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INEFFICIENCY IN THE POST ANESTHESIA CARE UNIT:
A QUALITY IMPROVEMENT INITIATIVE

By

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MM, Johns Hopkins University, 2009

CAPSTONE PROJECT

Submitted to the University of New Hampshire

in Partial Fulfillment of

the Requirements for the Degree of

Master of Science

in

Nursing

September, 2015

This Capstone Project has been examined and approved.

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Date

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Dedication

This project is dedicated to my grandfather, Warren L. Clifford (1932-2014), who inspired me to become a nurse.

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ABSTRACT

Inefficiency in the Post Anesthesia Care Unit:
A Quality Improvement Initiative
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September, 2015

Background: The post anesthesia care unit (PACU) is a busy environment in which nurses communicate with patients, family members, and a large team of perioperative professionals. PACU nurses were experiencing an unmanageable number of work interruptions due to a higher patient census which increased the daily surgical caseload.

Aim: The purpose of this project was to improve efficiency and nurses' job satisfaction by making work interruptions manageable in the PACU.

Methods: Based on Kotter's Change Theory, a quality improvement initiative was implemented using a change in the communication process. Qualitative and quantitative data was gathered in the PACU and on other units with the intervention roll-out. A pre and post-intervention survey was used to evaluate work interruptions and their effects experienced by nurses in the PACU environment.

Results: The use of communication technology impacted work interruptions, but not significantly enough to improve nursing efficiency and nurse satisfaction in the PACU.

Conclusion and Implications for CNL[®] Practice: The next step is to recommend adding a CNL[®] as a surgical nurse liaison (SNL) to the perioperative team. Ideally, a CNL[®] with excellent communication and quality improvement skills will exemplify the roles of lateral integrator and patient advocate to improve efficiency. This physical solution, coupled with the communicative technology tool being widely integrated to all members of the perioperative team is expected to influence work interruptions and improve nurse satisfaction more dramatically.

Keywords: post anesthesia care unit, work interruptions, nurse, efficiency, job satisfaction

**Inefficiency in the Post Anesthesia Care Unit:
A Quality Improvement Initiative**

There have been a number of recent studies regarding work interruptions in the acute care nursing environment. To date the literature has largely focused on work interruptions as they relate to medication errors, which ultimately affect patient safety. There is limited evidence specific to type and scope of work interruptions in the post anesthesia care unit (PACU) setting.

Global Problem

Hall et al (2010) quote Leape and Berwick's conclusion that "safe work performance cannot be expected from workers [...] whose job designs involve multiple competing urgent priorities" (p. 1046). Hall et al (2010) examined the outcomes of work interruptions and systems issues on patient safety; the authors concluded that nurse leaders should make system improvements to reduce work interruptions as they lead to loss of concentration and treatment delays. Yoder and Schadewald (2012) report that work interruptions contribute to medical errors, which are the 8th leading cause of death; these errors result in \$3.5 billion dollars of yearly losses for U.S. hospitals. Capasso, Johnson, and Strauss (2012) emphasize that nurses experience high stress during medication administration and are presented with increasingly frequent interruptions with the national shift towards patient-centered care. The high level of interruptions are inefficient because they do not allow nurses to meet timelines for delivery of medications (Capasso, Johnson, & Strauss, 2012). These fiscal challenges cannot be sustained if healthcare is to continue to be efficient and safe. The global aim of this quality improvement project was to explore work interruptions in a PACU with the goal of identifying ways to improve efficiency and reduce costs.

Local Problem

Of the eight types of waste in health care according to Graban (2012), work interruptions or inefficient motion is described as “unnecessary movement by employees in the system” (p. 38). “Waste interferes with us doing our work... Waste tends to be driven by the system and the design in our processes... To drive problem solving and continuous improvement, focus on the process” (Graban, 2012, pp. 46-47).

A survey conducted on May 2nd, 2015 regarding the processes at the setting of this quality improvement project, an open environment with little to no available escape from work interruptions, found that, 100% of PACU nurses *strongly agreed* or agreed that fewer work interruptions would increase their job satisfaction. See Appendix A. Staff are frustrated when they are frequently interrupted during their work and forced to either engage in interruptions or dismiss them and return to their work priority. It often takes time for the nurse to refocus after interruptions. The vast majority of PACU nurses surveyed (85%) indicated that their jobs frequently or always involve multiple competing urgent priorities. See Appendix A. Interruptions make nurses vulnerable to errors (Hall et al, 2010). PACU nursing staff and management, administration staff, OR staff, ASC staff, patients and families are affected by this problem.

Work interruptions may hinder the nurses’ ability to deliver medications and care efficiently. These inefficiencies may result in a compromise of patient safety and increase costs to the organization. A PACU is markedly different from traditional medical-surgical unit because of the physical layout which consist of bays instead of enclosed rooms. The bays may be separated by closing surrounding curtains, but they are small spaces and the curtains are only closed at the discretion of healthcare workers. This open environment makes work interruptions extremely prevalent because the nurses are constantly visible to other healthcare workers and

other patients.

