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Assessing Workflow in the Postanesthesia Care Unit

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Abstract

Background and Review of Literature: The postanesthesia care unit (PACU) environment must function smoothly as a critical recovery area for monitoring of immediate postoperative patients. Timely responsiveness to complications is imperative to ensure patient safety. Following postanesthesia observation, a patient is discharged from the PACU to home or is admitted to the hospital. If this transition is delayed by excessive discharge times or poorly managed patient adverse events, it can cause major bottlenecks and issues with throughput for the perioperative setting.

Purpose: This project aims to study the present workflow in the PACU, identify gaps in the workflow and provide recommendations to perioperative leadership.

Methods: Current PACU practices will be observed using an assessment tool to establish the barriers to a streamlined PACU workflow at a large urban academic hospital. Reoccurring workflow gaps will be determined and collected data presented to perioperative leadership with recommendations.

Implementation Plan/Procedure: The goal is to improve provider knowledge of PACU workflow barriers and ways to increase efficiency in PACU workflow. This will be done through observing individual patients in the PACU and assessing for workflow breakdowns related to handoff, postanesthesia complications, and adverse effects as well as discharge planning.

Implications/Conclusions: The PACU is a complex care setting due to the sensitivity and complexity of the patient population, requiring effective communication and coordinated care. The PACU is prone to workflow inefficiencies affecting staff, patients, and the hospital system; therefore, it is crucial that workflow is optimized.

Assessing Workflow in the Postoperative Care Unit

Background

According to a recent publication, approximately 40 to 50 million major surgeries are performed in the United States each year. (Dobson, 2020). This means that up to 50 million Americans are spending time in the postoperative care unit (PACU) after their surgery and before they are discharged. After any surgery and administration of anesthesia, patients are considered to be in the postoperative phase of their surgical care. Within a hospital, the PACU functions as a temporary 'recovery' area for postoperative phase patients. Here they are closely monitored and assessed prior to their discharge home or admission to the hospital. This is considered a vulnerable phase in a surgical patient's care, as there is considerable risk for complications to arise after receiving anesthesia and having surgery performed. As patients return to their baseline level of consciousness, they are observed closely over a period and can range greatly from person to person. The goal is to recover patients without complications in a timely manner, while preparing to discharge them to home or admit them to the hospital. When there are delays in discharging a patient out of the PACU, this can lead to an overwhelmed PACU, operating rooms (OR) and hospital system.

Nurses and physicians who staff the PACU have multiple roles and responsibilities. The workflow must progress smoothly, moving patients from the operating room to the postoperative care area where they are recovered, and then discharged to home or to a hospital room. According to Budelier et al. (2020), certain steps must be taken for the workflow to function smoothly. Listed below are the functions that must be addressed in a timely manner by the postoperative care personnel so that an efficient workflow occurs:

1. Participate in a meaningful handoff activity from the operating room (OR) to the PACU

2. Identify adverse symptoms requiring treatment

3. Detect physiological derangements and complications

4. Recognize situations requiring emergency medical intervention

5. Determine when patients are ready for PACU discharge

A critical responsibility of PACU clinicians includes receiving a patient handoff from the anesthesia provider who cared for the patient during surgery. During PACU handoff, the OR anesthesia provider is expected to follow a standardized protocol, relaying pertinent information to the receiving PACU nurse, and PACU anesthesia attending and/or resident if necessary. The dynamic PACU structure with multiple moving variables quickly creates a noise-filled, high-pressure, and high patient turnover environment. This environment makes postoperative handoffs especially susceptible to miscommunication and documentation failures, which can jeopardize patient safety (Halladay et al., 2018). The Joint Commission (2018) has stated that 80% of all adverse patient events and errors involved inadequate handoffs. Furthermore, over a five-year period, communication breakdown malpractice claims cost the United States healthcare system $1.7 billion and 1,744 deaths (The Joint Commission, 2018).

Along with receiving handoff, PACU nurses must be able to identify adverse symptoms and treat patients as soon as symptoms present. This may include dizziness, nausea and vomiting, pain, difficulty breathing, shivering, or itching. It may also include health-related events such as respiratory depression, hemodynamic instability, electrolyte imbalances, hypothermia, confusion or delirium, or low urine output. Even more serious situations may

include the patient needing to be intubated, or the patient coding and needing cardiopulmonary resuscitation (CPR).

Although the patient is no longer anesthetized, they are prone to medical decompensation requiring escalation of care. If a PACU patient is re-intubated or hemodynamic instability continues, they will be admitted to the intensive care unit (ICU), adding additional time to the patient's length of stay and consuming additional hospital resources. These complications must be recognized promptly and appropriately managed by PACU clinicians to maintain patient safety and fiscal efficiency for both the patient and the healthcare system. If these complications are not addressed in a timely fashion, it can lead to lengthier PACU stays and ultimately slow throughput. It is the responsibility of the PACU nurse to determine when the patient can be safely discharged to home or to the floor, or when the patient's condition is deteriorating that they need to be transferred to the ICU. Ensuring a smooth workflow and preventing patients from being bottle-necked in the PACU relies heavily on the PACU nurse.

Concepts/Definitions

Bottleneck: a slowing that impedes forward progress of an activity or environment.

Burnout: syndrome defined as emotional, physical and or mental exhaustion, which can impact one's ability to function as they would normally.

PACU: Postanesthesia care unit at Barnes-Jewish Hospital including, south campus, Center for Advanced Medicine and Parkview Tower.

Patient handoff tool: a worksheet that is included in the patient's medical chart and is filled out through all stages of the patients' perioperative care from the various staff members involved in their care (ie. pre-op nursing, OR nursing, surgery, PACU nursing, and anesthesia).

Perioperative: patient-centered, multidisciplinary care of patients from the preoperative arrival, through surgery and until full recovery following.

