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Facilitating Communication Between the Operating Suites and the Post Anesthesia Care Unit to Improve Efficiency in Post-operative Care

Melissa Klein

FACILITATING COMMUNICATION BETWEEN THE OPERATING SUITES AND THE POST ANESTHESIA CARE UNTION TO IMPROVE EFFICIENCY IN POST-OPERATIVE CARE

By

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FACILITATING COMMUNICATION 3

This DNP Project, submitted by Melissa Klein in partial fulfillment of the requirements for the Degree of Doctor of Nursing Practice from the University of North Dakota, has been read by the Faculty Advisory Committee under whom the work has been done and is hereby approved.

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This DNP Project is being submitted by the appointed advisory committee as having met all of the requirements of the University of North Dakota and is hereby approved.

Dr. Gayle Roux, Dean of the College of Nursing and Professional Disciplines

PERMISSION

Title	Facilitating Communication Between the Operating Suites and the Post Anesthesia Care Unit to Improve Efficiency in Post-Operative Care
Department	College of Nursing and Professional Disciplines
Degree	Doctor of Nursing Practice

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Melissa Klein

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Facilitating Communication Between the Operating Suites and the Post Anesthesia Care Unit to Improve Efficiency in Post-Operative Care

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Abstract

Root cause analysis reveals that miscommunications can account for up to 80% of preventable medical errors. Effective communication is an integral component of healthcare, and should not in any circumstance be overlooked. The peri-operative area is no exception. Professional standards set forth by the American Society of PeriAnesthesia Nurses (ASPAN) specifically address communication in the peri-operative area. Despite these recommendations, it was identified that there was no formal method of communication between the operating suite and the post anesthesia care unit (PACU) in a Midwestern hospital. The purpose of this quality improvement DNP project was to facilitate communication between the operating suite and the PACU in a large Midwestern hospital, through improved utilization of the electronic health record and the facility's electronic whiteboard in conjunction with a hospital developed PACU acuity scoring tool. This project was implemented utilizing a one-group, pre- and post-test study design. Study participants included 455 anesthesia providers and 99 PACU nurses; consecutive sampling was utilized to determine participation. PACU length of stay, PACU full frequency, and PACU full duration were analyzed comparing 24 weeks pre-process intervention versus 12 weeks post-process intervention. Data was collected in aggregate format using the facility's existing data mart. The results of this study revealed a significant decrease in PACU length of stay (p = .025), while PACU full frequency and PACU full duration results were statistically insignificant (p = .2992 and p = .663 respectively) during the pilot project.

Background and Significance

Problem Statement

According to a landmark report released by the Institute of Medicine (1999) titled, “To Err is Human: Building a Safer Health System,” each year between 44,000 and 98,000 patients die from preventable medical errors, with an associated cost of $17 billion to 29 billion dollars. The Joint Commission (TJC) credits 80% of these medical errors to miscommunication during patient transfers (2012). Recent data are even more sobering, with medical errors costing the United States about $20 million in 2008, and claiming nearly 200,000 lives per year (Andel, Davidow, Hollander, & Moreno, 2012). Miscommunication among health care providers can result in patient harm, delays in care, and an increase in length of stay (LOS) (Joint Commission on Accreditation of Healthcare Organizations, 2012). There are a multitude of opportunities for both effective communication and communication breakdown to occur throughout a typical day in the operative environment. Prior to patient transfer, formal communication between the operating suite and the post anesthesia care unit (PACU) is essential to facilitate patient placement for the recovery phase of anesthesia.

Background and Significance

The American Society of PeriAnesthesia Nurses (ASPAN) has established standards for nurse-to-patient ratios in the PACU as a guide for maintaining safe staffing levels (American Society of PeriAnesthesia Nurses, 2015a). However, a lack of communication between the operating suite and the PACU can make it difficult to meet this standard. A large Midwestern hospital utilized an electronic whiteboard (eboard) system in the peri-operative area as an initial communication tool between the operative suites and the PACU. This eboard provides real-time data and patient tracking capabilities on a large monitor or computer screen. Utilizing this system, the PACU charge nurse can visualize which operating rooms (ORs) had incision closure, however other pertinent information was not relayed between these two areas (Appendix A). Therefore, without a formalized communication strategy, the PACU may be unaware: (1) if the patient undergoing a procedure is destined to the PACU for recovery care, (2) of the acuity level of the incoming patient, and (3) of the approximate timing of transfer from the operating and procedural suites. Lack of knowledge about any one of these three factors creates inefficiencies in the entire operative care continuum. For example, it is not uncommon for multiple ORs to finish their surgical procedure at approximately the same time. If the PACU does not have sufficient nursing staff available to accept all the potential patients, the charge nurse may activate the PACU full light simply to control the incoming flow of patients. If instead the PACU charge nurse knew that of the multiple potential patients, only a manageable number were destined to the PACU, while the others were destined for either the outpatient area, a bed on the hospital ward, or the ICU, the PACU charge nurse may not inappropriately activate the PACU full light. Also, with the current model of practice, a knowledge gap related to incoming patients existed and the PACU charge nurse could inappropriately assign too many high-level acuity patients to a PACU nursing staff member. These inappropriate patient assignments not only contribute to delays in patient transfer, but also contribute to increased length of stay in the PACU, and could impact the quality of care and patient safety. These adverse events can bottleneck into the operating suites, and patients may need to be held in the operating room until a PACU nurse is available. When one considers potential fixed overhead operating room costs of $20-$80 per minute, any backlog in the PACU that delays the operating suite utilization can be costly to an organization (Macario, 2010).

