Progressive Care Nurses
Improving Patient Safety by Limiting Interruptions During Medication Administration

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BACKGROUND
Because of the high frequency of interruptions during medication administration, the effectiveness of strategies to limit interruptions during medication administration has been evaluated in numerous quality improvement initiatives in an effort to reduce medication administration errors.

OBJECTIVES
To evaluate the effectiveness of evidence-based strategies to limit interruptions during scheduled, peak medication administration times in 3 progressive cardiac care units (PCCUs). A secondary aim of the project was to evaluate the impact of limiting interruptions on medication errors.

METHODS
The percentages of interruptions and medication errors before and after implementation of evidence-based strategies to limit interruptions were measured by using direct observations of nurses on 2 PCCUs. Nurses in a third PCCU served as a comparison group.

RESULTS
Interruptions ($P < .001$) and medication errors ($P = .02$) decreased significantly in 1 PCCU after implementation of evidence-based strategies to limit interruptions. Avoidable interruptions decreased 83% in PCCU1 and 53% in PCCU2 after implementation of the evidence-based strategies.

CONCLUSIONS
Implementation of evidence-based strategies to limit interruptions in PCCUs decreases avoidable interruptions and promotes patient safety. (Critical Care Nurse. 2016;36[4]:19-35)

Nurses play a critical role in promoting patient safety through surveillance and interception of errors that cause patient harm as hospitals and health care systems strive to become high-reliability organizations.$^1$ The Institute of Medicine estimates that medication errors result in several thousand deaths annually.$^2$ Interruptions during complex or high-risk activities such as medication administration increase risk of...
patient harm, and strategies to reduce interruptions and manage them appropriately are needed. On the basis of the current evidence, the Institute of Medicine recommends that organizations adopt strategies to reduce interruptions during medication administration as part of a comprehensive medication safety program.

The quality improvement project described here evaluates the impact of adopting evidence-based strategies to limit interruptions during medication administration in 2 progressive cardiac care units (PCCUs) at Advocate Christ Medical Center, a Magnet-designated tertiary care center in the Midwest. A third PCCU served as a comparison unit and, therefore, did not adopt the interruption-limiting strategies. A secondary aim of the project was to evaluate how limiting interruptions affected medication errors in this setting.

**Background**

In a plenary speech at the 2008 National Teaching Institute, the former president of the American Association of Critical-Care Nurses challenged more than 9000 nurses in attendance to avoid multitasking and interruptions when administering medications in order to prevent medication errors.

Attendance at this speech was the inspiration for this project and became the springboard for addressing existing nursing concerns about interruptions.

**Review of the Literature**

Observational studies describe the high cognitive work of nurses coupled with frequent interruptions and multitasking behaviors during direct patient care activities in acute care settings. The work environment is error-prone, especially during complex or high-risk activities, because interruptions and multitasking behaviors create conditions affecting working memory and attention resources. Nurses’ cognitive processes during medication administration are complex and require a high degree of critical thinking and vigilance to prevent patient harm. Medication administration is one of the most frequently interrupted nursing activities, and strategies to limit interruptions are recommended to improve patient safety.

Studies describing the frequency and characteristics of interruptions during medication administration show that nurses have little protected time to focus on medication administration because of short, frequent interruptions. The most common source of interruptions is interactions with other nursing staff seeking information or assistance with patient care. The frequency of interruptions by other care providers varied significantly across studies. Although they were not the most frequent source of interruptions, phone calls were identified by nurses as one of the most disruptive sources of interruptions and one of the most likely sources of interruptions to be associated with medication errors. System failures such as missing medications and access to equipment and supplies were also identified as sources of interruptions that are potentially avoidable. Other avoidable interruptions cited in the literature are the tendency of nurses to interrupt each other with conversations unrelated to medication administration while preparing medications and to respond immediately to requests from others when interrupted. These findings support the idea that interruptions are an accepted part of nursing practice and suggest the

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need for culture change to limit avoidable interruptions, especially during complex or high-risk activities such as medication administration.

Development and testing of strategies to limit interruptions during the medication administration process are primarily based on research from the aviation industry. In 1981, the Federal Aviation Authority mandated use of standard operating procedures to create a sterile cockpit situation aimed at reducing unsafe working conditions and preventing errors during high-risk activities such as aircraft takeoff and landing. Essential aspects of the sterile cockpit concept include eliminating interruptions, prohibiting communication unrelated to critical tasks, and maximizing teamwork and coordination during high-risk activities.21,22 The majority of published clinical initiatives to limit interruptions during medication administration are nurse-led quality improvement projects involving implementation of a set of strategies to limit interruptions (Table 1). The goal of these initiatives is to provide nurses with time to remain focused and undisturbed while preparing and administering medications. Direct observations of nurses preparing and administering medications during peak, scheduled administration times were used to study interruptions in these quality improvement projects. Results of these projects demonstrate that implementation of a set of strategies is effective in limiting interruptions and may improve patient safety by decreasing medication errors.