In this setting there are no controls for of audible work interruptions, such as landline telephones ringing at the nurses' and providers' work stations, or devices used for necessary communication between the charge nurse and the operating rooms personnel. The landlines are centrally located in the center of the PACU and are where many calls are received from staff to maintain workflow processes such as handoff communication and bed placement in other areas of the hospital, and from the waiting area for family updates. Work interruptions can interfere with safe medication administration, compromised by the lack of a medication room and noise in the area because of foot traffic and surgical teams moving around the unit. Finally at the site of this quality improvement project work interruptions have been exacerbated by an increased patient census.

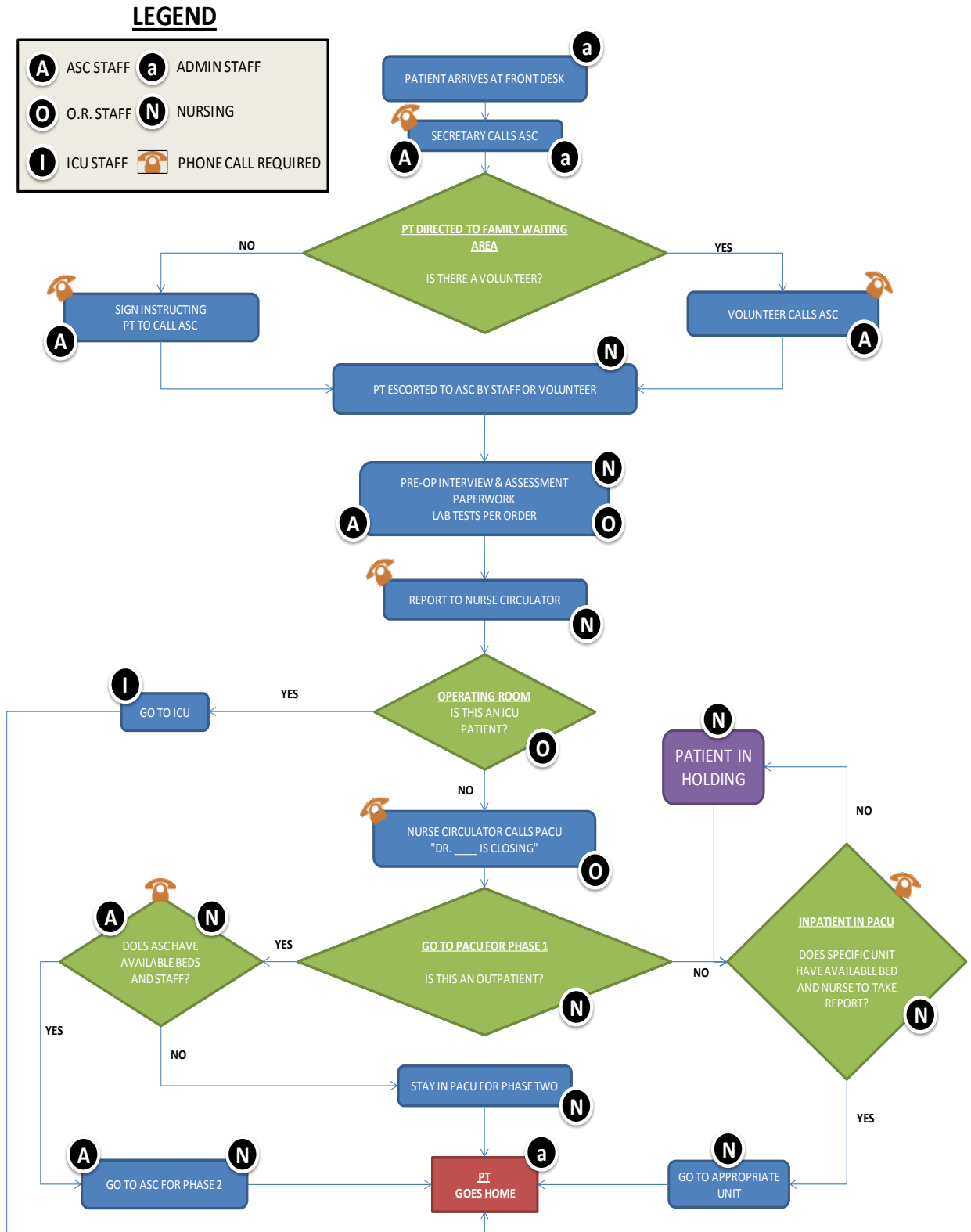
During a one month period lack of equipment as a source of work interruption and inefficiency was tracked and recorded daily for one month in a binder at the main PACU nurses' station. The number of instances when a patient came out of the operating room (OR) and into the PACU on a stretcher instead of a bed was logged with other pertinent data to present to nursing administration. The lack of equipment was observed as a large source of work interruptions, which contributed to both nurse and patient dissatisfaction. Ultimately, more beds were added to hospital circulation and the problem occurred less frequently.