Postoperative complications: complications that arise after a surgical course from either the surgical procedure or the anesthesia delivered during the procedure.

Recovery from anesthesia: Becoming more aware as the anesthetic wears off and the patient returns to their normal level of consciousness.

Problem Statement

There is a lack of efficient workflow in the postoperative care unit that can lead to problems managing care and transferring or discharging patients from the PACU. Through reported observations and anecdotal data, a gap exists between knowledge and current practices because workflow problems continue to persist. The aim of this quality improvement project was to identify and address gaps in the workflow care practices in the PACU, by educating staff on how to improve workflow and prevent discharge delays.

Purpose, Aims and Objectives

The goal of this project was to identify and assess gaps in PACU workflow, with the primary objective to determine breakdown themes or trends within the workflow. The objectives were measured by observing current workflow practices and obtaining baseline data using the PACU Assessment Workflow Tool (see Appendix A). This tool focused on handoff, clinical complications detection and treatment, and timely discharge.

PICOT Question

The project proposed the question, for all postoperative care team members recovering patients after surgery in the postoperative care area (P), does determining the cause of slow PACU workflow (I) compared to the current workflow (C), improve overall knowledge of the workflow in the PACU to streamline patient transition through the PACU (O) over 16 weeks (T)?

Significance

The termination of surgery and emergence from anesthesia in the immediate post-operative period is a critical phase in a patient's surgical course. Ideally the PACU environment functions as a recovery area where clinicians are able to closely monitor patients and provide prompt management of adverse symptoms and/or complications, while also transitioning patients to discharge or inpatient admission. Given the level of responsibility and heavy workload, PACU clinicians can quickly become overwhelmed and unable to provide exceptional care (Sillero & Zabalegui, 2018). In this dynamic environment with a high degree of acuity, the PACU environment is easily susceptible to workflow breakdowns.

When PACU workflow is compromised, there are considerable consequences to the patients, staff, and hospital system. Physiological derangements and complications may be late to be recognized and furthermore delay treatment of adverse symptoms. This can add additional time before discharge and require additional staff attention, extending the queue for discharge. Prolonged PACU stay and backlog of patients impair medical care. Wait times for patients to be discharged may feel even longer due to 'unoccupied' or inactive time compounded with anxiety and waiting alone (Maister, 1984). Collectively extended wait times can negatively impact a patient's perception of the care they receive, leading to further dissatisfaction (Maister, 1984).

Not only can patients feel dissatisfied with their experience in the PACU, but this feeling can also be felt by staff as workflow becomes compromised. If the PACU system is overwhelmed with staff stretched too thin, patient safety may be jeopardized. The downstream effects of PACU workflow issues may hinder the clinicians' ability to provide streamlined and efficient care, presenting as an overburdened workforce and healthcare system. Poor workflow on an overburdened system also may negatively influence nursing staff mentality and the overall culture of the PACU (Weigel et al., 2017). In addition, overwhelmed healthcare staff has been linked to suboptimal patient care, resulting in lower patient satisfaction and impaired quality care (DeHert, 2020). All of these concerns further potentate the risk of medical errors along with malpractice claims and increasing costs (Dehert, 2020).

When PACU workflow is inefficient, it can present a bottleneck effect, which further compounds these issues, forcing the hospital system into a gridlock (Ghosh, 2021). If patients are not discharged in a timely manner, this creates congestion with backed-up ORs and preoperative areas, which can place a financial burden on the hospital system. The operating room is the 'fiscal epicenter' of the hospital, accounting for 40% of hospital costs and 60-70% of hospital revenue (Rothstein & Raval, 2018). If operating room time is extended due to PACU bottlenecks, there are increased costs and lost revenue for the hospital system. Identifying gaps in PACU workflow has considerable cost savings potential, in addition to improving patient safety and discharge times, as well as improving staff and patient satisfaction.

Review of Literature

Search Strategies

The literature was obtained utilizing the online databases through Goldfarb School of Nursing and Washington University School of Medicine, including: CINAHL, MEDLINE,

PubMed, LWW and Sage Premier, in addition to Goggle Scholar. Searched terms were limited to the last five years and written in the English language. Key words and terms searched included such as *postoperative, perioperative, PACU, handoff, adverse events, complications, workflow, throughput, discharge.* Boolean operators "and" and "or" were used to combine terms. Selected journal articles strength of evidence and quality were organized and ranked using the John Hopkins Evidence Level and Quality Guide. The review of literature led to the following themes: postoperative patient handoff, postoperative monitoring and complications and discharge from PACU.

Postoperative Patient Handoffs

An identified topic amongst the current research on PACU throughput has indicated that there are evidenced-based protocols or a standardized handoff that is expected to be used for postoperative patients being admitted to the PACU after surgery; however, it was not routinely utilized (Budelier et al, 2020; King et al., 2019; Wang et al., 2021). This contrasted with other critical care areas of hospitals such as the ICU, which more often utilized systematic evidenced-based handoff reports, where there was direct communication between the receiving clinicians from the operative personnel (Krimminger et al., 2018). A standardized handoff tool has been developed by this hospital, but they are not routinely used in the PACU. In addition, there are facilities where there is no designated electronic health record (EHR) documentation for this transition of care. The handoff exchange may be documented on paper as it was received by a verbal report. The written notes taken during the handoff may be easily lost or the nurse may not have remembered the details if a verbal report was taken as the PACU is a fast-paced phase of care (Halladay et al., 2018). As a result, since PACU nurses did not routinely utilize the printed handoff checklist, details of the handoff report may not be communicated, compromising

productivity, and making the system vulnerable to poor patient outcomes. As described by King et al. (2019), an urgent need existed for intense research on the utility of telemedicine in the PACU care area to improve handoff reports, to better assess and diagnose negative patient events, and to improve and implement evidence-based practice initiatives to improve the care provided to perioperative patients.