To date, 1 study3 examining the direct relationship between work interruptions and hospital medication administration errors has been published. Results of this landmark study demonstrated that the frequency of interruptions during medication administration increased the risk of both the number and severity of medication errors. Table 2 provides a detailed analysis of the literature regarding cognitive work of nurses and the complexity of the work environment, interruptions during medication administration, strategies used to limit interruptions during medication administration, and the contribution of interruptions to medication errors.

### Introduction to the Progressive Cardiac Care Quality Improvement Project

The PCCU quality improvement project was developed and implemented on the basis of the work of Nguyen and colleagues.25 In the quality improvement project presented here, the project team implemented a set of evidence-based strategies to limit interruptions during scheduled, peak medication administration times in the progressive cardiac care setting. The project team embedded the interruption strategies into practice guidelines to promote communication, coordination of care, and teamwork during medication administration. The guidelines are referred to as the “NUPASS guidelines,” on the basis of the project’s name: Nurses Uninterrupted Passing Medications Safely (Table 3).

The project’s conceptual framework is based on the medical center’s Evidence-Based Practice (EBP) Model (Figure 1). The EBP model was adopted and modified on the basis of the Iowa model.30 Using the EBP model as a guide, the project team initiated a pilot practice change based on the current evidence supporting use of strategies to limit interruptions during medication administration. The pilot practice change was designed to answer 2 questions: (1) Does implementation of the NUPASS guidelines decrease interruptions during medication administration? and (2) Do medication errors decrease following implementation of NUPASS guidelines? The pilot practice change was conducted on 2 of the 3 PCCUs; PCCU1 and PCCU2 were the intervention units that implemented the NUPASS guidelines, and PCCU3 served as a comparison unit.

Patients cared for in the high-acuity PCCUs typically included patients who required invasive diagnostic and interventional cardiovascular procedures, cardiovascular surgery, and arrhythmia management. Common medical diagnoses included acute coronary syndrome, heart

### Table 1: Evidence-based strategies to limit interruptions during medication administration

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<th>1. Hourly patient rounds23</th>
<th>2. Scripts for triage of phone calls17,22,24-26</th>
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<td>3. Protected time for passing medications without interruptions17,22,25</td>
<td>4. Signage to remind staff to limit interruptions12,17,22,24-26</td>
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<td>5. “No interruption zone”/“quiet zone” established in medication rooms17,24-27</td>
<td>6. Phone calls to nurses limited during medication administration17,25</td>
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<td>7. Nurses don visible wear as a nonverbal cue that they are administering medications and are not to be disturbed12,17,22,26</td>
<td>8. Distribution of patient/family education materials about limiting interruptions during medication administration12,17</td>
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### Table 2 Detailed review of the literature

<table>
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<tr>
<td><strong>A. Cognitive work of nurses and complex work environment</strong></td>
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<tr>
<td>Potter et al,4 2005</td>
<td>Convenience sample of 7 nurses with acute care experience and clinical background Large, tertiary medical center in the Midwest</td>
<td>Mixed method ethnographic observational study combining quantitative human factor engineering techniques with summative nurse interviews Nurses were observed for a total of 48 h</td>
<td>Analyze nurses’ cognitive work and how environmental factors create disruptions that pose risk for medical errors</td>
</tr>
<tr>
<td>Eisenhower et al,11 2007</td>
<td>Convenience sample of 40 nurses working in intermediate medical-surgical intensive care unit (M/S ICU) and ante/postpartum unit Large, tertiary teaching hospital in the Northeast</td>
<td>Descriptive study with semistructured interviews</td>
<td>Describe nurses’ thinking during medication administration before and after implementation of bar-code medication scanning (point-of-care technology)</td>
</tr>
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<td>Kalisch and Aebersold,5 2010</td>
<td>Convenience sample of 36 nurses from 5 M/S units, 1 ICU, and 1 progressive care unit Seven patient care units in 2 Midwestern hospitals including an academic medical center and a community-based teaching hospital</td>
<td>Observational study A previously validated instrument referred to as the “Communication Observation Tool” was used by 4 trained staff nurses to collect data For the purpose of this study, both procedural failures and medication administration errors were counted as errors</td>
<td>Evaluate the type and extent of work interruptions, multitasking, and errors</td>
</tr>
<tr>
<td>Cornell and Riordan,6 2011</td>
<td>Convenience sample of 19 nurses from 2 hospitals including 8 nurses on an M/S unit at a suburban, acute care hospital and 11 nurses on a pediatric oncology unit at a pediatric research hospital in the United States</td>
<td>Observational study limited to nursing activities outside of the patient’s room during 85.2 h of observation</td>
<td>Assess the complexity of nurse workflow and review its cognitive implications</td>
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<td><strong>B. Interruptions during medication administration</strong></td>
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<tr>
<td>Kreckler et al,4 2008</td>
<td>Convenience sample of nurses working on a 37-bed surgical unit at a teaching hospital in the United Kingdom</td>
<td>Observational study Thirty-eight medication passes were observed in 5 weeks</td>
<td>Determine the time required by nurses to deal with interruptions and the nature of nurses’ work interruptions (WIs) during medication administration</td>
</tr>
<tr>
<td>Biron et al,7 2009</td>
<td>Convenience sample of 18 nurses working on a medical unit at a tertiary care teaching hospital in Quebec</td>
<td>Observational study Descriptive data included source and duration of interruptions, nursing tasks and location during interruptions and strategies used by nurses to manage interruptions</td>
<td>Document characteristics of nurses’ WIs during medication administration</td>
</tr>
<tr>
<td>Palese et al,8 2009</td>
<td>A convenience sample of nurses working on 7 surgical units across multiple, similar type hospitals in Northern Italy</td>
<td>Mixed-method study combining observation of nurses during medication administration followed by nurse interviews during a 3-month period</td>
<td>Examine the frequency and perceived risk of WIs during medication administration</td>
</tr>
<tr>
<td>Biron et al,11 2009</td>
<td>Articles from 1980 to 2008 were analyzed</td>
<td>Systematic review Fourteen of 23 studies selected for analysis reported observation times and interruption frequencies and therefore, underwent further analysis</td>
<td>Review the evidence on nurses’ interruption rates, characteristics of WIs, and contribution of WIs to medication administration errors</td>
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### Findings/conclusions