A total of 25 instances were captured in the log between 3/18/2015 and 4/18/2015 where a patient was received into PACU in a physical bed instead of a stretcher. This is an issue because staff wastes motion searching for beds and additional patient transfers are a safety risk for patients and staff alike. It requires multiple staff members to transfer patients from stretchers to beds and many of these patients are morbidly obese and/or have undergone procedures where

they are ordered to have minimal physical movement (i.e. back surgery, angiogram, etc.). The number of incidents in the physical beds log dropped significantly after 10 physical beds (matching the number of available bed placements in PACU) were added to hospital circulation. Observations of other types of work interruptions prompted further inquiry.

A flow chart was created to establish the typical surgical patient flow pattern from hospital admission to discharge. The purpose of this quality improvement project was to further explore processes that contribute to work interruptions and to explore ways to reduce these interruptions within the microsystem. See Figure A.

Figure A: Patient flow surgery



Literature Review: Search Methods

The purpose of this literature review was to locate evidence-based strategies for decreasing work interruptions resulting in inefficiencies. The databases searched were PubMed Central (PMC), CINAHL, and Ebscohost. The search engines used were the US National Library of Medicine and University of New Hampshire (UNH) Library (online). The key words searched were: inefficiency nurs*, equipment lack nurs*, nurs* time equipment motion, nurs* time equipment search, nurs* work interruption, nurs* inefficien* equipment, nurs* efficien* equipment, nurs* AND time AND motion. Many of the searches produced duplicate records. Articles were selected for review based on the following limits: English language, subject of nursing, published between 2005 and 2015, conducted within an acute care setting, with a focus on inefficiency and/or lack of equipment. Hundreds of titles were screened for relevancy to the research question by title, keywords, and/or abstracts. Inclusion criteria were originally set to include only locations within the United States published in the last five years, which were expanded due to a lack of applicable results retrieved from initial searches. Exclusion criteria were as follows: articles specific to medication administration errors, care settings outside of acute hospital care, and equipment not in findings. Two studies were included based upon titles and abstracts but later excluded due to lack of access to full text. Two studies were ultimately selected from 15 records which were examined closely for their significance and relevance to the research question throughout their full text. The two selected articles were further analyzed utilizing the American Nurses Association “Framework for How to Read and Critique a Research Study” tool (Kaplan, 2011). See Appendix B.

Critical Appraisal of the Evidence

Hall et al. (2010) completed a mixed method design study of qualitative and quantitative research; the aim was “To examine interruptions to nurses’ work, the systems issues related to these and the associated outcomes” (p. 1040). The quantitative portion of the study was completed by trained researchers observing nurses’ work over two weeks; the qualitative portion was comprised of nurse focus groups.

Hall et al. (2010) found that “The discrepancies that occurred in the present study were caused by missing or misplaced supplies or equipment, while fewer resulted from the need to clarify something related to patient care as highlighted by nurses in the focus groups” (p. 1044). Hall et al. (2010) determined that “The majority of interruptions to nursing practice that were observed in the present study resulted in negative consequences (n = 11 710; 90.0%) such as delays in treatment and loss of concentration or focus” (p. 1045).

In the context of this study the lack of equipment was labeled a work interruption and grouped with other discrepancies: “missing/misplaced/broken”, or “need clarification” (Hall *et al.*, 2010, p. 1043). Future research could tease out the lack of equipment/materials with subcategories for reasons to better understand the number of instances this caused work interruptions, the total time spent, and specific opportunities for improvement. For example, what type of equipment was missing and where was it ultimately found? These questions might be worthwhile to consider on each microsystem in a needs assessment aimed at reconciling inefficiencies. The present study did not quantify time spent on interruptions which would have enhanced the strength of the research.

A notable inconsistency in this study is that two additional types of named sources of interruptions (other health care workers, and staff nurses) may have involved a lack of equipment/materials. The authors learned from the focus groups that nurses are often interrupted

by others to ask for items and assist in searching for them. This means that the outcome marked discrepancy (which includes searching for equipment) is likely underrepresented by the reported results of an overall “missing/misplaced/broken” frequency of 8.9% (Table 1, p. 1043). It is unknown how much of the combined percentage of other health care workers and staff nurses’ (26.2%+22.3%) interruptions are comprised of needs relating to a lack of equipment. Other healthcare workers’ inquiries to nurses on the microsystem level regarding equipment is a frequent occurrence observed by this student nurse on the microsystem level. This issue of categorical overlaps was not addressed by Hall et al. (2010) as a limitation in the accuracy of their results.

