruptions in pediatric practice. Descriptive statistics were used to analyze the sources, type, causes, work interrupted, and outcomes of the interruptions. Analysis of variance was conducted to determine if there were significant differences in interruptions between the study units. Focus groups were taped, field notes were taken,

and a thematic data analysis was conducted by the research team—two of which have considerable experience with this methodology, including in the specific area of studying nursing interruptions. First, each member of the team reviewed a transcript and came up with a set of themes that were generated from the data. Next, the team members conferred to discuss the themes, deal with any inconsistencies that emerged, and come up with a consistent set of codes to be used for the data analysis of the focus group data. The analyzed focus group data were then triangulated with the work sampling data. Simultaneous triangulation was used in this study because it allowed for the use of qualitative and quantitative methods at the same time. In this case, there was limited interaction between the types of data during the data collection, but the findings were integrated to complement one another at the end of the study (Morse, 1991).

Protection of Human Subjects

No patients were involved in this study, and the data collectors were instructed to ensure that patients' privacy was protected. The nursing staff were approached by the research manager or data collector, who explained the purpose of the study, the activities expected of participants, and the participants' rights for and methods for ensuring self-determination, privacy, and confidentiality. Nurses were informed of their option to opt out of the study at this time. Nurses were told that their decision to participate would have

no effect on their work, that they could withdraw from participation at any time, and that they could decline to answer any question. Nurses were informed that although no benefits would be directly experienced by them, there would be no harm as a result of participating in the study. Nurses who agreed to be included were required to sign a consent form. A copy of the signed consent form was given to the nurse.

Results

Overall, 5,325 interruptions were observed in the nursing work environment during the work observation study period (Figure 1). Of these, 1,430 (26.9%) took place on the surgical care unit, 1,373 (25.8%) on the complex medical and surgical unit, 1,316 (24.7%) in critical care, and 1,206 (22.6%) on the medical unit. Thus, a consistent percentage of data was collected on each of the study units, suggesting that the data are representative of the types of interruptions that occur across these units.

Source of Interruption

The sources of interruptions to nursing work included the environment, other staff nurses, patients, family members, the individual nurse herself/himself, physicians, other health care providers, support staff, and others (Table 1). Factors within the work environment itself accounted for a third of the interruptions in this study overall ($n = 1,741$, 32.7%).