Nurses averaged 9 cognitive shifts per hour or a shift in attention focus once every 6-7 min. The human factor engineer found 5.9 interruptions per hour and the nurse researcher found an average of 3.4 interruptions per hour. Twenty-two percent of interruptions occurred in the medication room during medication preparation, and no attempt was made by nurses to control sources of the interruptions.

Nurses’ constant vigilance to provide the appropriate medication was a common theme found in the content analysis. Nurses’ thinking was categorized into 10 descriptive categories; the only change in thinking after implementing bar-code scanning was the descriptive category related to checking medications.

Key aspects of critical thinking identified included assessment of the patient before and after administration of medications, interpretation and verification of relevant laboratory data, application of knowledge to specific patient situations, anticipatory problem solving related to the patient's expected clinical trajectory, and consultation with health care team members to prevent medication errors and adverse drug events.

The mean interruption rate observed at the 2 hospitals was 10 interruptions per hour resulting in a break in task more than 1/3 of the time. Interruptions occurred every 6 minutes for hospital 1 and every 4.5 min for hospital 2; nurses were interrupted during medication administration 57% and 36% of the time in hospital 1 and hospital 2, respectively. Nurses engaged in multitasking an average of 30% and 40% of the time in hospital 1 and hospital 2, respectively.

Significantly more interruptions ($P < .001$), multitasking ($P < .001$), and breaks in task ($P < .001$) occurred in ICUs than in the M/S units. No more errors were found when nurses were interrupted or multitasking vs when nurses were not interrupted or multitasking.

More than 2000 tasks were recorded on each unit during 35.7 h of observation on the M/S unit and 49.5 h of observation on the pediatric oncology unit. The duration of tasks was short with a mean of 62.4 (SD, 127.7) s and 49.5 (SD, 81.6) s on the M/S unit and pediatric oncology unit, respectively. The reason for switching tasks (self-directed or external) was not discernible.

Nurses frequently changed locations when switching tasks.

Medication passes were interrupted a mean of 11% of the time. Two-thirds of the medication passes were interrupted with a mean of 2.61 interruptions per medication pass. The 3 most frequent sources of interruptions in descending order were (1) interruptions by the nurse administering medication (self-initiated), (2) interruptions by physicians, and (3) interruptions by other staff and patients. Phone calls were not the most frequent source of interruption; however, they were found to be significant because of their longer duration.

WIs averaged 6.3 per hour (5.2 per hour during medication preparation and 6.8 per hour during medication administration). WIs were of short duration with a mean of 1 min 32 sec (SD, 2 min). The most frequent WIs during medication administration were self-initiated and by patients during direct patient care activities. Nurses handled WIs immediately more than 98% of the time; the proportion of WIs handled immediately was similar during both medication preparation and administration (98.8% and 97.6%, respectively).

A mean of 1 interruption per 3.2 drugs administered occurred during medication administration. When there was an increased number of drugs per medication pass for a single patient, the number of interruptions increased significantly ($P = .05$).

Nurses intervened immediately when interrupted 96% of the time. Nurses perceived interruptions related to management of phone calls to be the highest risk for error during medication administration.

Pooled data from 14 studies found WIs occurred at a rate of 6.7 interruptions per hour. The majority of interruptions were self-initiated by nurses administering medications during face-to-face interactions, occurred most frequently during direct patient care, and were of short duration ranging from 45 sec to 1.2 min. Only 1 nonexperimental study documented the contribution of interruptions to medication errors with evidence of a significant association ($P = .01$).