Because the utilization of a standardized operating room to PACU handoff checklist is not always used, PACU workflow can be compromised. Research shows that a non-standardized handoff process resulted in a breakdown in communication, potential medical errors, and patient-centered adverse events (Halladay et al., 2019). Several studies reported an increase in satisfaction with patient transfer when the transferring providers utilized a standardized electronic checklist when handing off the patient (Halladay et al., 2019; Shah et al., 2019). It is important that a proper handoff checklist be utilized by the operating room personnel when giving a handoff report to the personnel in the PACU. This may prevent medication errors and poor communication and leads to improved patient outcomes and safety. An efficient method for passing along handoff information from the operating room to the postoperative care unit must be utilized.

After each patient was monitored and determined to be ready for discharge from the PACU, the nurse obtained discharge orders from the physician and then discharged the patient to either home or to an inpatient hospital room. The literature review found that workflow was not always completed efficiently, which can lead to an overflow of patients in the PACU area. It can also lead to delayed discharge. This project aimed to study the present workflow in a local urban hospital, identify gaps in the workflow, and make recommendations to the PACU team members

on how to improve workflow. A follow-up assessment was completed to determine if the workflow improved.

Postoperative Monitoring and Complications

While patients recovered in the PACU are often stable, they had the potential to experience complications or adverse events. If the patient became unstable or experienced any complications, the postoperative care team, in an ideal scenario, quickly responded and appropriately treated the patient to prevent further deterioration. While complications are not an uncommon happening, they do, however, lengthen the patient's PACU stay (Abebe et al., 2022). Postoperative complications can be predicated based on factors including female sex, longer duration of anesthesia, and the occurrence of intraoperative complications regardless of preexisting comorbidities (Abebe et al., 2022; Ganter et al., 2014). Along with that, pain and postoperative nausea and vomiting were also common complications that can predict an increased PACU length of stay (Ganter et al., 2014). Knowing these patient populations are at greater risk of experiencing postoperative complications, it is essential that PACU care teams are exceptionally attentive when caring for these patients to improve overall patient safety, outcomes and prevent unnecessary long PACU stay (Ebebe et al., 2022).

Discharge from PACU

In the perioperative setting, the discharge time frame reflected the time from termination of surgery to the time patient left the PACU, either being admitted to the hospital or being discharged to home. Discharging patients from the PACU in a time-efficient manner has been a universal problem for healthcare institutions and is difficult to address given its complexity (Ego et al., 2022). Postanesthesia adverse effects and complications are considerable clinical factors

that can impede discharge times; however, there are also nonclinical factors that play a role in the process (Ego et al., 2022). These nonclinical factors are not well defined or understood. One of the most reported nonclinical issues related to PACU discharge is lack of anesthesia and PACU nurse staffing (Cobbe & Barford-Cubitt, 2017). Meal breaks, shift changes, workloads and staffing ratios all provided systematic barriers to timely discharges (Cowie & Corcoran, 2012).

Another common reported theme for delayed discharges was due to bed availability (Cowie & Corcoran, 2012; Ego et al., 2022). Patients may "board" for several hours in the PACU waiting to be admitted, occupying a PACU bay and a PACU nurse. This limits the space and manpower for future patients to be safely brought to the PACU. To add to this, the unavailability of transporters to move patients from PACU to their hospital room or to the patient pickup area also slows PACU discharge (Cobbe & Barford-Cubitt, 2017; Ego et al., 2022). A bed may be unoccupied and clean with a nurse ready to take on the workload of a new patient, but there is no transportation staff member available to physically move the patient to their room. As a result, these patients remain in a PACU bay needed for a newly post-operative patient from the OR. Small breakdowns in PACU workflow can have considerable consequences on discharge times and room turnovers.

System Needs

PACU workflow has been studied at the hospital where this project was performed. However, delayed patient discharges, unfollowed standardized handoff and prolonged responsiveness to patients continue to be a problem according to the anecdotal data provided by perioperative leadership. Awareness of the problem and education about the current workflow

breakdowns redirect the cycle of compliancy and staff is routinely reminded of its significance. Analysis of the current PACU workflow practices was important to assess the extent of the problem and where they may have strayed from best practice guidelines and policies. If specific workflow issues were discovered, recommendations to improve workflow were provided. After the intervention, the issues were reassessed to determine if the intervention was helpful in improving the workflow process.

Evidence for the DNP Project

Overall, the review of literature indicated a need for a quality improvement project to access PACU workflow breakdowns. There were many articles which established and described PACU workflow problems with associated cost consequences. However, there was a lack of evidence focusing on the impact of education on key PACU stakeholders, including nursing staff and anesthesia providers. The literature review revealed a lack of articles with higher levels of evidence in addressing search terms and fewer publications that focused on comprehensive problems of workflow breakdown and instead assessed individual issues (i.e. discharge times or response times to patient adverse events).

From the body of evidence that was available, the literature suggested the need for hospital PACUs to implement sustainable resources to maintain workflow best practices. The literature suggests hospital workflow breakdowns and, specifically PACU workflow breakdowns have been a continuously evolving problem with defined areas of improvement yet without a definitive solution. This is a multifactorial, complex, patient care-related problem with potential significant negative consequences to staff, patients, and hospital revenue (Bello et al., 2022; Kellner et al., 2018; Halladay et al., 2018). In addition, a lack of compromised PACU workflow

set up the healthcare institution to regulatory violations and negative patient care-related consequences (The Joint Commission, 2018).

In summary, analysis of the current literature revealed the need for a quality improvement project focusing on educational interventions to address PACU workflow. By utilizing the current available data on established areas of PACU workflow breakdown, PACU workflow areas of study were organized into an observational tool sheet, which was used for individual patient observations. After the analysis of collected data, recommendations were made to perioperative leadership personnel. Following the distribution of recommendations to optimize the PACU workflow, the project team reached out to target individuals that received the recommendations to follow-up on their view of the helpfulness of the delivered recommendations and the feasibility of the recommendations to reduce the discovered workflow issues.