The objectives of the second study were multifarious—to determine the amount of time nurses spend on waste, time spent on nursing and non-nursing activities, the distance traveled in a typical shift, the efficiency of the travel, the physiologic effects of the work environment on nurses themselves, and to provide baseline data for documentation before electronic health records (EHR) were implemented (Hendrich *et al.*, 2008).

Hendrich et al. report that “Of all reported time, 6.6% (36.3 minutes) was categorized as waste. Activities within this category—many of which were ‘hunting and gathering’ behaviors—are clearly targets for improving efficiency” (2008, p. 31). In this context the lack of equipment must be assumed under the umbrella of waste and may be a factor in the three types of waste listed: waiting, looking/retrieving, and delivering (Hendrich *et al.*, 2008, p. 27). It is not possible to quantify the amount of time specifically related to lack of equipment from the results of this study. Care coordination with other healthcare professionals also frequently involves time spent looking for equipment as mentioned in the previous discussion on Study 1. Hendrich et al. (2008) do consider their groupings of nurse activities as a potential limitation, but do not delve

into particulars such as categorical overlap or the reliability of the categorical definitions being accurately and consistently understood (and reported) by participants.

Evidence Synthesis

The study by Hall et al. (2010) was completed in Canada which limits the comparison to nurses practicing in the United States (US). Studies that are more recently completed in acute care settings in the US would serve to substantiate the findings from previous research and provide a more accurate and current picture of how work interruptions affect nurses in microsystems. Further study would be required to quantify the amount of time lost in relation to work interruptions. Observations and logs to measure specific inefficiencies would help target quality improvement efforts to reduce waste. Pedometers could be utilized in the PACU setting as it is markedly smaller than other units, and available research were limited to large medical surgical units. Hendrich et al. (2008) support the use of technology to reduce workplace interruptions.

Global Aim

The global aim of this quality improvement project was to identify common work interruptions that interfere with efficiency.

Specific Aim

The specific aim was to use Kotter and Cohen's model of change to engage the interdisciplinary team within the microsystem to identify and propose solutions to work interruptions. The process begins with forming a coalition and ends with increase nurse satisfaction with number of work interruptions within the clinical microsystem.

Methods

Setting

The hospital mission statement is as follows, “The heart of [Wildcat Hospital] is to provide health, healing, and hope in a manner that offers innovative high quality services, compassion, and respect for the human dignity of every individual who seeks or needs our care as part of Christ’s healing ministry through the Catholic Church.” The post-anesthesia care unit (PACU) has a saying, “we care while you’re not aware” but does not have its own mission statement. Processes contributing to workflow are depicted in the flow chart of the care process/patient experience from admission to discharge (Figure A).

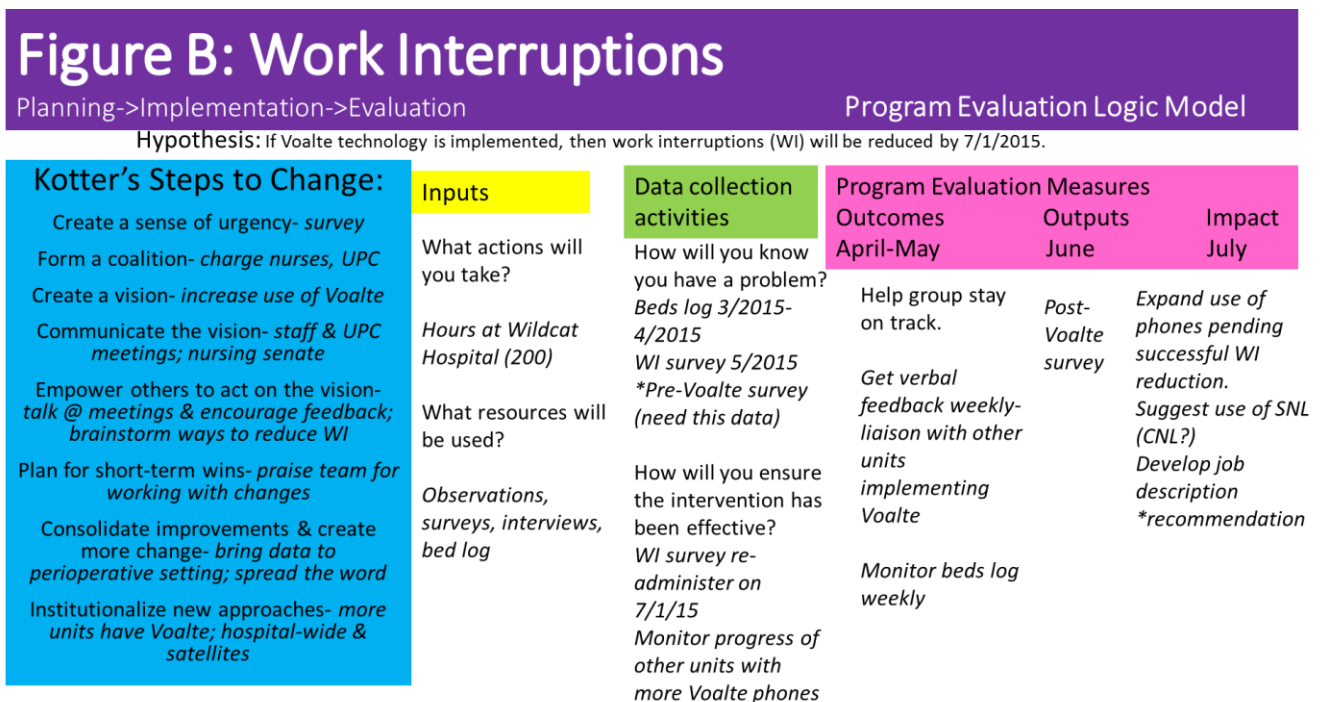
The census has grown hospital-wide which has not only caused a larger number of surgical cases but has created a bottleneck in PACU when there are no available beds (bed placement and/or physical beds) for new inpatients. The 24 hour daily census average for the eight bay PACU with 2 enclosed rooms reserved for patients on precaution protocols was 19 from January 1, 2015 to June 18, 2015. All surgical cases begin in the ambulatory surgical care unit (ASC), move to the operating room, and go to PACU for phase one of recovery. The PACU is staffed to be open from 0800 to 2100 Monday through Friday, with limited staff coverage for on-call overnight and during the weekends. The on-call hours are intended to be reserved for emergency cases, but the increased patient census has affected this workflow process.