A tipping point was reached with renovations of the surgical and PACU areas in this Midwestern hospital, which resulted in the division of the main PACU into two smaller PACUs. This structural re-engineering not only led to an increased total patient PACU length of stay of nearly 500 minutes per day, but also decreased staff satisfaction due to the increased OR wait times for PACU nurse availability and increased nurse workload. This subsequently led to a three-fold increase in the incidence and duration of the PACU being at capacity, from seven times for a total of four hours and 42 minutes between the dates of February 19, 2016 through May 21, 2016 (prior to renovation), to 25 times for a total of 17 hours and 12 minutes between the dates of May 22, 2016 through August 20, 2016 (post renovation).

Definition of Terminology

For the purposes of this study:

- PACU LOS is defined as the time period from which a patient is admitted into the computer system in the PACU until s/he is discharged from the PACU.
- PACU full is defined as the time at which PACU is at capacity and unable to accept any patients from the operating rooms. This is measured in both frequency and duration, where frequency is the number of times the PACU reaches capacity within the given time frame, and duration is the total cumulative time the PACU is not accepting admission from the operating suites.

Literature Review

A review of the literature was completed to assess for any existing communication tools and modalities utilized in the operative environment. CINAHL and PubMed were searched for the keywords and MeSH terms "operating room," "cost & cost analysis," "efficiency," "post-anesthesia care unit," "recovery room," “acuity scoring,” “length of stay,” “acuity,” “scoring tool," "handoff," "electronic," and "whiteboard." Results were limited to articles published in English, and written within the last five calendar years. In addition, a search was completed on Google Scholar with the search terms "post-anesthesia care unit," "staffing," "communication," and "electronic whiteboard."

Enhancing Communication

The literature overwhelmingly supported implementing strategies for enhancing communication between the operative and post-operative area to improve patient safety, handoff quality, and cost containment (Breuer, Taicher, Turner, Cheifetz, & Rehder, 2015; Guiyab et al., 2016; Hoefner-Notz, Wintz, Sammons, & Markowitz, 2013; McElroy, Collins, et al., 2015; McElroy, Macapagal, et al., 2015; Petrovic, Martinez, & Aboumatar, 2012; Sullivan, 2007). This is also supported by McLaren, et al. (2015), who found that increased communication between units increased throughput, thereby reducing OR costs. Lalani, Ali, & Kanji (2013) argued that PACU nurse direct patient care activities demanded a greater percentage of time when patient assignment was inappropriate, and that collaboration between peri-operative areas to increase efficiency in the operative arena was essential. The ASPAN standards require that "The receiving care provider will be notified of the impending transfer" (American Society of PeriAnesthesia Nurses, 2015b). Failure to meet these standards can jeopardize patient safety. The Joint Commission (2012) recognized the need for more research into the improvement of handoffs between the peri-operative areas. They define the peri-operative areas as the OR to Intensive Care Unit (ICU) or the PACU (Petrovic et al., 2012). A search of the current literature revealed the existence of a growing body of evidence regarding OR to ICU handoffs, but very little literature regarding OR to PACU handoffs.

Pre-transfer Communication

Regarding OR to ICU handoffs, many authors highlighted the importance of advanced notice of the impending transfer of care. McElroy, et al. (2015) completed a qualitative study of ICU staff perceptions of OR to ICU handoffs, where they found that advanced notice allowed them to be more prepared for impending patient transfer, thus facilitating appropriate care upon arrival. The authors felt that early communication improved patient safety. Another team led by the same lead investigator also identified various process steps in the OR to ICU transfer. They identified that the first critical step often missed in the handoff process is the preliminary call to the ICU. This omitted step caused the receiving staff to feel underprepared for patient transfer. Operating room staff identified the lack of a designated individual responsible for this communication as the major barrier to this practice (McElroy, Collins, et al., 2015). Breuer et al. (2015) studied patient transfers from the OR to the pediatric ICU, and found that increased communication prior to patient transfer allowed the ICU to be better prepared for patient admission, contributing to improved patient outcomes. In a review of OR to PACU communication at Brigham and Women's Hospital in Boston, Sullivan (2007) emphasized the importance of pre-transfer communication, where she noted that the first integral step in the handoff was a call from the OR to the PACU to communicate patient information. This phone call allowed the PACU staff time to prepare for patient arrival, and plan for and optimize patient assignments.

Acuity Scoring Tools

There is a great deal of literature regarding acuity scoring tools in the ICU population (Bouch & Thompson, 2008; Breslow & Badawi, 2012a, 2012b; Rapsang & Shyam, 2014), as well as one identified scoring tool for PACU patients (Halfpap, 2016). These tools are well validated, and have proven useful in their respective systems to improve communication, patient safety, and staffing. Upon review it was found that while respective ICU tools are validated for the ICU population and can accurately identify acuity levels, they could not be extrapolated for use with the peri-operative patient for a multitude of reasons reviewed below. Residual anesthetic can alter a patient's mental status and hemodynamic stability, and has been identified as a confounder in a scoring tool generally utilized in the ICU setting (Breslow & Badawi, 2012b). According to Halfpap (2016), post-operative patient scoring is increasingly complex, as comorbidities do not always coincide with acuity level and required nursing activities. Post-operative acuity is determined by not only patient comorbidities, but also type and duration of anesthetic, airway patency, type of procedure performed, patient age, and potential for post-operative complications. Moreover, many tools utilized in the ICU assess data such as laboratory values obtained from arterial blood gas samples or other invasive monitoring techniques. While such lab values and techniques are common in the ICU patient population, not all patients undergoing surgery require such invasive monitoring.