Theoretical Framework

The Theory of Comfort was an applicable framework for this project (See Appendix B). Dr. Katherine Kolcaba, the theorist behind the Theory of Comfort, described a holistic perspective on a patient being strengthened by having needs for relief, ease, and transcendence met in physical comfort, psychospiritual comfort, sociocultural comfort, and environmental comfort (Bergström et al., 2018). Throughout the care provided in the PACU setting, patient comfort and well-being were at the forefront of the care providers' minds. Addressing a patient's pain and anxiety were a top priority under the Comfort Theory (Kolcaba, 2003). Surgery can be an anxiety-provoking, often painful experience. Therefore, the application of the Comfort Theory was very applicable in the perioperative care areas, especially the PACU where surgical pain was

experienced. The patient may also experience side effects of anesthesia, including nausea and vomiting, where a patient's comfort level is worsened. Because of this, it was important to apply Comfort Theory in the PACU to ensure all patient needs were met efficiently and offered reassurance to ease any discomfort, provided relief for experienced symptoms, and supported all aspects of a patient's well-being as they transcended and felt empowered by their own strength to overcome the discomfort (Kolcaba, 2003). Through the application of the Comfort Theory, the goal was to help patients find hope and manage symptoms that cannot be eliminated (Bergström et al., 2018).

Methodology

This project followed a plan that collected baseline data on current workflow practices in the PACU, identified gaps in the workflow, and made recommendations on how to best optimize PACU workflow to perioperative and anesthesia leadership. After recommendations on workflow breakdowns were provided to leadership, additional data was collected to assess whether the leadership team found the recommendations helpful and feasible.

Project Design

This project design was deemed to be quality improvement (QI) and utilized a workflow assessment tool along with direct observation of PACU departments in PVT, south campus and the CAM (see Appendix A). The assessment criteria of the PACU functions utilized in the assessment tool were developed from the 'critical PACU functions' described by Budelier et al. (2020) (see Appendix A). Project team members recorded observations using the assessment tool for 105 individual patients along with responses from that patients PACU nurse. Quantitative data recorded discerned high quality vs. low quality handoff procedures, slow vs. appropriate

acknowledgment adverse symptoms, slow vs. appropriate acknowledgment of physiological

derangement and discharge of patient within 15 minutes of discharge orders vs. beyond 15

minutes. Project team members documented issues which delayed the patient leaving the PACU

beyond the 15 minutes of anesthesia discharge orders. Each patient PACU nurse was asked of

their years of experience, employment status (i.e. staff nurse vs. agency nurse) and their

subjective option to what gaps exist in the current workflow practices in the PACU area they are

currently working in. Project team members documented any additional assessment information

in the 'general observation/other' section.

Following the collection of baseline data, an analysis was performed to establish any

trends. A comprehensive data analysis was presented to PACU leadership with proposed

recommendations to optimize workflow for perioperative services.

Health Promotion/Disease Prevention

Throughout the design and implementation phases, the project team prioritized health

promotion throughout the project design. The focus on providing education to the PACU staff

indirectly encouraged health promotion through improving clinical practices. Striving for

reduced patient adverse events through workflow optimization in the PACU can lead to surgical

complication prevention and the maximized health experience of perioperative patients.

Stakeholders

The patients of the PACU care areas across the studied facility were the largest

stakeholders of this quality improvement project. They were the personnel most affected by

workflow in the PACU. If the intervention was found successful, improved PACU workflow will

result in a more efficient perioperative care model. This improvement has the potential to have increased patient safety as well as higher patient and staff satisfaction.

The patient was the most important stakeholder in this quality improvement project. However, there were several other important individuals that played an important role in the success of this project. The project was led by two graduate students pursuing their Doctor of Nursing Practice degree in Nurse Anesthesia. They fulfilled the role of designing and implementing the project, communicating with other involved stakeholders, collecting pre-intervention and post-intervention data, developing the necessary education, and analyzing the data to evaluate the project progress. Other important stakeholders included project team members, Dr. Bernadette Henrichs, Program Director of the Goldfarb School of Nursing Nurse Anesthesia Program as well as a practicing nurse anesthetist and Dr. Joanna Abraham, Associate Professor for the Department of Anesthesiology and Institute for Informatics at Washington University St. Louis. These key members served as project consultants and offered their expert opinions toward the project design and implementation. Dr. Ivan Kangrga, Professor of Anesthesiology and Director of Perioperative Safety and Quality as well as Dr. Gail Davis, Director of Perioperative pre/post and Perioperative Education Programs, were also key stakeholders for this project and served as experts from the Anesthesia Department and Nursing Perioperative Department. They provided oversight and approval for the quality improvement project.

Each individual anesthesia provider and PACU nursing staff member was a pivotal team member for this quality improvement project as their daily workflow allowed for the data collection and the outcome of the project. Their daily cooperation was imperative to the success of the educational implementation of this project by reading and putting the education provided

into practice. All team members involved were apprised of the project progress and the findings throughout the entire project.

Resources

The cost to complete the study was minimal (See Appendix C). The cost of the two graduate anesthesia nursing students for their time would have been the largest cost. However, they did not receive any pay given the nature of the project. Other costs included the purchase of the Statistical Package for the Social Sciences (SPSS) program and paper copies of the tool to conduct the assessment. The SPSS Software for statistical analysis costs approximately $100 and was downloaded on the project team leader's personal computer. The paper used to make copies for the assessment tool and educational document cost approximately $0.01 per sheet for 100 sheets (50 sheets to print the tool and 100 sheets to print the education material) for a total of $1 (Fu, 2022). In summary, the costs for this project were minimal.