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<td>Pape,²² 2003</td>
<td>Convenience sample of M/S unit nurses were observed during a single medication pass for assigned patients in a 520-bed acute care hospital in Texas</td>
<td>Quasi-experimental 3-group study design including a comparison group and 2 intervention groups. A validated instrument referred to as the Medication Administration Distraction Observation Sheet (MADOS) was used to count distractions.</td>
<td>Test the effectiveness of 2 interventions (“focused” protocol and “medsafe” protocol) to reduce distractions during medication administration in comparison to usual practice. Determine which distractors are more predictive of nurses being distracted during medication administration.</td>
</tr>
<tr>
<td>Nguyen et al,²⁵ 2009</td>
<td>Forty-five nurses working on a 25-bed M/S unit at an academic teaching hospital in Northern California. The project was conducted in partnership with a larger quality improvement (QI) initiative sponsored by the Integrated Nurse Leadership Program aimed at improving patient safety and involved 7 hospitals in the San Francisco Bay.</td>
<td>A longitudinal observational QI project. One hundred medication passes were observed before the intervention and at 6 months and 1 year after the intervention.</td>
<td>Evaluate whether a safety initiative referred to as the “Med Pass Time Out” was effective and sustainable in reducing medication administration errors.</td>
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<td>Anthony et al,²⁷ 2010</td>
<td>Convenience sample of medical ICU and surgical ICU nurses working in a tertiary academic medical center in Cleveland, Ohio.</td>
<td>Observational pilot project. A “no interruption zone” (NIZ) was created by placing red tape around all medication preparation areas to signify that nurses were not to be disturbed while preparing medications. The number of interruptions before and 4 weeks after the NIZ was implemented were measured. Nurses observed were blinded to the purpose of the study.</td>
<td>Evaluate the effect of a NIZ on the number of interruptions during medication preparation.</td>
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<td>Freeman et al,¹⁷ 2013</td>
<td>Convenience sample of 99 nurses in a cardiac and thoracic surgical step-down unit at a large, academic medical center in the Midwest.</td>
<td>Observational QI project. A modified version of the MADOS instrument was used to count the number and type of interruptions.</td>
<td>Determine whether implementation of a set of interventions would reduce interruptions during medication administration. A secondary project goal was to reduce medication errors. Interventions implemented were previously described in the literature, including wearing a lighted lanyard during medication administration, triage of phone calls, creating an NIZ in the medication preparation area, signage, and staff and patient/family education.</td>
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<td>Williams et al,²⁶ 2014</td>
<td>Convenience sample of nurses working in a surgical progressive care unit (52 before intervention and 48 after intervention). Academic medical center in the southeastern United States.</td>
<td>Observational study. Distractions and interruptions were measured using the MADOS instrument before and 2 months after implementation of 5 evidence-based safety strategies including nursing staff education, use of a medication safety vest, NIZ in medication preparation areas, signage on the unit and patient rooms, and a resource tool for scripting responses to interruptions.</td>
<td>To evaluate the effectiveness of implementing 5 evidence-based safety strategies to reduce distractions and interruptions during medication preparation.</td>
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Findings/conclusions

Significant differences in the mean number of distractions were found between the comparison group and both intervention groups (\( P < .001 \)) as well as between the 2 intervention groups (“focused” protocol \( P = .01 \) and “medsafe” protocol \( P < .001 \)). The significant difference between the 2 intervention groups was attributed to use of a visible symbol that the nurse wore during medication administration (a red vest with the lettering “Medsafe Nurse, Do Not Disturb”). Conversation accounted for the majority (93%) of the variance in distractions, followed by interruptions by personnel (90%) and loud noises.

Uninterrupted time increased from 81% to 99% of the time at 6 months and 1 year after implementation of the “Med Pass Time Out.” Medication errors decreased from 2% to 1% at 6 months and improvement was sustained at 1 year. No statistical analysis.

The number of interruptions decreased by 40.9% (from 31.8% to 18.8%) after implementation of the NIZ (\( P = .03 \)). The proportion of interruptions initiated by nurses preparing medications (self-initiated interruptions) decreased from 25% to 0% following implementation of the NIZ.

Mean number of interruptions decreased from 3.29 to 1.18 during medication administration. Medication errors decreased by 28 events when compared with the same time period the year before. Patients, nurses, and patients’ family members represented the top 3 sources of interruptions before implementing interventions to reduce interruptions; 1 month after implementation of the interventions, no interruptions were made by family members. No statistical analysis.

Four types of distractions and interruptions decreased significantly after implementation of the safety strategies including those initiated by (1) physicians, nurse practitioners, and physician assistants (\( P = .001 \)), (2) phone calls and pages (\( P = .001 \)), (3) other personnel (\( P < .001 \)), and (4) conversations unrelated to medication administration (\( P = .002 \)). Nurse were not found to be compliant with wearing the safety vest or using the resource tool when responding verbally to interruptions but were compliant with use of signage and the NIZ when preparing medications.
Table 2  Continued

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<td>Westbrook et al.3, 2010</td>
<td>Convenience sample of 98 nurses from 6 units at 2 major teaching hospitals in Sydney, Australia</td>
<td>Observational study A total of 505 hours of observation was conducted during an 18-month period</td>
<td>Examine the direct relationship between WIs and hospital medication administration errors</td>
</tr>
<tr>
<td>Hopkinson and Jennings,29, 2013</td>
<td>A total of 31 articles published between 2001 and 2011 were selected for analysis, including 12 that specifically examined nurse WIs during medication administration Studies were conducted in 7 countries, including 14 studies conducted in US acute care facilities</td>
<td>Systematic review Most studies used a nonexperimental design and involved direct observation methods for data collection</td>
<td>Examine empirical evidence from studies of nurse WIs in the acute care setting</td>
</tr>
<tr>
<td>Raban and Westbrook,21, 2014</td>
<td>Ten studies meeting inclusion criteria and published up to September 2012 were analyzed Eight of the 10 studies were published in North America All studies used direct observation for data collection, but studies were not limited to the acute care setting</td>
<td>Systematic review Studies included for analysis were observational studies that reported quantitative data on interruptions or medication administration errors with a pre- and postintervention design or use of a comparison group Studies included were not limited to the acute care setting</td>
<td>Assess evidence of the effectiveness of interventions aimed at reducing interruptions during medication administration on interruption and medication administration error rates</td>
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Table 3  Nurses Uninterrupted Passing Medications Safely (NUPASS) guidelines