Literature was reviewed for the presence of validated acuity scoring tools in the peri-operative period. It was noted that acuity scoring tools for PACU patients are a rarity. The scoring tool developed by Halfpap (2016) is a relatively thorough tool that is completed retrospectively following the patient stay in the PACU. This tool's primary purpose was to justify staffing and salary variances in the facility, and the length of the tool was determined to be inappropriate for the intent of this study.

Electronic Whiteboard

The proposed intervention for this DNP project to facilitate communication and improve efficiency in the peri-operative area is the expanded use of an eboard. The eboard has demonstrated the potential for improving communication practices and patient flow (Aronsky, Jones, Lanaghan, & Slovis, 2008; Hertzum, 2011; Powter, Brougham, & Gillett, 2016; Wong, Caesar, Bandali, Agnew, & Abrams, 2009; Wood & Wood, 2015; Xiao, Schenkel, Faraj, Mackenzie, & Moss, 2007). The results of implementing an eboard have been promising in terms of enhanced efficiency and improved patient outcomes. Powter et al. (2016) found the implementation of an eboard reduced wait time to see a physician from 190 minutes to 71 minutes. While most studies reviewed were completed in the emergency department setting, this setting correlates appropriately with the high volume and varying acuity levels experienced in the operative environment.

Project Purpose

Purpose

The purpose of this DNP project was to initiate a practice change in a Midwestern hospital to improve communication practices and increase efficiency in the peri-operative area.

Goals and Objectives

The primary goal of this DNP project was to facilitate communication in the peri-operative area, with one major outcome objective associated with this goal: By May 2017, the anesthesia in-room provider and PACU charge nurse would utilize a patient disposition acuity scoring tool to communicate the transfer of post-operative patients to the PACU in 85% of the operative cases.

A secondary goal for this DNP project was to increase patient flow and efficiency in post-operative care. This goal was prompted by a recent structural renovation of the PACU that presented significant unanticipated challenges to patient flow, as evidenced by a 500-minute increase in total patient PACU length of stay per day following the renovation The outcome objectives for this goal were:

- By May 2017, a statistically significant decrease in average PACU LOS as measured over a period of twelve weeks would be achieved.
- By May 2017, a statistically significant decrease in the frequency of "PACU full" displayed on the anesthesia call light would be achieved.
- By May 2017, a statistically significant decrease in the cumulative time of "PACU full" displayed on the anesthesia call light would be achieved.

Theoretical Foundation

Kotter's model of Eight Steps to Change was utilized as a conceptual framework for this project to facilitate change and assist in the transition process (Appendix B). These eight steps are: 1) creating a sense of urgency, 2) building a guiding coalition, 3) forming a strategic vision and initiatives, 4) enlisting support, 5) enabling action by removing barriers, 6) generating short term wins, 7) sustaining acceleration, and 8) instituting change (Kotter International, 2016).

According to Kotter (2016), creating a sense of urgency entails portraying a problem as an opportunity for change that will excite people for the upcoming change. This was recently provoked by a structural renovation of the PACU, which has proven to be counterproductive to the visualization of patient placement upon entry into the PACU patient care area. This was recognized as an area for practice improvement, with both anesthesia and PACU staff excited for the opportunity for an improvement in communication and efficiency.

Building a guiding coalition is defined as enlisting the support of those within an organization with the influence to lead a change effort (Kotter International, 2016). The support of organizational leadership was obtained by gathering data to identify and define the problem, working collaboratively with the departments and staff involved to develop a workable solution, and presenting these findings and recommendations to organizational leadership. This leadership team consisted of the CRNA supervisory group, the co-directors of the anesthesia department, and the PACU nurse manager. The risks and benefits of implementing a formalized communication tool were reviewed and the benefits to the practice were deemed to outweigh the costs.

Forming a strategic vision and initiatives includes devising a vision to guide the change, with strategic initiatives in place to achieve the vision (Kotter International, 2016). “The needs of the patient come first” is an organizational value statement coupled with patient safety at this Midwestern medical facility. Creating a vision of increased efficiency in the peri-operative area while increasing patient safety propelled this project into the forefront of practice concerns.

Kotter next outlines enlisting support as recruiting a group of individuals who are excited for the change and ready and willing to work for it (Kotter International, 2016). The Chair of the Clinical Practice Committee, the leadership board for the electronic health record (EHR), the PACU nurse manager, and the PACU charge nurses all needed to be aligned in support of this project to ensure its successful transition into practice. This project had the full support of the individuals listed above, and this was accomplished by presenting factual data regarding inefficiencies as well as voicing patient safety concerns. Also, in order to be successful, support needed to be garnered from the nearly 450 in-room anesthesia providers. Incorporating this factual information into an educational module that was completed by staff in January and February 2017 incentivized staff to support this process change.

The next step in change as outlined by Kotter is to enable action by removing any barriers, structural or organizational, that will prevent the change from occurring and thus reaching the vision (Kotter International, 2016). Utilizing familiar technology (the current EHR) with minor modification of required documentation coupled with the implementation of an eboard communication tool provided a visualized report to the PACU charge nurse. The charge nurse already utilized this eboard, and following implementation could assess which patients were destined to come to the PACU, and the anticipated acuity level of those patients.

Generating short term "wins" is defined by Kotter as producing and celebrating accomplishments along the project timeline, and correlating these accomplishments with results as applicable (Kotter International, 2016). This project overcame many obstacles to see it to fruition, thus the opportunity for many celebrations. The project required administrative approval to update the current EHR to reflect necessary charting changes, as well as approval from the implementation team of the incoming EHR in 2018 to ensure sustainability. Distribution of the education model, "go-live" of the utilization of the tool, and data collection and analysis all were subsequent wins celebrated.