Project Site

This project was conducted at a large, urban, academic medical center in the Midwest of the United States, where hundreds of surgical patients pass through the PACU every day. This was a single-center, quality improvement project conducted to evaluate the current workflow of the PACU and identify any gaps that may exist. In addition, the focus was on patients admitted to the PACU. This included all PACU areas in the hospital, including Barnes-Jewish Hospital south campus, the Center for Advanced Medicine north campus and Parkview Tower. The plan was for each graduate student to evaluate 50-100 PACU patient encounters from the time the patient is brought from the OR throughout their length of stay in the PACU. The initial, pre-intervention phase was to observe current workflow practices and identify barriers to efficient

workflow. The intervention phase was to make recommendations to PACU and anesthesia leadership to improve knowledge of PACU workflow. The last phase involved the post-intervention data collection to determine if leadership found the recommendations helpful and feasible for the PACU moving forward.

Population

The population studied included all potential PACU patients at Barnes-Jewish Hospital south campus, the Center for Advanced Medicine, north campus and Parkview Tower. Both inpatient and outpatient PACU patients were included.

Recruitment/Sampling Strategies

The recruitment of patients for this quality improvement project was a convenience sample. The two graduate students observed the PACU when they were not in class and not in the operating room. Both students collectively assessed 105 PACU patients and filled out the assessment tool. They conversed with the PACU nurse to further assess workflow. They assessed the workflow in all three clinical PACU settings (north, south and Parkview Tower).

Inclusion criteria included all surgical patients who were transferred to the PACU. Exclusion criteria included patients who were directly transferred to the ICU after their surgery. Any PACU nurse that received a patient from the OR was potentially included, depending on the project's team members' time and days spent in the PACU.

Ethical Consideration /Protection of Human Subjects

This project was deemed a quality improvement project and was exempt from Investigational Review Board (IRB) approval. Personal identifying and demographic data were not collected from any patient. Nursing and anesthesia staff names were not reported. The study was nonbiased as the project team conducted convenience sampling of the PACU workflow, depending on when they were available to collect data. The assessments did not exclude anyone due to race, gender, color, religion, sex, marital status, national or ethnic origin, sexual orientation, disability, or other factor protected by law. All data was securely stored in a secure location with project leaders.

Measurement Instruments

To measure the outcomes of this DNP Project, 50 observations of the PACU workflow were completed by each graduate student for a total of 100 observations using the designed assessment tool. The PACU assessment tool was created using data on critical PACU functions from Budelier et al. (2020). This tool assessed how often each criterion occurred and was addressed by PACU staff as they recovered patients during the patient's length of stay in the PACU. Based on the findings of the total 100 observations, findings and recommendations were presented to the perioperative leadership team on how to improve PACU workflow and decrease PACU discharge delays. A follow-up discussion occurred between the project leaders and perioperative leadership on helpfulness and feasibility of the recommendations for workflow improvement.

Data Collection Procedure

The project was implemented using the Define, Measure, Analyze, Improve, and Control (DMAIC) process. As the name suggests, DMAIC includes five phases that make up the quality improvement process: define, measure, analyze, improve, and control (American Society for Quality, n.d.). It begins with defining the problem or quality improvement interest while specifying goals for the project. The measurement phase included establishing baseline data of the current environment prior to any improvement implementation. Following the DMAIC process, the next phase was the analysis of the collected data to identify any current practice process weaknesses and discern the root cause of the issue at hand. Once the analysis of the current practice deficits was determined, the project team implemented a plan to address the identified causes of the problem. Following a successful improvement implementation, a control plan was developed to maintain the new improved process at its current level of success and prevent practices from reverting to previous, less adventitious ways (American Society for Quality, n.d.).

Pre-intervention

The pre-intervention phase of the project included defining the need for improvement and collecting baseline data on current practices to uncover the practices that were contributing to ineffective PACU workflow and delayed discharges. A thorough literature review revealed that poor PACU workflow, including ineffective handoff, lack of quickly addressing patient complications, and delayed discharge can negatively affect overall perioperative patient care (Halladay et al., 2019; King et al., 2019; Shah et al., 2019). Negative nursing attitudes can also negatively affect PACU workflow.

Once the aim of the project was established, baseline data was collected on the current workflow of the PACU, detecting patient derangements and complications and the speed at which they were addressed. Project team members utilized a PACU Workflow Assessment Tool to measure and record PACU workflow activities which included patient handoff, patient complications, patient emergencies, patient discharge, and PACU staff assessments. The data collector observed the thoroughness of the patient handoff, the timeliness of the PACU personnel on addressing patient needs and the thoroughness of the task completion. Timeliness of discharge was also assessed including cause of potential delay if one was found. The project team gathered information by surveying the PACU nurses on their number of years working in the PACU, whether they were travel nurses, and their attitude toward their role as a PACU nurse. The project team also gathered information from PACU nurses on what they believed to be the most common causes of patient throughput delays and PACU bottlenecking. All of the information was recorded on the PACU Workflow Assessment Tool. Upon completion of observational data collection using the workflow assessment tool, project leaders interviewed PACU stakeholders to identify provider-identified barriers to workflow. The project team did not blind the staff if asked about their presence in the PACU and assured the staff that the presence of the project team and observed metrics were not used punitively, but only to improve processes. After the baseline data on PACU workflow and staff attitudes was assessed, the project team analyzed the data collected finding averages to determine hindrances in PACU workflow and possible root causes of the inefficient workflow.