Before administering medications
1. Nurses update the charge nurse (CN) before administering medications if there are changes in patients’ status that affect scheduled procedures or transport needs; otherwise, nurses simply place a colored magnet next to their name on the assignment board (board in clear view at the front desk) to indicate that they are administering medications.
2. Nurses dock their phones just outside the medication room before entering to prepare medications. Docked phones are programmed to forward all calls to the front desk.
3. Nurses don a yellow safety sash before leaving the medication room to administer medications.

After administering medications
1. Once medication administration is compete, nurses return their yellow safety sash to the medication room, pick up their docked phone, remove the colored magnet from the assignment board, and check at the front desk for any new messages recorded on a communication log.

General practice progressive cardiac care unit (PCCU) guidelines
1. Nurses perform hourly rounds on odd hours (corresponds with peak, scheduled medication times). Patient care assistants (PCAs) perform hourly rounds on even hours.
2. Phone and face-to-face requests by family for patient information are screened for a password in accordance with the medical centers’ policy for compliance with the Health Insurance Portability and Accountability Act (HIPAA) before contacting the assigned nurse.
3. Nursing staff use key phrases to respond to nonemergent requests or inquiries: “For the safety of our patients,” we do not interrupt the nurse while administering medications. Is there something I can help you with?
4. Unit secretaries refer requests/inquiries to the CN only in situations where they cannot triage or manage the communication themselves.
5. Prespecified peak, scheduled medication administration times for “no interruption” except emergencies: 5 AM-7 AM, 8 AM-10 AM, and 8 PM-10 PM. Emergencies include imminent patient safety concerns, patients’ request for pain medication, emergency response to cardiac arrhythmia alert, need to communicate information only assigned nurse has specific knowledge of in a critical event, rapid response, or cardiopulmonary arrest of assigned patient.
6. Signage on closed medication room door reminds staff that medication room is a “quiet zone.”
7. “No interruption zone” (NIZ) outlined on floor in the medication room next to the medication storage/delivery system.
8. “Daily Patient Care Activity Flowsheet”: Day-shift CN receives a brief report on each patient from the assigned nursing staff, including scheduled procedures and patient transport needs for the next 24 hours before 8 AM daily during “huddle-up.” This information is logged by the day-shift CN on a structured daily flow sheet and is updated by the evening and night CNs on the basis of the corresponding shift reports by nursing staff to assist with coordination of patient care activities.
9. “Communication log”: used to document nonurgent messages while nurses are administering medications.
10. Patient/family education tool: written patient/family education provided on admission to help explain the pilot practice change.
failure, and uncontrolled atrial fibrillation. Patient care was delivered by nursing staff including registered nurses and certified nursing assistants referred to as patient care associates (PCAs). The nurse to patient ratio was 1 to 4 on the day and evening shifts and 1 to 5 on the night shift. The number of beds on each unit was from 36 to 46, and the daily patient census was from 34 to 39. Technology used to support the medication administration process at the time of the pilot practice change included a centralized medication storage system, computer physician order entry, and electronic medication administration record. Bar-code scanning of medications was not available at the time of the pilot practice change. Geographic differences in the layout of the PCCUs included the number of medication rooms and the number of semiprivate versus private patient rooms. The project team for the pilot practice change consisted of 5 bedside nurses from the PCCUs, an advanced practice nurse, and a nurse researcher.

Methods
Data Collection

The pilot practice change was conducted for 18 months. The baseline percentages of interruptions and medication errors were measured in July 2009, and these measures were repeated after implementation of the NUPASS guidelines in December 2010 (Figure 2). A convenience sample of nurses from each PCCU was randomly observed during peak, scheduled medication administration times. Nurses were aware of being observed during data collection. Data collectors used the following script to explain why they were conducting observations during medication administration:

We are conducting a quality improvement project to identify opportunities to improve patient safety during medication administration. All data [are] being collected anonymously and [do] not include the identity of the nurses being observed during medication administration.

Observations were conducted during prespecified times (5 AM - 7 AM, 8 AM - 10 AM, and 8 PM - 10 PM). The number of observations conducted for each prespecified time was based on the mean number of medications scheduled during these peak administration times. The project team staff nurses collected all data and observed medication passes on PCCUs other than their own. Two standardized data collection tools referred to as the Medication Administration Accuracy Observation

Findings/conclusions

Each interruption was associated with a 12.1% increase in procedural failures and a 12.7% increase in medication errors. The frequency of interruptions during medication administration increased the risk of both the number and severity of medication errors. The estimated risk of a major error, defined as an error most likely to cause harm, permanent damage or death, doubled from 2.3% with no interruption to 4.7% with 4 or more interruptions during administration of scheduled medications to a single patient.