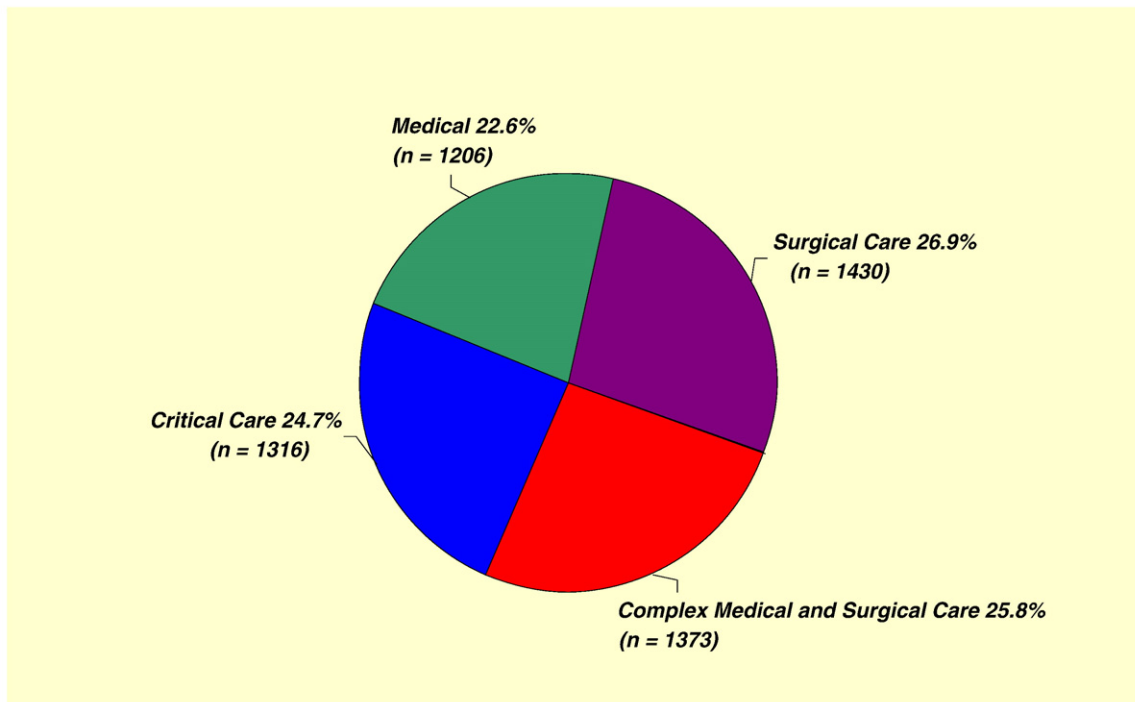


Figure 1 Interruptions across study units.

Table 1 Sources, Types, and Outcomes of Interruptions in Pediatric Nursing Work Environments

	Surgical Care Frequency (%)	Complex Medical and Surgical Frequency (%)	Medical Frequency (%)	Critical Care Frequency (%)	Overall Frequency (%)
Source of interruption					
Environment	428 (29.9)	420 (30.6)	405 (33.6)	488 (37.1)	1,741 (32.7)
Nurse	382 (26.7)	309 (22.5)	330 (27.4)	317 (24.1)	1,338 (25.1)
Patient	180 (12.6)	136 (9.9)	86 (7.1)	60 (4.6)	462 (8.7)
Family member	146 (10.2)	96 (7.0)	114 (9.5)	89 (6.8)	445 (8.4)
Self	79 (5.5)	127 (9.2)	75 (6.2)	46 (3.5)	327 (6.1)
Physician	44 (3.1)	90 (6.6)	53 (4.4)	105 (8.0)	292 (5.5)
Other health care provider	63 (4.4)	69 (5.0)	31 (2.6)	128 (9.7)	291 (5.5)
Support staff	57 (4.0)	66 (4.8)	67 (5.6)	42 (3.2)	232 (4.4)
Others	51 (3.1)	60 (4.4)	45 (3.6)	41 (3.1)	197 (3.7)
Totals	1,430 (100)	1,373 (100)	1,206 (100)	1,316 (100)	5,325 (100)
Type of interruption					
Intrusion	876 (61.3)	729 (53.1)	673 (55.8)	882 (67.0)	3,160 (59.3)
Distraction	395 (27.6)	402 (29.3)	373 (30.9)	343 (26.1)	1,513 (28.4)
Discrepancy	138 (9.7)	192 (14.0)	140 (11.6)	74 (5.6)	544 (10.2)
Break	21 (1.5)	50 (3.6)	20 (1.7)	17 (1.3)	108 (2.0)
Totals	1,430 (100)	1,373 (100)	1,206 (100)	1,316 (100)	5,325 (100)
Outcome of interruptions					
Negative	1,234 (86.3)	1,220 (88.9)	1,085 (90.0)	1,197 (91.0)	4,736 (88.9)
Positive	196 (13.7)	151 (11.0)	121 (10.0)	119 (9.0)	587 (11.0)
Missing	0 (0)	2 (0.1)	0 (0)	0 (0)	2 (0.1)
Totals	1,430 (100)	1,373 (100)	1,206 (100)	1,316 (100)	5,325 (100)

Following this, other nursing staff accounted for a quarter of the interruptions observed ($n = 1,338$, 25.1%). Patients ($n = 462$, 8.7%) and family members ($n = 445$, 8.4%) accounted for interruptions to a lesser extent. Nurses themselves ($n = 327$, 6.1%), physicians ($n = 292$, 5.5%), other health care providers ($n = 291$, 5.5%), support staff ($n = 232$, 4.4%), and others ($n = 197$, 3.7%) contributed to interruptions to a much lesser degree.