The next step in Kotter's model is sustaining acceleration. This includes changing the systems, employees, and organizational structures that do not align with the vision of the change (Kotter International, 2016). This was addressed by obtaining buy-in from the implementation committee of the incoming EHR, ensuring that these charting events will continue into the new charting system. As the results of this project were analyzed, they were disseminated to staff as well as to leadership committees throughout the health system's sites.

Finally, Kotter identifies instituting the change as connecting the change to organizational success, and ensuring leadership and succession for the change (Kotter International, 2016). This project did achieve a statistically significant decrease in PACU LOS, as well as function to fill a gap in communication in the peri-operative area. The data highlighting the results of the pilot will be distributed to the health sites enterprise-wide for analysis and implementation, as appropriate, to other clinical areas. This data supported the incorporation of this communication tool into the upcoming transition to a new EHR system.

Design and Methods

Setting

The setting of this study was a large Midwestern hospital with a high-volume, high-acuity surgical department. Founded in 1889, this not-for-profit facility is a faith-based organization that has since evolved into a large health system, with three flagship hospitals and many satellite community hospitals and clinics. At the time of the DNP project, there were 67 operating rooms in the hospital, averaging 136 surgical cases per day, with an average PACU volume of 100 patients per day

The anesthesia department serving this hospital's ORs is large and complex. The anesthesia department employs anesthesiologists and Certified Registered Nurse Anesthetists (CRNAs), as well as maintains an anesthesia residency program and a student registered nurse anesthetist (SRNA) program.

The department of surgical services houses a 45 bed PACU, and is led by a nurse administrator and nurse manager. Routinely, three nurses are assigned charge nurse duties, and 99 nurses staff the PACU.

Ethical Consideration

Following protocol for the protection of human subjects in research, the principal investigator submitted a letter of determination to the University of North Dakota's Internal Review Board (IRB). Upon review, this project was determined to be a quality improvement project that would gather and use data in an aggregate format, and would not pose additional risk to participants; therefore, this study did not require IRB review. The principal investigator also contacted the IRB department at the Midwestern hospital. This IRB also considered this project to be a quality improvement project, therefore not requiring IRB review. Throughout the study period the principal investigator collected no data which contained protected information.

Population

All anesthesia providers rotate through the various operating suites and therefore had the potential to utilize the OR to PACU communication tool. Therefore, inclusion criteria for the project population included all in-room anesthesia providers. In the department of anesthesia this included 301 certified registered nurse anesthetists (CRNAs), 54 anesthesia residents, and 100 student registered nurse anesthetists (SRNAs). In addition to the anesthesia providers in the operating rooms, this project also included the nursing staff of the PACU serving the main operating suites. There were 99 registered nurses employed by the department of surgical services to care for patients in this PACU setting. Anesthesiologists were excluded from this project, as they do not function as an in-room provider and therefore would not be completing patient scoring.

Consecutive sampling was used to determine participants for this study. All in-room anesthesia providers and PACU nurses working within the level one PACU at a large Midwestern hospital within the selected timeframe (24 weeks pre-implementation and 12 weeks post-implementation) comprised the selected population. In this particular work environment, anesthesia and PACU nursing staff rotate assignments within and between facilities, supporting this type of sampling. This sampling technique was chosen secondary to the need to include all providers working in the selected area within the timeframe of the project. Polit & Beck (2012) refer to this technique as “rolling enrollment” (p. 279).

Study Design

This project was a time series design of one group pre-test/post-test. The institution continually records and collects data on PACU LOS and anesthesia call light data. PACU LOS was retrieved from the institution's data mart in aggregate format. Anesthesia call light data revealed the frequency and duration of "PACU full" within the defined time periods. These de-identified data were readily available from the surgical IT systems department for analysis, and was obtained with minimal intrusion. Automated data retrieval also ensured objectivity in outcomes.

An acuity scoring tool was developed based on the existing PACU scoring system already utilized by the PACU staff at this Midwestern Hospital. The existing tool was developed by the PACU practice committee and was utilized enterprise-wide; hence, it was well known to PACU staff. Modifications made to this tool were to condense the tool for ease of use for the in-room OR anesthesia provider. An example of this tool can be seen in Appendix C.

Methodology

In January and February of 2017, all subjects in the identified population underwent training related to the use of the PACU patient acuity scoring tool, and knowledge of ASPAN requirements via a MyLearning emodule. This emodule training modality was frequently utilized by the facility and is well- known to the staff. This educational tool allowed assignment of the learning module to all providers, as well as tracked who had or had not completed the module.

On February 15, 2017, the additional electronic charting events went live in the EHR, and were available for the staff to select when entering patient transfer events. Staff were previously required to enter a patient disposition event (to PACU, to intensive care unit (ICU), to room).

The acuity score along with the disposition event were uploaded automatically from the EHR to the PACU charge nurse eboard (Appendix E). This allowed the charge nurse to quickly assess the acuity and potential workload of the patients that were transferring to the PACU from the surgical suites and aided in appropriate planning and patient assignment. The facility utilized a pre-existing infrastructure of information being uploaded from the EHR into the eboard. For example, descriptors like patient ready in the pre-op area, entry into the OR, surgical incision, surgical closure, and OR exit readily informed PACU staff of the current event.

Costs associated with this project were minimal. The largest resource utilized was manpower by the programmers of the electronic health record and the eboard in the form of hours utilized to enter the charting events into the current EHR, the programming of the eboard to obtain the information from the EHR, and the labor cost for the time for the CRNA staff to complete the education module. Resident and SRNA staff are not on salary, so their time was not reimbursable.