The evidence for reducing medication errors by limiting interruptions remains at the level of descriptive research because the majority of projects were nurse-led QI projects. Interpretation of results was limited because of the different methods used for unit sampling, measuring, and defining interruptions.

Five studies had statistically significant changes in the number of interruptions before and after implementation of a set of interventions; interruptions decreased in 4 studies and increased in 1 study. The 3 studies that measured changes in medication error rates showed reductions, but all 3 studies implemented multiple interventions besides those aimed at reducing interruptions. Weak evidence of the effectiveness of interventions intended to reduce interruptions and medication error rates exists primarily owing to the small number of studies, and the lack of robust study design, appropriate statistical analyses, and small sample size.
Code Sheet and the Medication Administration Accuracy Record Review Worksheet developed by the California Nursing Outcomes Coalition (CALNOC) were modified and adapted for use with written permission of CALNOC (March 26, 2009). Before implementation of the pilot practice change, an interrater reliability study involving 30 observations (10 per unit) was conducted to establish agreement among trained data collectors and resulted in 96% agreement. Operational definitions used for the purposes of data collection during the pilot practice project are listed in Table 4.

During observations, the data collectors were blinded to the electronic medication orders to prevent confirmation bias. The Medication Administration Accuracy
Observation Code Sheet is a flowsheet used to record each medication administered during the observation period and to tally each interruption observed during the medication pass. Data collectors used the Medication Administration Accuracy Observation Code Sheet to record each medication administered, including the medication name, dose, route, and the time the medication was administered to the patient. Data collectors were trained to record the reason for all interruptions observed by using a free-text, narrative approach. The project team planned to review the reasons for interruptions after completion of the project and based on post-hoc analysis, develop a scheme for categorizing the sources of interruptions.

The Medication Administration Accuracy Record Review Worksheet is a flowsheet used to identify medication errors retrospectively by comparing medications administered during the observation period with scheduled medication orders on the electronic medication administration record for the same time period.
Following the observed medication passes, data collectors used the Medication Administration Accuracy Record Review Worksheet to reconcile the electronic medication orders with the medications actually administered to the patients to identify medication errors. The number and type of medication errors identified were recorded on the data collection tool, including wrong drug, dose, form, route, and technique and omission of drug dose errors.

**Communication Strategies**

Once baseline data collection was complete on all 3 units, the project team trained the PCCU1 and PCCU2 nursing staff how to implement the NUPASS guidelines. Staff members were trained to use communication scripts to respond to nonemergent requests when nurses were passing medications. The communication script simply stated, “For the safety of our patients, the nurses are not interrupted while passing medications. Is there something I can help you with?” Use of the phrase “for the safety of our patients” was essential to avoid misconceptions that the nurse was just “too busy” to speak to them. The unit secretary managed most communication with visitors and requests for clerical assistance from physicians and other health care providers while the charge nurse was responsible for addressing patient care issues with physicians and other care providers. The nursing staff was provided with operational definitions of emergencies as part of the NUPASS guidelines; however, because no guidelines address all situations, the members of the nursing staff were coached to consider if a safety concern existed before deciding whether or not to interrupt a nurse during a medication pass.

The nurses and PCAs coordinated patient care activities by alternating hourly patient care rounds to ensure that the timing of nursing rounds corresponded to the peak times for administering scheduled medications. Purposeful, hourly rounding has been demonstrated to decrease patients’ use of call lights and was a best practice established on the PCCUs before the pilot project change. However, as part of the pilot practice change, nurses wore a yellow safety sash during scheduled, peak medication administration times as a visible sign that they were passing medications and were not to be disturbed. Before beginning the medication pass, nurses also placed a colored magnet next to their name on the assignment board to alert other care providers that they were in the process of passing medications. Because the PCCU assignment boards were in clear view from the centralized nursing stations, this tactic provided another visible sign to alert others of the medication pass. Once nurses were done administering medications, they removed their yellow safety sash, picked up their docked phone, removed the magnet from the assignment board, and checked with the charge nurse for any logged messages or updates.

**Educational Strategies**

Unit staff, physicians, and other care providers hospital-wide were educated on the pilot practice change, including the purpose of the project and instructions for communicating and coordinating care during scheduled, peak medication administration times. Care providers from numerous departments (pharmacy, rehabilitation, nutrition, cardiodiagnostics, emergency, and transportation service) were educated in 6 months. Education strategies included staff newsletters tailored to specific departments, poster presentations, unit-based in-service training programs, and presentations at scheduled staff and physician meetings. Upon admission to PCCU1 and PCCU2, a patient-specific newsletter (Table 5) was used to educate patients and their families about the pilot project change.

**Results**

During the pilot practice change, 130 medication passes were observed on the 3 PCCUs, including 64 medication passes before and 66 medication passes after guideline implementation. During the 130 medication passes, nurses were observed administering 631 medications: 316 medications before and 315 after guideline implementation. The mean number of medications administered per patient was 4.10, and the mean duration of medication passes was 11.69 minutes. Neither the mean number of medication doses nor the duration of medication passes differed significantly between units before or after guideline implementation.