Small differences in the sources were noted among the study units, although none of these differences were statistically significant. For example, the critical care unit had higher numbers of interruptions originating from within the environment ($n = 488$), whereas the medical unit had the least ($n = 405$). As well, patients were more often the source of interruptions on the surgical care unit ($n = 180$) and the complex medical and surgical unit ($n = 136$), than on the medical and critical care units. Higher levels of interruptions from family members occurred on the surgical care unit and the medical unit than on the other units in the study. Interruptions from physicians and other health care providers were highest in critical care. Finally, more interruptions were self-initiated by nurses on the complex medical and surgical unit than the overall sample (6.1%). These findings were substantiated by focus group participants who provided detailed examples of some of the sources of interruptions related to the environment, other nurses, patients, family members, the nurse themselves, physicians, and other health care providers. Focus group attendees indicated that being interrupted by other nurses was common, primarily as fellow

nurses requested assistance or answers to questions. Some nurses felt that this was a typical occurrence on a unit and therefore not seen as an interruption.

“You don’t want to be completely away from everything, but sometimes all the noise and chaos and extra people at the desk—the doctor is sitting right next to you when you’re doing your work or something—they can just interrupt you or the patient can. The family can still see you and still walk up, or all the noise that goes on, like call bells going over heads, you’re hearing things all the time.”

“When a patient needs you, they call out.”

“Having to go back and get supplies.” “I actually do that a lot. I’m halfway down the hall to my room and go ‘oh I forgot that,’ and have to backtrack.”

“Consulting services don’t have access to the computer so they’re constantly coming to us, asking us to sign in to the program so they can have access.”

“Even some other nurses can’t go in and sign on in.”
“We’re dependent on the other nurses.”

Type of Interruption

The types of interruptions observed in the nursing work environment were categorized as intrusions, distractions, discrepancies, and breaks (Table 2).

Table 2 Definitions of Types of Interruption (Jett & George, 2003)

Interruption Type	Definition
Intrusion	“An intrusion is an unexpected encounter initiated by another person that interrupts the flow and continuity of an individual’s work and brings that work to a temporary halt.” (p. 495)
Distraction	“Distractions are psychological reactions triggered by external stimuli or secondary activities that interrupt focused concentration on a primary task; generally instigated by competing activities or environmental stimuli that are irrelevant to the task at hand.” (p. 500)
Break	“Breaks are planned or spontaneous recesses from work on a task that interrupt the task’s flow and continuity.” (p. 497–498)
Discrepancy	“Discrepancies are perceived inconsistencies between one’s knowledge and expectations and one’s immediate observations that are perceived to be relevant to both the task at hand and personal well-being.” (p. 502)

More than half were intrusions ($n = 3,160$, 59.3%); whereas more than a quarter of them were distractions ($n = 1,513$, 28.4%); and fewer ($n = 544$, 10.2%) were discrepancies and breaks ($n = 108$, 2.0%). The findings appear relatively consistent across the participating units, although some statistically significant differences were noted, $F(5,320, 4) = 13.223$, $p = .000$. Specifically, critical care interruptions were significantly different from all of the other individual units. For example, intrusions were less evident on the medical unit ($n = 673$) and highest in critical care ($n = 882$) and on the surgical care unit ($n = 876$). Distractions occurred least in critical care ($n = 343$) and most on the complex medical and surgical unit ($n = 402$) and surgical care unit ($n = 395$). Discrepancies occurred the most on the complex medical and surgical unit ($n = 192$), followed by the medical unit ($n = 140$) and the surgical care unit ($n = 138$) but were much less visible in critical care ($n = 74$). Finally, breaks were most apparent on the complex medical and surgical unit ($n = 50$), whereas the numbers were lower for the surgical care ($n = 21$), medical ($n = 20$), and critical care units ($n = 17$).

Comments from focus group participants provided additional context regarding how nurses perceive the types of interruptions in nursing work in this setting.

“We’re just used to it. It’s just our practice.”

“Interruptions when you have to help out another staff person are—like a built in thing—you don’t think of it as an interruption.”

“Usually when you’re interrupted, it’s at a time when you’re just really trying to get your work going—sometimes they’re just always calling you.”