The seven-slide power point module took approximately five minutes to complete, and was completed during scheduled work time. Assuming five minutes per individual for MyLearning emodule completion, and 301 CRNAs completing training, a total of 25.1 hours were necessary; assuming an average salary of $97 per hour, the total institutional costs were approximately $2,400. Additional resources needed included office supplies to create acuity scoring tool reference cards to attach to the in-room computer modules for the anesthesia provider to reference. The primary investigator completed these tasks on personal time, so that time and supply cost is not accounted for in the cost summary.

Data Measurement

To assess utilization of the acuity scoring tool, post-implementation data was gathered, and measured in percentage of patient records with presence of post-operative disposition and acuity scores for the pilot project time frame February 15, 2017 through May 9, 2017.

To evaluate patient flow and efficiency in post-operative care, data were collected regarding PACU LOS for 24 weeks prior to implementation of the PACU scoring tool - from August 31, 2016 through February 14, 2017; corresponding data were then collected for 12 weeks post-implementation - February 15, 2017 through May 9, 2017. These data were analyzed using an independent samples ***t***-test (for normally distributed data). These ratio data were retrieved from charting events in the EHR.

The primary endpoint for this investigation was frequency and duration of PACU reaching capacity. These data were collected in aggregate form for 24 weeks prior to implementation - August 31, 2016 through February 14, 2017, and for 12 weeks post-implementation - February 15, 2017 through May 9, 2017.

Anticipated Outcomes

It was anticipated that following the implementation of the PACU acuity scoring tool, the PACU nursing staff would be better prepared for incoming patients, thus appropriately assigning patients based on acuity. This would, in turn, decrease patient LOS in the PACU, as nursing staff would be able to provide nursing interventions in a timely manner and expedite patient discharge from the PACU. It was also anticipated that a decrease in the frequency and duration of the “PACU full” light notification would be displayed, as throughput in the PACU increased and PACU nurses were aware of the volume of incoming patients.

Results

The purpose of this DNP project was to initiate a practice change in a Midwestern hospital to improve communication practices and increase efficiency in the peri-operative area. The primary goal was to facilitate communication in the peri-operative area utilizing an eboard. The metric established for this goal was for 85% of patient records to have a post-operative disposition and/or patient PACU acuity score charted. This was measured by a review of accumulated data retrieved from the facility's data mart. This review revealed that 74.6% of patient records contained the appropriate charting events. Throughout the pilot period, weekly data revealed a low of 71% compliance and a high of 79% compliance.

The secondary goal of this project was to improve flow in the peri-operative area. This goal had three outcome objectives, the first being a statistically significant decrease in PACU LOS. It was hypothesized that this facilitation of communication would allow for the PACU charge nurse to plan appropriately for patient admission, therefore optimizing PACU nurse patient assignments. This would improve flow throughout the PACU, decreasing patient PACU LOS. This was measured by reviewing aggregate data of patient PACU LOS for 12 weeks post-implementation of the communication process, and comparing these values to the 24 weeks pre-implementation. This data was adjusted for average surgical volumes. Statistical analysis revealed an average difference in pre-implementation PACU LOS (M = 82.44, SD = 2.4563) versus post-implementation PACU LOS (M = 80.44, SD = 2.31) of two minutes. Using the independent samples ***t***-test, a statistically significant reduction in PACU LOS was found (***p*** = 0.025, 95% CI [CI = 95%]) (Appendix F).

The purpose of the remaining objectives was to create a significant decrease in both the frequency and duration of the PACU reaching capacity. This was analyzed by measuring both the frequency and duration of the "PACU full" light being displayed on the anesthesia call light system for 12 weeks post-implementation, and comparing these values to the 24 weeks pre-implementation. For the pre-intervention period of study (24 weeks), the PACU full light was activated 38 times – a proportion of 0.6316; for the post-intervention period of study (12 weeks), the PACU full light was activated 16 times – a proportion of 0.7500. Inferences about the Difference Between Two Population Proportions for Large and Independent Samples was used to analyze this data, and a statistical comparison of these two proportion was not significant (z = 0.5628; p = .2992, 95% CI[-.00990, 0.4246]). In regards to PACU full duration, statistics revealed 24 week pre-implementation data was not normally distributed, while 12 week post-implementation data was normally distributed. Therefore, both the independent samples ***t***-test and the Mann-Whitney ***U***-test were used to determine significance. The average difference in pre-implementation PACU full duration (M = 0:42:17, SD = 0:28:55) versus post-implementation data PACU full duration (M = 0:38:05, SD = 0:24:51) was four minutes and twelve seconds. This difference was not significant using both the Independent Samples ***t***-test (p = .613) and the Mann-Whitney ***U***-test (p = .663) (Appendix G).

Discussion

The primary goal of this project was not met. It was anticipated that the patient disposition acuity scoring tool would be used to communicate the transfer of post-operative patients from the surgical suite to PACU in 85% of the operative cases. Analysis revealed however, that this tool was utilized appropriately in 74.6% of operative cases by in-room anesthesia providers and PACU charge nurses. Although the compliance goal for tool utilization was not met, this tool did function to fill a communication gap recognized in this practice, which was an absence of formal communication between the operative area and the PACU. This facility is now in compliance of ASPAN guidelines for communication in the peri-operative area.

The secondary goal of increasing efficiency in the peri-operative area was partially met. The specific objective of decreasing PACU LOS was found to be statistically significant, while decreasing the frequency and duration of PACU reaching capacity were not found to be statistically significant. There are intrinsically many confounders that impact PACU LOS and the frequency and duration of the PACU reaching capacity and communication from the OR is only one factor. PACU LOS is dependent on patient variability, type of anesthetic, complexity of the surgery, duration of the surgical case, complications of the surgery and/or the anesthetic, and availability of ward beds post-operatively. PACU full frequency and duration can be dependent on PACU staffing level variability from day to day (e.g. sick calls), surgical volumes, continued renovation of the PACU and outfield areas, and the variability in charge nurse practices of utilizing the "PACU full" light on the anesthesia call light system.