The PACU must stay open and/or hold patients passed their expected PACU stay until bed placements are available on other units. The intensive care unit (ICU) has also been frequently full or close to capacity.

Theoretical Framework

This quality improvement project was guided by Kotter and Cohen’s model of change, the steps of which are outlined in the Program Evaluation Logic Model utilized at Wildcat Hospital and described by Gupta (2011). See Figure B. The principles of Kotter and Cohen’s theory were utilized in addressing the initial work interruption problem and as a guide to

navigate the timeline and the course of this project. The model had demonstrated utility during other quality improvement projects at the microsystem level and throughout the organization. The model was introduced to motivate staff and share visions from shared governance and flowed through microsystem meetings, journal club, staff buy-in through individual conversations, and resulting in the establishment of a small coalition for change. The model begins with creating a sense of urgency and appealing to the feelings of nurses who are not satisfied with the current processes in order to establish a seeing, feeling, and changing pattern for successful behavioral change (Melnyk & Fineout-overholt, 2011).



Intended Improvement

Waiting interrupts work and is another of the eight major types of healthcare waste (Graban, 2012). Using Kotter and Cohen's framework for change was used for the purposes of forming a coalition and creating a vision for change. It was intended that this vision would

identify interruptions and solutions to create short term wins toward improving inefficiency in the PACU. The vision will be consistent with organizational strategic initiatives and produce sustained change within the clinical microsystem.

Data Analysis Plan

A work interruption survey (Appendix A) was created to evaluate nursing staff's perception of work interruptions in the PACU microsystem. The survey was established with terminology taken from Hall et al.'s (2010) definitions of types of interruptions and their sources. Definitions were provided throughout the survey to facilitate participant understanding and results reliability. The survey was re-administered in 8 weeks' time, July 1st, 2015 to allow sufficient time for the coalition to propose and initiate change to produce short term wins. A short term win would be described by the staff as a reduction in the number of work interruptions. The goal was to have the majority of nurses report 6-10 interruptions per hour whereas the pre-intervention survey nurses reported a majority of 11-15 interruptions per hour.

Data was analyzed by comparing pre and post intervention survey results with an online t-test calculator. This test compared the means of each data point and evaluate whether or not changes between pre and post data were considered to be statistically significant by conventional standards (p value <0.05) or if the changes may be attributed to chance. Further intervention was planned as a next step. Results were analyzed for their clinical significance because qualitative and quantitative data help to understand the clinical microsystem and the effects of the intervention. Post-intervention data will be used to guide future quality improvement regarding work interruptions.

Results

Create a Sense of Urgency: A sense of urgency to decrease work interruptions and inefficiencies was created by the increasing census and the increasing sense of nurse dissatisfaction with care. The unit had been previously empowered to enact change by their ability to provide evidence to senior leadership that there was a lack of physical beds in the PACU which was disrupting their workflow. Identification of the process problem resulted in further exploration of process problems and it was identified that a second urgent problem was fragmented interdisciplinary communication resulting from a reliance on a central hardwired landline telephones.