Causes of Interruptions

Close to a third of intrusions were in the area of communication with the nurse related to patient care ($n = 1,871$, 35%), followed by monitors or pumps ($n = 357$, 6.7%), the need for assistance ($n = 312$, 5.9%), socializing ($n = 211$, 4.0%), telephone calls for the nurse or patient ($n = 145$, 2.7%), pagers ($n = 133$, 2.5%), another health care provider ($n = 63$, 1.2%), and call bells ($n = 51$, 1.0%)

Statistically significant differences were found between the study units, $F(5,318, 4) = 15.018$, $p = .000$, again most often in relation to critical care. For example, intrusions from monitors and pumps were significantly higher in critical care ($n = 194$) than on the surgical care unit ($n = 89$), the complex medical-surgical unit ($n = 39$), or medicine ($n = 35$). As well, distractions from overhead pagers were significantly lower in critical care ($n = 89$), in comparison to surgical ($n = 129$), complex medical-surgical unit ($n = 195$), and highest on the medical unit ($n = 195$). In contrast, distractions from alarm bells and pagers were significantly higher in critical care ($n = 149$) than on the complex medical-surgical unit ($n = 139$), surgical care ($n = 135$), and medicine ($n = 74$). Finally, discrepancies related to missing or misplaced supplies or broken equipment were significantly higher on the complex medical-surgical unit ($n = 103$), surgical care unit ($n = 91$), and medical unit ($n = 85$), than in critical care ($n = 61$). In addition, discrepancies caused by the nurse forgetting something were significantly higher on the complex medical-surgical unit ($n = 42$), medicine ($n = 18$), and surgical care unit ($n = 13$), than in critical care ($n = 4$).

Most interruptions were intrusions that relate to communicating to the nurse. Information obtained during the focus groups highlight some of the types of communication activities that interrupt nurses in their work.

“Every service, like Infectious Diseases comes in and you’re in the middle of doing something and they want to ask you questions, or Gastroenterology comes in or that sort of thing.”

“They come in and instead of looking through the chart and saying, ‘oh yeah, he had a fever last night’...they’re asking you, ‘what antibiotics is he on?’ You want to say, well, look in the med sheet.”

“Monitors are always interrupting us when we’re getting report. Monitors going off. You go into the other room for the monitors and the call bell system goes off.”

Overhead pages, which are a form of distraction in this study, were also identified as one of the most common types of interruptions. Participants stated that they were constantly being “called out” of rooms to either go to the desk, answer the telephone, answer questions, assist another nurse, or be sent to another room for either their patient or another nurse.

“You’re in the middle of something in here, but you’re being called to the other room.”

Table 3 Nursing Work Being Performed When Interrupted in Pediatric Nursing Work Environment

Nursing work being performed when interrupted	Surgical Care Frequency (%)	Complex Medical and Surgical Frequency (%)	Medical Frequency (%)	Critical Care Frequency (%)	Overall Frequency (%)
Patient care assessment/procedure	469 (32.8)	524 (38.2)	257 (21.3)	454 (34.5)	1,704 (32.0)
Documentation	394 (27.6)	331 (24.1)	293 (24.3)	271 (20.6)	1,289 (24.2)
Transit	168 (11.7)	135 (9.8)	119 (9.9)	73 (5.5)	495 (9.3)
Medications	107 (7.5)	115 (8.4)	150 (12.4)	122 (9.3)	494 (9.3)
Consulting	103 (7.2)	91 (6.6)	112 (9.3)	125 (9.5)	431 (8.1)
Break/Not doing anything	53 (3.7)	41 (3.0)	122 (10.1)	52 (4.0)	268 (5.0)
Intravenous	17 (1.2)	41 (3.0)	60 (5.0)	46 (3.5)	164 (3.1)
Communicating	37 (2.6)	20 (1.5)	41 (3.4)	54 (4.1)	152 (2.9)
Equipment/Supplies	40 (2.8)	33 (2.4)	10 (0.8)	43 (3.3)	126 (2.4)
Laboratory work	0 (0)	12 (0.9)	20 (1.6)	35 (2.7)	67 (1.3)
Housekeeping/Clerical	27 (1.9)	9 (0.7)	7 (0.6)	9 (0.7)	52 (1.0)
Universal precautions	11 (0.8)	11 (0.8)	5 (0.4)	11 (0.8)	38 (0.7)
Telephone	4 (0.3)	3 (0.2)	8 (0.7)	19 (1.4)	34 (0.6)
Missing	0 (0)	7 (0.5)	2 (0.2)	2 (0.2)	11 (0.2)
Totals	1,430 (100)	1,373 (100)	1,206 (100)	1,316 (100)	5,325 (100)

“Usually it’s something that we’re waiting for, in order to make the plan of care for the next step. If you’re waiting for procedures to be done and they’re calling us to tell us about procedures, you need to take the call.”