Strengths and Limitations

The major strength of this DNP project was to fill an identified knowledge gap in peri-operative practice at the project setting. In-room anesthesia providers and PACU staff are now aware of the ASPAN recommendations for communication in the peri-operative area, and can utilize the acuity–based communication tool to communicate the disposition and anticipated acuity level of the operative patient.

There were identified, several limitations to this project. Education and utilization of the acuity scoring tool was met with some limitations. The MyLearning emodule was assigned and required to be completed by all in-room anesthesia providers. Shortly after initiation of the elearning module, the principle investigator was made aware that in some circumstances the module was unexpectedly closing prior to the provider completing the module. Time constraints did not allow for the module to be re-assigned, so an email was sent to all providers with the power-point attachment for their review. Preferably, the principal investigator would have had the opportunity to provide live educational sessions to clarify concepts and answer any questions the providers may have had prior to implementation. Due to time constraints and the number of participants in this project, lack of completion of the education module did not preclude study participation. Therefore, if a provider did not complete the assigned module, and did not review the email attachment, they were not excluded from this study. Finally, the electronic mode of communication lent itself to significant disadvantages. While very convenient and unobtrusive, because there was no personal communication between the two areas, there was no guarantee that the information was being used in the manner in which it was intended. The communication relayed required a certain level of interpretation, and there was no way to ascertain that the PACU charge nurse was able to visualize the disposition or acuity score prior to the patient entry into the PACU.

Staffing practices at this institution certainly provided a significant challenge. Ideally, the study would have taken place with a consistent cohort of both anesthesia providers and PACU nurses. However, due to changing staffing needs all anesthesia providers and PACU nurses rotate between the facilities in this institution. This project was piloted in the level one PACU at the largest of the facilities, therefore if an anesthesia provider or PACU nurse floated from the hospital not participating in this pilot, they would not be as familiar with the tool, despite having been provided with the education module to review.

This communication tool enhanced the level of communication between the operating room and PACU, however it did not provide a complete picture of the patient status. It was a "snap shot" of information that required provider interpretation of the situation. Ideally, a phone call would have taken place to provide a pre-transfer report; however, until PACU charge nurses are able to handle the high call volume required, this electronic method of communication is likely the most efficient method in this practice. This method also relied on the in-room anesthesia provider completing the charting elements in a reasonable amount of time prior to patient transfer to allow the charge nurse to assess and appropriately plan for patient arrival. This acuity based communication tool also could not predict the potential timing of the transfer, given that the nature of the procedure (e.g. cast application), and patient variability (e.g. prolonged wake-up) provided great inconsistencies in how much time transpired from incision closure until the patient was transferred to the PACU. This provides a foundation for further study/project review. Also, although the acuity scoring tool was developed in collaboration with the PACU nurses based on their existing scoring system, and anesthesia staff were educated regarding this scoring system, the validity of this tool has not been determined. Finally, this surgical practice is unique in it's size and complexity, making this communication practice and scoring tool not generalizable to PACU settings outside of this facility.

There were also extraneous factors that potentially impacted the validity of the data. Due to the magnitude of this surgical practice, there was a cohort of patients that presented in both the pre-implementation and post-implementation data (e.g. weekly wound debridement, sequential operations). With the patient volume of 18,506 in the given time period, this was felt to have minimal impact on analysis. Also, there are a small number of patients that are transported directly from the OR to another surgical or procedural area, such as computed tomography (CT) or magnetic resonance imaging (MRI). Including these post-operative destinations in the communication tool would be an area for continued improvement with this project.

The time limitations inherent in this DNP project potentially skewed the validity of the data. Ideally, post-implementation data collection would have occurred for 24 weeks to account for surgical volume fluctuations and provide consistency in pre- vs post-implementation data. The initial satisfaction with this new communication process quickly prompted PACU staff to request an updated paging system to notify the in-room anesthesia provider of changes in PACU destination. This new process also had the potential to impact data, given that the pre-emptive shifting of patients or staff between recovery areas could decrease the number of times each PACU area reaches capacity.

Clinical Implications

Following implementation of this project, this facility now meets ASPAN standards for communication in the peri-operative area. The PACU nurses at this institution are now able to assess the volume and acuity of incoming patients to the PACU and plan patient placement accordingly. By utilizing this communication tool, the charge nurses are now able to assess the anticipated care needs of the incoming patients, and if it is deemed that the patient's acuity requires more nursing care than the assigned nursing station can handle, the charge nurse can either redirect the anesthesia provider to the correct nursing station via an automated paging system or call on additional nursing staff to transfer from the other nursing station.

Suggestions for Future Clinical Projects

Based on clinical findings and the limitations outlined, there are many opportunities for future clinical projects and research. Firstly, validation of the acuity scoring system should occur to ensure that a validated scoring tool is utilized that is congruent with the scoring practices and unique needs of the PACU. Additionally, investigation into the timing of patient transfer from the OR to the PACU and methods of communicating this information with the PACU staff would be beneficial to the flow in the peri-operative area. Finally, qualitative data regarding provider satisfaction with the tool and suggestions for changes and improvements would be valuable for the advancement of this practice.

This pilot project has provided the structure for future study of communication strategies in the peri-operative patient care environment to enhance patient safety, organizational efficiency, and quality care in this progressive Midwestern health care center.