Intervention

After the baseline data was collected and analyzed by the project team, the delay of discharge findings was summarized, and recommendations developed to present to the

perioperative leadership team. Prior to the presentation of recommendations, it was paramount

for the project team to thoroughly examine the data and correctly determine the root cause of the

inefficient workflow and slow throughput. Without careful analysis, the goal of improvement

would be challenging to achieve (Six Sigma US, 2022). Once the recommendations were

developed, a document, which also included summary of findings, was sent in a portable

document format (PDF) to all perioperative leadership via email.

Post-intervention

Following the presentation, a follow up email was sent to the leadership members asking

for their feedback on the helpfulness of the presentation and the feasibility of the

recommendations made to optimize the PACU workflow and prevent future bottlenecks in the

perioperative care areas. The project team worked to maintain the positive changes made toward

the improvement of PACU workflow through the recommendations and discuss with the

perioperative leadership on the importance of the findings and continued implementation of

recommended improvements to PACU workflow.

Data Analysis

The information collected on the PACU Workflow Assessment Tool was totaled and

averages completed. In the patient handoff section of the assessment tool, the handoff was

assessed for completeness of the report and the quality of the report. Other assessments included

whether the room was quiet, and whether the team was actively listening, how well the

information was thoroughly communicated, and the quality of the handoff report. The type of

complications or adverse events that occurred and the number of times they occurred were

tabulated, along with the treatment of adverse events or complications. Regarding discharge,

documentation indicated if it took beyond fifteen minutes to discharge a patient after the

anesthesia provider placed discharge orders or safe to transfer orders. If it took more than fifteen

minutes, reasons for the extended time were noted after conversing with the PACU nurse. This

information was used to help guide the recommendations that were given after the results were

analyzed.

Procedures for Project implementation

Appendix D outlines the timeline for the project. The project received IRB exempt status

in May 2023. Perioperative nursing leadership and anesthesia leadership approval was granted in

June 2023. Baseline observational data was collected over a 10-week period starting in June.

After the completion of 105 total baseline observations, project leaders took three weeks to

analyze the collected data and determine trends or patterns in documented workflow

breakdowns. Project leaders then created a document describing recommendations based on the

findings from the patient assessments to improve knowledge of PACU workflow. The document

was sent to perioperative leadership via email. A follow-up email was sent to leadership to gather

their feedback on the helpfulness of the document and feasibility of the recommendations

proposed to improve PACU workflow. Project leaders also directly communicated with several

leadership members. Project findings were detailed and summarized in a final project written

paper and an oral presentation was also given to communities of interest. A poster presentation

was developed, and the poster will be presented in the future for Research Day in the spring of

2024.

Cultural considerations were made throughout the project. During the observations and

throughout data analysis, all the PACU Workflow Assessment Tool forms were reviewed and

closely scrutinized to prevent any bias and include any cultural considerations that may affect

workflow. As needed, language accommodations were offered for staff that preferred the

educational document presented in a language other than English. The project leaders also

consulted project team members to review the recommendation document and presentation for

feedback prior to sending to leadership.

<div align="center">**Outcomes and Evaluation**</div>

Results

PACU observations and workflow assessments were collected for a total of 105

individual PACU patients over a 10-week period. Of the 105 pre-assessments completed, five

agency nurses cared for the observed patients (5%). Of the BJH PACU nursing staff, years of

experience varied between the different PACU areas, with the majority of years of experience

being 4 years (m = 9). Staffing ratios were most often one nurse to two PACU patients (95%),

but 1:1 and 1:3 ratios were also observed.

After collecting 105 baseline patient workflow assessments, the raw data was analyzed to

determine the PACU workflow barriers and delays in discharge. Data was divided into groups

based on the PACU location (Parkview Tower, Center for Advanced Medicine, Modules B, E,

and F on south campus). Appendix E shows time, disposition of patient on discharge, whether

the patient was discharged within 15 minutes of discharge orders from the PACU

anesthesiologist, and reason for delays. Across all the PACU areas, there was not a single patient

who left the PACU within 15 minutes of the anesthesiologist signing discharge orders. Module B

within South Campus of BJH experienced the longest time in the PACU (average of 148

minutes), with the CAM, a part of North Campus at BJH, having the fastest time spent in the

PACU (average of 72 minutes). Reoccurring reasons for delayed discharges included mobile

pharmacy wait times, incorrect surgical postoperative orders, boarding the patient due to no inpatient bed being available, and anesthesiologist being available for discharge orders.

Appendix F represents the quality of the handoff, the speed of acknowledgement for physiologic derangements, adverse events, and emergency interventions. Meaningful handoff was consistently seen with high quality (100%). There were no emergency interventions, including CPR or reintubation. There were several patients who experienced physiological derangements (13.2%), but all derangements were immediately acknowledged. Several patients also had an adverse event requiring treatment (35.8%), with two of those patients experiencing an adverse event where nursing was slow to acknowledge the adverse event or was slow to escalate treatment (1.9%). However, no patient experienced permanent harm.

After data analysis was complete, a summary of findings and observations were presented in a document along with recommendations for improvement. This document was then distributed to perioperative leadership. The perioperative leadership team members were from both nursing and anesthesiology, including the director of perioperative pre/post and perioperative education programs, the director of quality and safety for perioperative services, and a faculty member from Informatics and Innovation Research. Leadership team members were given the opportunity to ask questions and provide feedback to project leaders.

Discussion of Findings/Outcomes

The project members noted that the PACU does experience slow throughput and bottlenecks throughout the day, with some days being worse than other days. The project members noted lengthy boarding in the PACU of inpatient admissions due to no beds being available, lengthy wait times for discharge orders, or complications that occurred, delaying discharge.

The PACU workflow has many barriers to smooth throughput and these findings were presented to leadership. Many of these barriers were already known by the PACU leadership. However, the documentation of these findings presented evidence of the barriers occurring in the PACU which could then be presented to upper management as a positive method for change to occur. After presenting the findings and recommendations, the PACU and anesthesia leadership were given then the opportunity to ask questions which were answered by the project team members.