Nurse Work Being Performed When Interrupted

Close to one third of the interruptions to nursing work take place when nurses are engaged in patient care assessment or procedures ($n = 1,704$; 32%). As well, almost one quarter of the time ($n = 1,289$, 24.2%), nurses were involved in documentation activities when interrupted. Less than 10% of the interruptions occurred while nurses were either in transit between one location and another, preparing or administering medications, consulting about a patient with other members of the health care team or patients, on their break, working with the intravenous equipment or other supplies, involved in communication activities including the telephone, or doing laboratory work, housekeeping, or clerical duties (Table 3).

Some statistically significant differences in the work nurses are performing when interruptions occur were evident among the study units, $F(5,309, 4) = 20.183$, $p = .000$, primarily in relation to the medical unit. For example, interruptions during patient care assessments or procedures were significantly less evident on the medical unit ($n = 257$) than they were on the other units, with the complex medical and surgical unit ($n = 524$) experiencing the most interruptions during care. In addition, nurses on the medical unit were interrupted significantly more while preparing or administering medications ($n = 150$), followed by nurses in critical care ($n = 122$), and complex medical–surgical unit nurses ($n = 115$), and the surgical care unit ($n = 107$). As well, although not significant, interruptions while nurses

were documenting occurred more frequently on the surgical care unit ($n = 394$) than on the complex medical–surgical unit ($n = 331$), medicine ($n = 293$) and critical care ($n = 271$). Nurses on the surgical unit ($n = 168$) and the complex medical–surgical unit ($n = 135$) experienced more interruptions while in transit than nurses on the medical unit ($n = 119$) and in critical care ($n = 73$), although these differences were not significant.

Focus group participants provided insight into the impact that interruptions had on patient care delivery.

“When you’ve got the really complex kids and you’re speaking to families and then you get a phone call from the pharmacy in the middle of the parent crying and so, you’re interrupting ... and you can never get back to helping that person through their grieving process.”

“You have to go to the other patient in the room whose alarm is ringing, so it’s just that communication with the family, the time that you’re spending trying to support them, that’s always interrupted.”

“I think that is the kind of thing, because you can never recapture that moment and I think all it does is tell them that we’re too busy, we don’t have the time to listen and so, then we’re reticent then, as time goes on, to really talk.”

Outcome of the Interruption

Most interruptions to nursing practice that were observed in this study could have negative consequences ($n = 4,736$, 88.9%), whereas few could lead to a positive outcome ($n = 587$, 11.0%), as outlined in Table 1.

Almost two thirds ($n = 3,216$, 60.4%) of the interruptions resulted in a delay to the original work that the nurse was

engaged in when interrupted, whereas just over one quarter ($n = 1,459$, 27.4%) of the interruptions resulted in a loss of concentration or focus from their original work. Some interruptions resulted in incomplete work ($n = 46$, 0.9%), nurses being required to multitask ($n = 9$, 0.2%), and an increased risk of error ($n = 7$, 0.1). At the same time, there were interruptions that may help the nurse ($n = 283$; 5.3%) and contribute to increased safety ($n = 261$, 4.9%), improvements in patient comfort or the patient's condition ($n = 23$, 0.4%), and increased accuracy ($n = 17$, 0.3%). No statistically significant differences in outcomes were noted among the study units.

Nurses participating in the focus groups were able to provide additional comments that help to explain how delays occur and how concentration on their work can be impeded.

"Forgetfulness is a problem—like sometimes you're in the middle of doing something and you go and run and do something else and you're trying to think, okay, what was I just doing, you know, trying to recall what it was."