**Interruptions**

To answer the first question, the percentage of interruptions decreased significantly in 1 of the 3 PCCUs after...
You may hear today:
“For the safety of our patients, we do not interrupt the nurses while they are administering medications. Is there something I can assist you with?”

A team of nurses is conducting a project to improve patient safety. The purpose of the project is to increase patient safety by limiting interruptions during medication administration.

Why is this project important? Numerous studies suggest that interruptions during medication administration contribute to medication errors.

How are interruptions limited when the nurses are administering medications? Nurses will not take phone calls or respond to inquiries from others including nursing staff, therapists, physicians, patients, and families when they are administering medications except for emergencies during these times:
- 8 to 10 AM
- 8 to 10 PM
- 5 to 7 AM

How will I know when the nurse is administering medications?
Nurses will wear a yellow safety sash to signify that they are administering medications and are not to be interrupted. Limiting interruptions allows the nurses to keep their attention focused on medication administration and the needs of the each patient who is receiving medications.

What if I need to communicate with my nurse?
- The phone numbers of your nurse and patient care assistant (“PCA”) are posted on your communication board. You can call them directly to avoid waiting for your call light to be answered.
- When your nurse is administering medications, his/her calls will be automatically forwarded to the front desk for further assistance.
- The nurse and the PCA take turns rounding at your bedside hourly to offer assistance so that your needs are met promptly.
- If you need help to the bathroom, with bathing, or need something to drink or eat, you can call your PCA.

Who can I talk to if I have more questions about the project? Your nurse will be able to answer most questions. Please also feel free to direct any questions or comments to the Manager or Advanced Practice Nurse during their daily rounds. This project is a team effort, and we need your help and support to make it a success!

Thank you from the project team!

Table 5 Patient medication safety newsletter

Table 6 Interruptions before and after Nurses Uninterrupted Passing Medications Safely (NUPASS) guidelines were implemented

<table>
<thead>
<tr>
<th>Progressive cardiac care unit (PCCU)</th>
<th>Before NUPASS</th>
<th>After NUPASS</th>
<th>P</th>
</tr>
</thead>
<tbody>
<tr>
<td>PCCU1 (intervention unit)</td>
<td>22/95 (23%)</td>
<td>5/113 (4%)</td>
<td>&lt;.001</td>
</tr>
<tr>
<td>PCCU2 (intervention unit)</td>
<td>25/118 (21%)</td>
<td>22/99 (22%)</td>
<td>.46</td>
</tr>
<tr>
<td>PCCU3 (comparison unit)</td>
<td>10/103 (10%)</td>
<td>15/103 (15%)</td>
<td>.24</td>
</tr>
</tbody>
</table>
Avoidable interruptions decreased from 18 to 3 (83%) in PCCU1 and from 19 to 9 (53%) in PCCU2 while avoidable interruptions in PCCU3 increased from 7 to 12 (71%) after implementation of the NUPASS guidelines (Figure 4). Although PCCU2 did not show a statistically significant decrease in the total percentage of interruptions following implementation of the NUPASS guidelines, the unit was successful in decreasing avoidable interruptions by more than half. Unavoidable interruptions decreased from 4 to 2 (50%) in PCCU1, increased from 6 to 14 (133%) in PCCU2 and increased from 1 to 2 (100%) in PCCU3 after implementation of the NUPASS guidelines.

**Medication Errors**

To answer the second question, the percentage of medication errors decreased in all 3 PCCUs after implementation of the NUPASS guidelines (Table 7). A statistically significant decrease in the percentage of medication errors was found in 1 of the 2 intervention units and in the comparison unit. The percentage of medication errors in PCCU1 decreased from 11% to 3% after the guidelines were implemented ($P = .02$). Although the percentage of medication errors in the second intervention unit (PCCU2) decreased from 2% to 1%, the number of observations conducted was not powered to demonstrate a statistically significant change between such low percentages of medication errors. An unanticipated finding was a significant decrease in the percentage of medication errors ($P = .01$) in the comparison unit (PCCU3).

**Discussion**

Consistent with the findings of numerous published studies, nurses observed during the pilot practice change were frequently interrupted during medication administration.\(^6\,^8\,^{11,12}\) In addition, results of the pilot practice change support earlier reports that the majority of interruptions during medication administration are avoidable and may lead to adverse consequences for patients.\(^{16,31}\) The greatest impact of implementing the NUPASS guidelines was the significant decrease in avoidable interruptions, particularly those related to phone...
calls. Successfully decreasing interruptions related to phone calls was highly dependent on teamwork and highlights the important role of support staff in prioritizing and managing phone calls during peak scheduled medication administration times.

An important paradigm shift for PCCU nurses was to assume accountability for interruptions, including avoiding social chatter in the medication room and delegating or deferring tasks when appropriate to maintain a concentrated focus on medication administration. The pilot project team identified differences in unit culture, workflow demands throughout the 24-hour period, visibility of leadership, and informal leadership support on each shift as factors that may have influenced nursing staff buy-in and adherence to the NUPASS guidelines. Adherence to the guidelines by physicians, other care providers, and patients was greatly enhanced by education and the use of key messages. The most important message for gaining cooperation and support from physicians was that the practice change was to help “manage” rather than limit communication among care providers.