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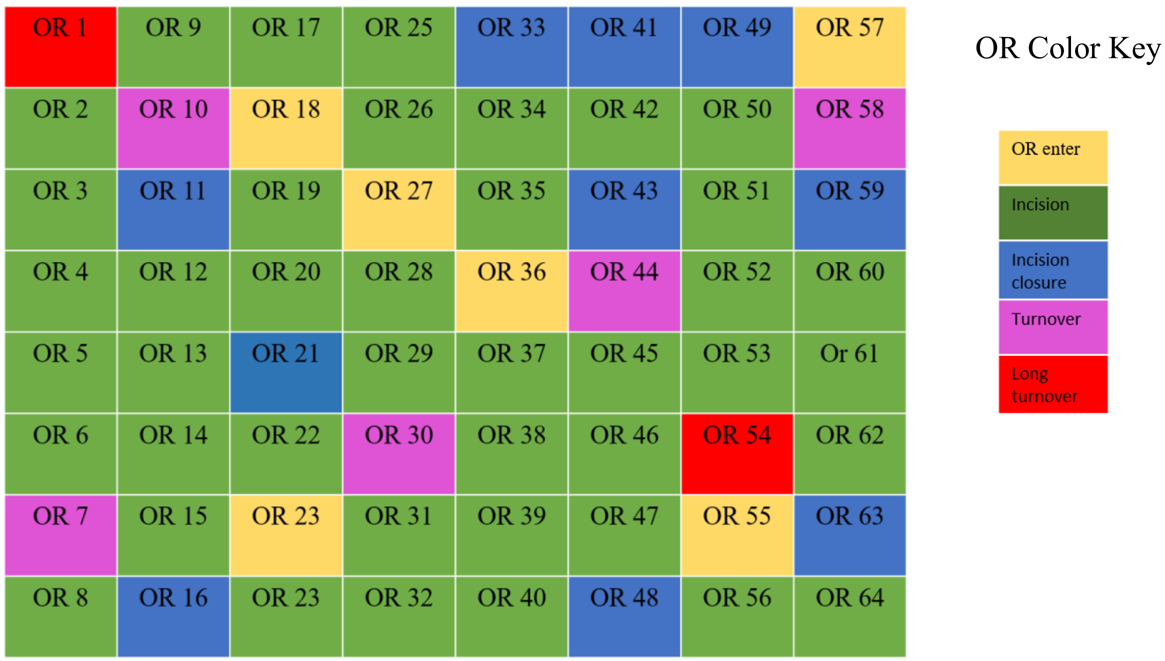
Appendix A

OR Closure Map



Appendix B

Kotter's Model of Eight Steps to Change

Steps outlined by Kotter	Translation to practice
1) Creating a sense of urgency	Information provided to staff regarding increased PACU LOS, PACU full frequency and duration
2) Building a guiding coalition	Enlisting support from organizational leadership by presenting data and working collaboratively to create a solution.
3) Forming strategic vision and initiatives	Created a vision of increased efficiency in the OR while improving patient safety. This meets the organizational value of "The needs of the patient come first."
4) Enlisting support	The Chair of the Clinical Practice Committee, the leadership board for the electronic health record (EHR), the PACU nurse manager, and the PACU charge nurses were provided with factual data regarding inefficiencies and patient safety concerns. The support of this group ensured the projects successful transition into practice.
5) Enable action by removing any barriers, structural or organizational, that will prevent the change from occurring and thus reaching the vision.	Utilizing familiar technology for education and implementation. Placing the acuity score charting events next to the "To PACU" event in the EHR to promote usage.
6) Generating short term wins	Obtaining approval to change current EHR, integration into new EHR, distribution of education module, go-live of project, data collection, and analyses were all celebrated wins for this project
7) Sustaining acceleration	Obtaining buy-in from implementation committee of upcoming EHR, dissemination of results for continued evolution and growth of project
8) Instituting the change	Incorporation into the new EHR, implementation other facilities associated with this health system, dissemination to health system sites for review and potential implementation

Appendix C

PACU Acuity Scoring Tool

Level 5 (1:1) – Patients with any one of the following characteristics:	▪ Hemodynamically unstable ▪ Combative
Level 4 (2:1) – Patients with any one of the following characteristics:	▪ Intubated/new trach ▪ Hemodynamically stable on antiarrhythmic, inotropic, or vasopressor infusions ▪ High risk for re-intubation ▪ EVD ▪ Deep extubation ▪ Isolation ▪ PCU/ICU status planned after discharge from PACU ▪ Post-op placement of regional block/epidural
Level 3 (2:1) – Patients with any one of the following characteristics:	▪ Patients who are awake and hemodynamically stable ▪ Non-emergent airway support (ie. jaw thrust, requiring nasal or oral airway) ▪ Communication barrier ▪ Altered mental status/delirium (RASS of +1/+2) ▪ Continuing colloid/blood product administration ▪ Routine nursing assessment and care ▪ Age 17 and under
Level 2 (2:1)	▪ Patients who have met criteria for transfer out of the PACU.
Level 1	▪ Pre-operative use only
Total acuity level assigned to each nurse ideally would not exceed 6.	