Form a Coalition: A coalition was formed to explore options to landline phones. An alternative, Voalte communication technology, which allows healthcare professionals to communicate through wireless messaging and phone calls was identified as a possible solution. Voalte is an iPhone application with capabilities to operate with or without sound and vibration. The iPhones are encased with a battery pack and hospital logo so that patients can recognize that the phone is used to facilitate care. Healthcare workers may carry the phones with them which eliminates the need to walk to a phone.

Create a Vision: The coalition identified that implementation of Voalte phones should decrease nurse-reported work interruptions from 11-15 to 6-10 per hour in the PACU by July 1, 2015.

Communicate the Vision: A reduction in the number of phone calls and health care worker face-to-face inquiries would decrease work interruptions. Incoming phone calls from the operating room (OR) and other hospital locations (see phone icons in Figure A) could be sent directly to healthcare workers' Voalte accounts. Currently calls are diverted to the Voalte application on only the charge nurse's iPhone, and only the charge nurse gets the notification.

This does limit disruptions and noise to the other staff. The notifications may be set to silent, vibrate, or audible. The text feature may also be utilized to locate physical beds as needed with other charge nurses and staff on other units. In Voalte's (2015) white paper it is stated that "efficient workflow can help ensure patients don't spend time waiting for a bed" (p. 3). The vision of having all staff carry Voalte phones was communicated to the staff.

Empower others to Act on the Vision: Assistance was needed from the team in order to gather survey data, updates on how the project was going, and initially to complete the equipment log. Nurses enjoyed having a say in how work interruptions were documented and were eager to offer suggestions on how to reduce interruptions. They were empowered by the lack of equipment log because it was less cumbersome than filing incident reports, and it resulted in more equipment being put into circulation. Nurses felt their voices were being heard.

Plan for Short term wins: There was a short term win for the PACU when the equipment log resulted in more equipment being brought into circulation. There were also short term wins of increased staff member satisfaction with the new communication tool and efficiency expressed on the units with the full Voalte rollout. To evaluate next steps, post survey data was examined.

Pre and post survey data comparison is found in Appendix A. Only one item was considered statistically significant according to the t-test analysis. In response to the survey question "How much stress do work interruptions cause you?" (item 8), there was a reported change in the amount of stress that nurses perceive work interruptions cause them. Post intervention, nurses reported a decrease in the mean (3.92 to 3.40) towards work interruptions causing moderate instead of extreme stress. It is postulated that even if the number of work interruptions were not decreased by the intervention, their impact on nurses was reduced.

However, the majority of nurses (91%) still reported post intervention that fewer work interruptions would improve their job satisfaction.

Discussion

Consolidate Improvements and Create More Change: There were different themes of qualitative data from the PACU and other units which had the full Voalte rollout. Employees from other departments reported an increase in timeliness, convenience, and a quieter work environment due to fewer overhead pages after the rollout. Nurses and LNAs on units with the full rollout reported satisfaction with these changes in their workflow and care environment.

A mix in adherence to the planned intervention was noted from unit to unit with the full rollout because the Voalte features were utilized to varying degrees. For example, as noted in the binder on each rollout unit it was intended that nurses would write their Voalte extension on the patient whiteboards. Some nurses practiced this on select units with the rollout, but many did not. Some units did not adopt this practice at all. This is a limitation to the ability to interpret the post intervention data because the intervention was not fully implemented as intended. Processes could be made more efficient by providing the patient with the nurse's Voalte extension because it would eliminate the routing of call bells to the unit coordinator, who subsequently contacts the nurse.

Overall, Nurses were more satisfied with the communication technology than they were before the intervention. A limitation is that Voalte was inconsistent in both the PACU and in units with the full rollout. A reason for this may be dead zones in the wifi connection, which resulted in communication delays in delivery and receipt of text messages. Time delays were a common frustration with the rollout, but it was still positively viewed overall with the understanding that kinks in the system will be addressed to create further change by optimizing

the system.

Institutionalize New Approaches: Studies have typically focused on how nurses spend their time in addition to identifying and measuring the interruptions to nurses' work in the medical surgical environment. As noted by Hendrich et al. (2008), "There is hope that EHRs will improve efficiency, but whether they can has not yet been documented" (p. 31). Up-to-date studies could contribute new evidence by adding observational data of work interruptions in PACUs and standardization in waste category terminology. Next steps could involve tackling specific inefficiencies with quality improvement projects, recommending interventions, and adding technological tools such as electronic tracking of equipment. A member of senior leadership at Wildcat Hospital stated that equipment tracking has been approved, but the timeline was unknown.