Discussion of the findings with the clinical research coordinator for the perioperative telehealth projects revealed an interest in this project, and they were grateful for our time and energy spent collecting and analyzing data. Their interest specifically focused on workflow barriers in POD 1 or Parkview Tower where the current ePACU project is taking place. The ePACU is an investigative PACU that is done via telehealth. The project leaders felt that the ePACU may be a helpful resource for improving PACU discharge. If the ePACU could assess the patient for discharge and then write the order, this may make discharge occur quicker, especially when the anesthesiologist covering the PACU is busy with other patients and cannot write the discharge orders. The ePACU attending may be able to assess the patient and write discharge orders, allowing the patient to be discharged to home in a more efficient timeframe.

Barriers to discharge also included waiting for the mobile pharmacy at the hospital to deliver medications to the patient prior to discharge. This is an area that will be assessed and analyzed to see if there is a way to improve wait times. Overall, the clinical research coordinator found the findings and recommendations helpful and aided in understanding the PACU workflow in its entirety.

Another member of the perioperative telehealth project and the department of anesthesiology informatics director shared positive feedback and found it interesting that handoff practices were of high quality for 100% of the documented interactions. They further expressed their appreciations for the findings surrounding PACU workflow practices. They appreciated the qualitative data and direct information from the PACU nurses that the project team members shared with them.

The nursing director of perioperative pre/post and perioperative education expressed appreciation for the workflow assessment. They felt the findings were as they expected. Regarding the recommendation to utilize advanced practice nurses in the ePACU for writing orders and discharges, there was concern on the legality due to scope of practice limitations. Additionally, they provided insight into the extended mobile pharmacy wait times. The outpatient pharmacist is on the opposite end of the campus for module B, E and F for the south campus PACU areas. The PACU director has requested another pharmacist to improve workflow, but there are limited resources/personnel available from the pharmacy department. Because of this, PACU nurses in module B, E and F have been advised to submit mobile pharmacy orders immediately when the patient first arrives to the PACU. Since it normally takes about 1.5 hours for the mobile pharmacy order to be filled and delivered, this will allow for the medications to arrive before the discharge orders are written, allowing the patient to be discharged without waiting for their discharge medications. However, if the surgical resident did not place discharge prescription orders correctly or did not place the order prior to the patient's arrival to the PACU, this can add more time before the patient is discharged. They also mentioned that for PACU patients waiting for an inpatient bed, they communicate with the PACU nurses frequently to get them to transport the patient to the floor as soon as possible. At

times, there is no bed available, which leads to "boarding" or keeping the patient in PACU until a bed is available. This is the most common reason patient discharge is delayed from the PACU in module B. Overall, nursing perioperative leadership was pleased with the findings and was able to share it with the perioperative nursing team and upper management with the hope that the information provided can help make positive changes in the future.

Project leaders were unable to get a return response from other recipients of the summary of findings and recommendations documents. However, they were offered the opportunity to ask questions. It was assumed that the information was clear and helpful

Strengths and Limitations of Findings

Analysis of the collected data revealed a few limitations of the findings. Demographics of the PACU staff only included years of experience and whether or not they were permanent staff or travel nurses. No demographics were collected on the patients observed. Information on the type of surgery, length of the anesthetic period, and ASA score were also not collected. This information can greatly affect length of stay in the PACU and predictability of physical derangement occurrence. It may also impact the time in PACU and any possible discharge delays. Another limitation to the project was that the project team could not physically be present during the whole time that each patient was in PACU. This most likely led to the project team members missing adverse events that may have occurred while the patient was in PACU. .

Project leaders did not communicate with the surgical team regarding their impact on the workflow of the PACU. However, the project team discovered that missing surgical orders was an issue that led to extended time in PACU and delays in discharge. Future collaboration with the department of surgery may help with improving PACU workflow.

The project leaders for this project were both full-time graduate students throughout data collection. Since a convenience sampling method was used, data collection was limited to the availability of the project leader's schedule and the rigid time frame of the project. Despite the tight schedule and availability for data collection, over 100 PACU patient experiences were observed, resulting in a meaningful amount of data.

Another limitation was the lack of communication from some leadership following the distribution of the findings and recommendations. The project team was hoping to get feedback from these leaders; however, lack of communication occurred even when a follow-up email was sent to them.

Strengths of the findings included, a large group of PACU patients being assessed with data collected over five weeks in several PACU settings to gain helpful information on the barriers of PACU workflow. This allowed a greater chance of capturing possible workflow barriers during this time period.

Evaluations of the Process

The design of this project was successful in establishing quantitative and qualitative data on PACU workflow practices and barriers. Due to the magnitude of the items on the assessment tool, the project team focused on PACU assessment, findings and recommendations to leadership instead of trying to measure interventions that would involve major hospital changes to PACU workflow and then determining if those actions were successful. This would have been impossible to carry out during the limited time span that the project team had to complete the project. Instead, the project shared a summary of observational findings and recommendations for workflow improvement with leadership involved in the PACU. This communication was followed up with leadership individuals to determine the impact and critiques of the findings and

recommendations. In evaluating the process of this project, there were multiple departments and

disciplines involved, each with their own understanding of PACU workflow barriers and

differing concerns regarding PACU workflow improvement. This project showed the complexity

of the PACU and how upper management is needed to change major hospital systems to prevent

some of the barriers to PACU workflow. For example, due to the neurosurgical ICU having

limited available beds and patients remaining in PACU for days, the hospital would need to open

more neurosurgical beds. This is not something that can immediately be addressed for multiple

reasons. Some of the solutions for improved workflow were beyond the project team members'

interventions.