"Usually if I'm giving a med and resetting my pumps, I just kind of set my pump up, you know? Maybe I just don't take that time to reset it, make sure everything is running fine, and that's something I will try and make a note to myself to get back to do, but then, oftentimes if it's a busy day, something else is going to come to you before you get back to that. So, just the double checking on what you just completed and having that extra time to do it, is what is lost."

"They'll come in the middle of you doing a dressing change or doing something at the bedside and, so you're taken away, so then meds are late and aren't done on time...to get answers that they could easily look up."

Discussion

Findings from this research highlight the complexity of nursing work environments in pediatric tertiary settings and how this can have a direct influence on interruptions in nursing work and related patient safety outcomes. Overall, the work environment and other nurses are the predominant sources of interruptions. When the study findings are examined together, it is evident that these environmental and interruptions from nursing peers take the form of intrusions and distractions, at a time when the nurse is involved in patient care assessments, procedures, or documentation. From a patient safety perspective, the result is most often negative, resulting in delays and loss of concentration or focus.

The core value of pediatric care relates to providing the best in family-centered care while striving for excellence in a safe and healthy environment. Despite these core beliefs, the complex nature of the work environment may be in opposition. If nurses are experiencing intrusions at the point of care, the bedside, this may be causing challenges to

the principles of family-centered care. In addition, distractions while nurses are involved in patient care can have implications for patient safety.

It is not unexpected that nurses are the primary source of interruptions for their peers. After all, nurses are the only staff member providing patient care around the clock in hospital health care. As well, although a care delivery model may emphasize family-centered care or total care for a patient, the structure of nursing work schedules often results in nurses working in teams or groups together. These work schedules promote nurses to work together as a team, relying on one another for assistance and support in patient care delivery. In a study comparing pediatric and nonpediatric nurses' perceptions of hospital work environment, pediatric nurses reported more positive perceptions of unit supports such as the relationships that nurses have with one another and the extent they feel that supplies and material resources are available to them (Cox, Teasley, Lacey, Carroll, & Sexton, 2007). It is also plausible that interruptions by other nurses are a result of the influence of systems and technology factors (e.g., system failures, multichanges, lack of a safety net, documentation, regulatory/legal, budget, staffing, technology), thus impacting organizational mechanisms designed to accomplish health care delivery (e.g., family-centered care; Krichbaum et al. 2007).

Work environment interruptions involving intrusions from monitors and pumps were highest in the critical care area, both as a result of the degree of technology involved in patient care combined with the level of acuity of patients being cared for. Although this provides some explanation for the study findings, it also brings to light some areas for consideration in the redesign of work processes. Nursing interruptions are of concern on any patient care unit; however, the critical nature of these patients only adds to their vulnerability to patient safety occurrences. Recent research has demonstrated that pediatric central line infection rates are highest in intensive care units, and the author suggests there may be a need to closely monitor procedures that have a higher risk for nosocomial infection to improve patient safety (Stratton, 2008).

At the same time, intrusions were significantly lower on the medical unit, where complexity in the pediatric work environment takes on a different form, with nurses required to provide extensive support and care to terminally ill children. However, medical nurses were interrupted significantly more than nurses on other units, when they were preparing or administering medications. Some authors suggest that pediatric nurses who work with terminally ill children possess attributes that can be linked to a higher level of nursing practice (Hale, Long, Sanderson, & Carr, 2008). These attributes include partnering with children and their parents to develop trust relationships, clinical skill related to drug therapy, strong multidisciplinary teamwork and communication, and professional yet friendly personal attributes (Hale et al., 2008).

Finally, nurses on the complex medical–surgical unit and in surgical care had significantly higher numbers of discrepancies related to missing or misplaced supplies or broken equipment. At the same time, it was on these units that nurses were noted to encounter more self-interruptions. In the context of work redesign, it is plausible that the challenges with supplies and equipment are hampering these nurses' ability to organize their daily care.

Conclusions

This study provides the first evidence of the context of interruptions to nursing work in pediatric tertiary-care settings. These data can serve to inform hospital administrators and nurse leaders about the key environmental factors that have an impact on patient safety outcomes. Findings from this research can be used to develop specific redesign strategies for pediatric hospital settings, aimed at decreasing work-related interruptions in nursing care.

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