There is a growing body of evidence advocating for the implementation of a surgical nurse liaison, and nurses at Wildcat Hospital believe that this position would reduce work interruptions. According to Herd and Rieben (2014), "A literature review revealed that adding a surgical nurse liaison can increase patient, family member, and staff member satisfaction" (p. 594). The article is double blind and expert peer reviewed, and rated as level C according to the AACN system (Armola *et al.*, 2009). Qualitative and quantitative survey data obtained by Herd and Rieben (2014) support their hypothesis that the surgical nurse liaison causes higher patient and employee satisfaction. Lerman, Kara, and Porat (2011) report, "Results indicated that the nurse liaison makes a significant contribution to the welfare of patient companions during surgery" (p. 385). A quantitative descriptive survey classifies this as level C according to the AACN grading system (Armola *et al.*, 2009). Nurses in PACU have shown interest in this role and/or a secretary to reduce the number of phone interruptions. Adding this professional to the

PACU team may improve communication and satisfaction if the Voalte launch is unsuccessful or insufficiently addresses current local and global problems relating to work interruptions.

Implications for the Clinical Nurse Leader

The role of the clinical nurse leader (CNL[®]) would be advantageous to this organization, especially as a member of the perioperative team. Ideally, the surgical nurse liaison would be a CNL[®] who could work to ensure positive patient outcomes by coordinating care throughout the perioperative process and follow-up after discharge. For example, PACU nurses have trouble including follow-up phone calls to discharged patients into their daily workload. This is an excellent opportunity for a CNL[®] to be directly involved in efforts to decrease readmissions as a consistent care coordinator who has been following the patient's case from beginning to end. If follow-up communication is completed in a timely manner by a CNL[®] surgical liaison who is familiar with all aspects of the perioperative process, it is likely to contribute to better patient outcomes, improved patient and staff satisfaction. The CNL[®]'s time may be spent coordinating care amongst perioperative and interdisciplinary teams, updating families, and researching outcomes to guide future quality care initiatives. The full extent of the CNL[®]'s talents and training will be realized by directly and indirectly facilitating quality improvement in the PACU microsystem. The CNL[®], with excellent communication and quality improvement skills will exemplify the qualities of lateral integrator and patient advocate to improve efficiency. This physical solution, coupled with the communicative technology tool of Voalte being widely integrated to all members of the perioperative team is expected to better mitigate work interruptions, which will improve nurse satisfaction and efficiency more dramatically.

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Appendix A: Survey Data

<i>*Questions were formatted with a 5-point Likert-type scale.</i>	Pre-intervention Survey N=13 Fulltime RNs	Post-intervention Survey N=12 fulltime RNs	Analysis
1. How many times per hour are you interrupted in your daily work (distractions, intrusions, and discrepancies)?	15.4% 1-5 or 6-10 Wl/hr 84.6% 11-15 or 16+/hr	41.7% 1-5 or 6-10 Wl/hr 58.3% 11-15/hr or 16+/hr	P value=0.3251 95% CI (-0.35-1.00)
2. Rate the frequency of each type per hour:			
Distractions (environmental noise & communication)	23.1% rarely or occasionally 76.9% frequently or always	50% rarely or occasionally 50% frequently or always	P value=0.0831
Intrusions (consultation assistance, telephones/pagers/call bells)	0% rarely or occasionally; 100% frequently or always	0% rarely or occasionally; 100% frequently or always	P value=0.5674
Discrepancies (missing/misplaced/broken equipment (bed, thermometer, etc.), drugs, or supplies; need clarification from provider)	53.8% rarely or occasionally 46.2% frequently or always	75% rarely or occasionally 25% frequently or always	P value=0.1261
3. Rate the frequency of interruptions from each source.			
Nurses	58.3% rarely or occasionally 41.7% frequently or v. frequently	58.3% rarely or occasionally 41.7% frequently or v. frequently	P value=0.8278
Other health care workers	53.8% rarely or occasionally 46.2% frequently or v. frequently	41.7% rarely or occasionally 58.3% frequently or v. frequently	P value=0.7605
Self	66.7% never, rarely, or occasionally 33.3% frequently or v. frequently	83.3% never, rarely, or occasionally 16.7% frequently or v. frequently	P value=0.5591
Environmental noise	38.5% rarely or occasionally 61.5% frequently or v. frequently	58.3% rarely or occasionally 41.7% frequently or v. frequently	P value=0.5365
Answering the telephone	100% frequently or v. frequently	100% frequently or v. frequently	P value=0.08