The responses of patients and their families were overwhelmingly positive when the pilot practice change was introduced, and they often shared how impressed they were that the staff took the patients’ safety so seriously. However, the fact that the number of patient-related interruptions remained the same before and after implementation of the NUPASS guidelines suggests the need to reinforce patient education about the pilot project change throughout the hospital stay such as signage in the patients’ rooms and verbal reminders. Although no clinically significant difference was found in unavoidable interruptions before and after implementation of the NUPASS guidelines in PCCU1 or PCCU3, a large increase in unavoidable interruptions occurred in PCCU2 after guideline implementation; that increase was attributed to orientation and training of newly hired nurses during this period.

Medication Errors

It is not clear why the percentage of medication errors in PCCU2 was lower than in the other 2 units at baseline. The only observable difference between units was that PCCU2 has 2 centralized medication rooms compared with only 1 such room on the other 2 PCCUs. In addition, the finding that the percentage of medication errors decreased significantly after guideline implementation in the comparison unit (PCCU3), independent of the percentage of interruptions, highlights that numerous factors besides interruptions affect patient safety outcomes.

Sustainability of the Pilot Practice Change

The Institute of Medicine recommends that nurses be observed periodically to measure actual medication errors rather than relying completely on voluntary reporting of medication errors. Observation methods to measure medication errors are useful for overcoming pitfalls of traditional event reporting, including underreporting of errors. However, direct observation to measure interruptions and medication errors is time- and resource-intensive because it requires trained data collectors and coordination of data collecting activities. A novel quality improvement approach used at Stanford Health Care for ongoing measurement of interruptions and medication errors shared by Elisa E. Nguyen (e-mail communication, May 22, 2015) is to observe nurses administering medications as part of regularly scheduled hospital prevalence studies. Regardless of the method used for collecting interruption and medication error data, ongoing monitoring for quality improvement and regular, timely feedback to nursing staff regarding measured outcomes is essential to promote a culture of safety and sustain results in high-reliability organizations.

After the official project was completed, the NUPASS project team was not able to continue the quality improvement monitoring activities to evaluate the sustainability of the outcomes associated with the pilot practice change because of time constraints, nursing staff turnover, and lack of funding. Lack of a sustainability plan for this project resulted in a drift back to former practice and is consistent with the findings of Freeman and colleagues, who evaluated the use of a similar set of strategies to limit interruptions in a single progressive care unit. However, in July 2014, a modified version of the pilot practice change was implemented in all patient care units as a best practice with the leadership support of the medical center’s chief nurse executive. A major change in the guidelines is that the yellow safety sash has been replaced by a hand-held...
bar-code scanner as a visible sign that the nurse is administering medications and is not to be disturbed.

Limitations of the Pilot Practice Change

Although approximately one-third of the PCCU nurses participated in the project, use of a convenience sample of nurses limits the representativeness of the sample. Second, observations were limited to 3 specialty units at a single site, preventing generalization of the findings to other patient populations and health care settings. Third, because the nurses were aware that they were being observed, they may have followed administration safety practices more consistently, leading to fewer medication errors (Hawthorne effect). Finally, the comparison unit (PCCU3) was restructured after the baseline data were collected for the pilot practice change. The restructuring involved cohorting cardiovascular surgical patients at a lower nurse to patient ratio; both of these factors limit the use of PCCU3 as a comparison unit.

Last, for the purposes of this project, the definition of medication errors was limited to administering medications as ordered by the physician. However, progressive care nurses continuously make clinical judgments about the appropriateness of carrying out medication orders. These judgments are based on the patient’s clinical status, relevant laboratory data, and contraindications related to risks of complications associated with diagnostic and interventional procedures. The critical thinking and decision-making processes involved in making these judgments represent important monitoring and surveillance activities nurses use to keep patients safe regardless of the prescribed medication order.

Conclusions

Results of the NUPASS pilot practice change demonstrate that using evidence-based strategies to limit interruptions during medication administration in the progressive cardiac care setting decreases avoidable interruptions and promotes patient safety. Recognizing medication administration as a high-risk activity is critical to transforming the culture and engaging nursing staff to promote the kind of teamwork necessary to limit avoidable interruptions during medication administration. In this pilot practice change, we evaluated the impact of limiting interruptions during medication administration during scheduled, peak administration times. The impact of limiting interruptions on medication errors during unscheduled administration of medications including as-needed medications and initiation and titration of high-risk intravenous infusions (eg, antiarrhythmic and inotropic agents) administered in the progressive care setting warrants further study.

Although no “magic bullet” is available to prevent medication administration errors, the outcomes of this project support the use of evidence-based strategies to limit interruptions during medication administration as part of a comprehensive medication safety program. Bedside nurses have little control over the physical layout of the patient care unit, the nurse to patient ratio, or access to technological advances to prevent medication errors; however, they can successfully affect the work environment to promote patient safety with little or no cost to the organization by adopting evidence-based strategies to limit work interruptions during high-risk activities such as medication administration.

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None reported.

Letters
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References