Appendix D

Project Timeline

	8/16	9/16	10/16	11/16	12/16	1/17	2/17	3/17	4/17	5/17	6/17	7/17
Developed problem statement	■											
Literature review	■											
Obtain approval from anesthesia directors	■											
Obtain approval from clinical practice committee		■										
Obtain approval from electronic health record committees		■										
Pre-implementation data collection		■	■	■	■	■	■					
Obtain IRB waiver from clinical institution			■									
Development of scoring tool					■							
Obtain IRB waiver from UND						■						
Learning module assigned						■	■					
Implementation of scoring tool into electronic record							■					
Post-implementation data collection							■	■	■	■		
Final Data Analysis										■		
Dissemination of results											■	■

Appendix E

PACU Charge Nurse EBoard View

Cases Coming to PACU

O.R.	MC#	Initials	Block	Destination	Closure	OR Exit	Dispo	Alerts
OR					11:16		ICU	ICU|RRU
OR					12:16		ICU	ICU
OR				CPU	12:17		3	GEN
OR					12:18		ICU	ICU
OR				CPU	12:19	12:37	3	
OR				EPP	12:19		OP	
OR				CPU	12:29		3	
OR				PEDS	12:29		4	PED
OR				CPU	12:31		3	GEN
OR				EPP	12:33		3	GEN

Appendix F

Pre- and Post- Implementation PACU LOS Difference

				Statistic	Std. Error
Mean Minutes per Case	Pre-Intervention	Mean		82.4425	.48175
		95% Confidence Interval For Mean	Lower Bound	81.4053	
			Upper Bound	83.4797	
		5% Trimmed Mean		82.5242	
		Median		82.7450	
		Variance		6.034	
		Std. Deviation		2.45634	
		Minimum		76.73	
		Maximum		86.38	
		Range		9.65	
		Interquartile Range		3.26	
		Skewness		-.469	.472
		Kurtosis		-.197	.918

Mean Minutes per Case	Post-Intervention	Mean		80.4400	.66705
		95% Confidence Interval For Mean	Lower Bound	78.9718	
			Upper Bound	81.9082	
		5% Trimmed Mean		80.4067	
		Median		80.4850	
		Variance		5.340	
		Std. Deviation		2.31074	
		Minimum		76.4	
		Maximum		85.08	
		Range		8.68	
		Interquartile Range		3.08	
		Skewness		.207	.637
		Kurtosis		.606	1.232

Tests of Normality

		Kolmogorov-Smirnov[a]			Shapiro-Wilk		
	Condition	Statistic	Df	Sig.	Statistic	Df	Sig.
Mean Minutes per Case	Pre-Intervention	.107	24	.200*	.969	24	.639
	Post-Intervention	.161	12	.200*	.970	12	.911

*. This is a lower bound of the true significance.

a. Lilliefors Significance Correction

T-Test

Condition		N	Mean	Std. Deviation	St. Error Mean
Mean Minutes per Case	Pre-Intervention	24	82.4425	2.45634	.50140
	Post-Intervention	12	80.4400	2.31074	.66705
	Total	37			

Independent Samples Test

		Levene's Test for Equality of Variances		t-test for Equality of Means
		F	Sig.	t
Mean Minutes per Case	Equal variances assumed	.468	.498	2.350
	Equal variances not assumed			2.400

Independent Samples Test

		t-test for Equality of Means		
		df	Sig. (2-tailed)	Mean Difference
Mean Minutes per Case	Equal variances assumed	34	.025	2.00250
	Equal variances not assumed	23.373	.025	2.00250

Independent Samples Test

		t-test for Equality of Means		
		Std. Error Difference	95% Confidence Interval of the Difference	
			Lower	Upper
Mean Minutes per Case	Equal variances assumed	.85213	.27076	3.73424
	Equal variances not assumed	.83446	.27777	3.72723

Appendix G

Pre- and Post- Implementation PACU Full Duration

				Statistic	Std. Error
PACU full duration	Pre-Intervention	Mean		0:42:17	0:04:41
		95% Confidence Interval For Mean	Lower Bound	0:32:47	
			Upper Bound	0:51:48	
		5% Trimmed Mean		0:40:25	
		Median		0:37:42	
		Variance		3012890.137	
		Std. Deviation		0:26:55	
		Minimum		0:01:12	
		Maximum		2:00:24	
		Range		1:59:12	
		Interquartile Range		0:39:48	
		Skewness		.798	.383
		Kurtosis		.662	.750

PACU full duration	Post-Intervention	Mean		0:38:05	.66705
		95% Confidence Interval For Mean	Lower Bound	0:24:50	
			Upper Bound	0:51:19	
		5% Trimmed Mean		0:35:50	
		Median		0:31:15	
		Variance		2224828.267	
		Std. Deviation		0:24:51	
		Minimum		0:11:29	
		Maximum		1:45:03	
		Range		1:33:34	
		Interquartile Range		0:38:10	
		Skewness		1.364	.637
		Kurtosis		.2.129	1.232

Tests of Normality

		Kolmogorov-Smirnov[a]			Shapiro-Wilk		
	Condition	Statistic	Df	Sig.	Statistic	Df	Sig.
PACU full duration	Pre-Intervention	.094	38	.200*	.944	38	.057
	Post-Intervention	.195	16	.105	.862	16	.021

Group Statistics

	Before or After	N	Mean	Std. Deviation	Std. Error Mean
Difference	Pre-implementation	38	0:42:17	0:28:55	0:04:41
	Post-implementation	16	0:38:05	0:24:51	0:06:12

Independent Samples Test

	Levene's Test for Equality of Variances		t-test for Equality of Means			
	F	Sig.	t	df	Sig. (2-tailed)	Mean Difference
Equal variances assumed	.342	.561	.508	52	.613	0:04:12
Equal variances not assumed			.541	32.674	.592	0:04:12

Independent Samples Test

	t-test for Equality of Means		
	Std. Error Difference	95% Confidence Interval of the Difference	
		Lower	Upper
Equal variances assumed	0:08:17	-0:12:25	0:20:50
Equal variances not assumed	0:07:47	-0:11:38	0:20:03

Mann – Whitney Test

		N	Mean Rank	Sum of Ranks
Difference	Pre-Intervention	38	28.11	1068.00
	Post-Intervention	16	26.06	417.00
	Total	54		

Test Statistics

	Difference
Mann-Whitney U	281.000
Wilcoxon W	417.000
Z	-.436
Asymp. Sig. (2-tailed)	.663