Missing/misplaced/broken equipment (bed, thermometer, etc.), drugs, or supplies	53.8% rarely or occasionally 46.2% frequently or v. frequently	75% rarely or occasionally 25% frequently or v. frequently	P value=0.2957
Patient	33.3% rarely or occasionally 66.7% frequently or v. frequently	50% rarely or occasionally 50% frequently or v. frequently	P value=0.2372
Family member/visitor	30.8% rarely or occasionally 69.2% frequently or v. frequently	33.3% rarely or occasionally 66.7% frequently or v. frequently	P value=1.0000
4. My current job in PACU involves multiple competing urgent priorities.	15.4% rarely or occasionally 84.6% frequently or v. frequently	100% frequently or v. frequently	P value=0.3014
5. As a result of work interruptions in a typical hour, time is spent waiting, looking/retrieving, or delivering.	30.8% rarely or occasionally 69.2% frequently or always	16.7% rarely or occasionally 83.3% frequently or always	P value=0.1965
6. Redirecting my focus after a work interruption takes time.	61.5% rarely or occasionally 38.5% frequently or always	58.3% rarely or occasionally 41.7% frequently or always	P value=0.6842
7. In a given hour, how much time is spent on interruptions and refocusing?	61.5% 6-10 or 11-15 38.5% 16-20 or 21+	81.8% 6-10 or 11-15 18.2% 16-20 or 21+	P value=0.9716
8. How much stress do work interruptions cause you?	23.1% moderate stress 76.9% high or extreme stress	60% moderate stress 40% high or extreme stress	P value=0.0474 95% CI (0.01-1.04)
9. To what extent do interruptions negatively affect the quality of direct patient care?	23.1% mildly affects 76.9% moderately or extremely affects	27.3% mildly affects 72.7% moderately or extremely effects	P value=0.5821
10. Fewer work interruptions would give me higher job satisfaction.	100% agree/strongly agree	9% not sure 91% agree/strongly agree	P value=0.1881
11. How might work interruptions be reduced in PACU?	Secretary, patient liaison, more LNAs, more RNs, decrease # of phone calls, more coverage for waiting room	Secretary, patient liaison, more LNAs, someone to update families & answer phones, more staff, make sure PCAs are well stocked, encourage anesthesia to sign records	Feedback considered and reported to management

12. How have the following factors impacted work interruptions during May and June?			
Communication technology	N/A (post intervention only)	9.1% more WI 54.5% no effect 36.4% fewer WI	
Increase in staffing		30% more WI 30% no effect 40% fewer WI	
Increase in equipment (beds, etc)		70% no effect 30% fewer WI	
OR scheduler working in waiting area		10% no effect 90% fewer WI or significantly fewer WI	
Other (write-in)		Fewer WI: Voalte system—less calls to field from bed placement	

Appendix B: Article Critique Matrix

Article	Introduction/Background	Aim/Purpose	Methods
Going blank: Factors contributing to interruptions to nurses' work and related outcomes (Hall <i>et al.</i> , 2010)	<p>Framework: "Jett and George's (2003) conceptualization of interruptions as intrusions, distractions, breaks and discrepancies was employed to understand interruptions in the environment of nursing work" (p. 1041)</p> <p>previous research has focused mostly on the relationship between interruptions and medication errors, but not other outcomes and related systems issues</p>	"To examine interruptions to nurses' work, the systems issues related to these and the associated outcomes" (p. 1040)	Mixed method: work observation of 360 nurses & stratified random sample of 113 nurses who participated in focus groups
A 36-hospital time and motion study: How do medical-surgical nurses spend their time? (Hendrich <i>et al.</i> , 2008)	Nurses are integral in patient safety and hospital function—there is an opportunity to improve nursing processes and the culture of their environment to achieve greater efficiency and cost reduction	"... to document how nurses spend their time. The goal was to identify drivers of inefficiency in nursing work processes and nursing unit design" (p. 25)	763 nurses completed the time & motion study. Four study protocols: A. PDAs record pre-EHR data, B. PDAs used to record how

			nurses spend time, C. RFID tags document nurse location & movement, D. armbands document physiologic metrics
Article	Results/Implications	Limitations/Conclusion	Applicability to Practice
Going blank: Factors contributing to interruptions to nurses' work and related outcomes (Hall <i>et al.</i> , 2010)	13 025 interruptions observed; most often caused by team members	<p>Limitations: generalizability—medical & surgical units were studied in Canada, which may not reflect nurses' time in the US; potential for observer error, but authors claim “inter-rater reliability of rater observations was very high” (p. 1046); nurses chosen for observation were randomly selected from a list of nurses who “had indicated an interest” (p. 1042) which may show bias</p> <p>Conclusion: “an interdisciplinary team-based approach to changing the organization and design of work should be explored” (p. 1040)</p>	“Nurse leaders should examine ways in which nurses' work can benefit from system improvements to reduce interruptions that lead to patient safety issues such as treatment delays and loss of concentration” (p. 1040)
A 36-hospital time and motion study: How do medical-surgical nurses spend their time? (Hendrich <i>et al.</i> , 2008)	3 subcategories comprised most of nursing practice time: documentation, med. admin., & care coordination	<p>Limitations: the study itself may have caused interruptions to nurses' work; some nurses forgot to turn off PDAs after their shift; possible debate on the categorization of nursing/non-nursing activities</p> <p>Conclusion: target the 3 subcategories (doc., med. admin., & care coordination) for improvement</p>	<p>“Changes in technology, work processes, and unit organization and design may allow for substantial improvements in the use of nurses' time and the safe delivery of care” (p. 25)</p> <p>“test solutions” (p. 33)</p>