<h2 style="text-align:center">System and Practice Impact</h2>

Implications for Organizational and Systems Change

The organizational and systemic change required to improve PACU workflow and

decrease PACU discharge/transfer times requires a comprehensive approach, fostering

collaboration and communication between all those involved. Based on feedback from

anesthesiology and nursing perioperative leadership, all are invested in improving PACU

workflow and found the project findings very "interesting" and "helpful". The project's findings

and recommendations provided new information or increased awareness of the issues and

allowed leadership to further investigate how workflow in the PACU can be improved. This

project has been able to enhance the quality and effectiveness of PACU operations within the

system.

Recommendations for Nursing Practice

Further investigation is needed to determine the full extent of PACU workflow

bottlenecks and barriers caused by systemic hospital issues. Nursing staff should maintain a high

level of patient care including quality handoff and teamwork to move patients through PACU in a safe and efficient manner. PACU nursing staff must continue to advocate for the perioperative care areas and push for improvements in systemic protocols and practice models to enhance the care and experiences of their patients. For PACU nurses to make improvements to their department, they need to be included in the process. They will be the end users for any protocol or innovative systems changes, so their feedback on workflow issues will have a greater impact on the success of PACU improvement projects.

Sustainability

The findings of this project have been dispersed throughout perioperative leadership. From follow-up discussions, project leaders have discovered that the findings have already been shared with PACU nursing staff and upper management. This knowledge is imperative to maintain the drive for positive change in the PACU workflow and care of perioperative patients. The findings and recommendations will be available to all PACU leadership to utilize as leverage to make changes moving forward. In the future, new projects may be able to look again at the PACU workflow and see if improvements have been made. Hopefully, the findings and recommendations may provide helpful information for future utilization of the ePACU.

<div align="center">

Summary and Conclusion

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Project Summary

Addressing workflow breakdowns in the PACU of a hospital is of paramount significance for several reasons. The PACU is a critical phase where patients transition from anesthesia to recovery, and any disruptions in the workflow can have profound implications for patient safety and outcomes. Efficient workflow ensures timely postoperative monitoring, pain management,

and identification of complications, allowing for immediate intervention if necessary. Addressing breakdowns in the PACU workflow can streamline patient care, reduce wait times, prevent bottlenecks, and enhance the overall quality of care. Moreover, it aids in optimizing resource utilization, minimizing errors, and maintaining a conducive environment for healthcare professionals to work effectively, thereby ensuring a smoother patient recovery process. Identifying and rectifying workflow issues in the PACU ultimately contributes to better patient experiences, improved outcomes, and the overall efficiency of the healthcare system.

This project aimed to observe and assess current PACU workflow practices in the different PACU settings of a large, academic medical center. Observational data showed various workflow breakdowns which involved multiple different departments within the hospital system. Given the complexity of workflow in the PACU, project leaders did not find a singular solution to improve throughput all PACUs. Instead, the summary of findings and recommendations shared with perioperative leadership helped bring insight to the different leadership members and new information for future projects surrounding PACU workflow. The most significant recommendation being the implementation of the continued ePACU initiative to assist with PACU orders, management of patient derangements including pain and nausea as well as assist with patient discharge.

Plan for Dissemination

This project was shared with key stakeholders within perioperative leadership and anesthesiology telehealth clinical research. A summary of the project and findings was presented to students, staff, and faculty of Goldfarb School of Nursing, including the Doctorate of Nursing Practice program. Further dissemination of the project findings will occur with a poster presentation in Spring of 2024.

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Appendix A: PACU Assessment on Workflow Tool

Activity	High Quality	Poor Quality	Not Done	N/A
Participated in a meaningful handoff from OR to PACU	Addressed all of items listed	Did not address all items	-	-
Name, ID, Procedure, Surgeon				
Medical History, past surgeries, allergies				
Anesthesia type, airway management/concerns, antibiotics, IV access, invasive monitoring				
Anesthetic events/treatments, analgesics, antiemetics, NM blockade/ & reversal, surgical events, I & O, EBL, labs				
Patient status, oxygen, analgesics, sedatives				
General observations/comments about handoff:				
Detected physiological derangements and complications	Immediately acknowledged	Slow to acknowledge	-	-
Persistent confusion/delirium				
ST, SB, atrial fibrillation				
Respiratory depression, hypoxemia				
Hypotension				
Weakness				
Emesis, vomiting				
Hyperglycemia				
Hypothermia				
Low urine output				
Other:				
Identified adverse systems/events requiring treatment	Immediately recognized adverse event and treated	Slow to respond to adverse event and treatment	-	-
Dizziness, lightheadedness				
Nausea				
Severe pain				
Difficulty breathing				
Chest pain unrelated to surgery				
Shivering				
Itching				
Other:				

Recognized situations requiring emergency medical intervention	Immediately recognized instability and treated	Slow to respond to instability and treatment	-	-
Intubation				
Assisted ventilation				
CPR				
Cardioversion				
Unplanned transfusion				
Naloxone administration				
Return to OR				
Other:				
Determine when patients were ready for PACU discharge	When ready, immediately notified MD and discharged patient within 15 minutes	Slow to notify MD; patient was discharged more than 15 minutes later	-	-
Notified anesthesiologist that patient was ready for discharge and was discharged within __??__ minutes (write in time from notification to discharge)				
Aldrete Score at discharge				
Other comments:				
Additional Questions regarding PACU Nurses				
Are you a BJH employee (vs a travel nurse)? If so, how many years have you worked at BJH?	Yes	No	Yrs	
What is the current staffing ratio (# of patients the RN is recovering i.e. 1:4)		Comments		
What barriers do you see that lead to decreased PACU workflow and delays in discharge of the patient?				
Other comments/observations that may impact workflow:				

Modified from Robins, H & Dai, F: Handoffs in the postoperative anesthesia care unit: Use of a checklist for transfer of care. *AANAJ* 2015; 83(4): 264-268.

Appendix B: Conceptual Framework for Comfort Theory
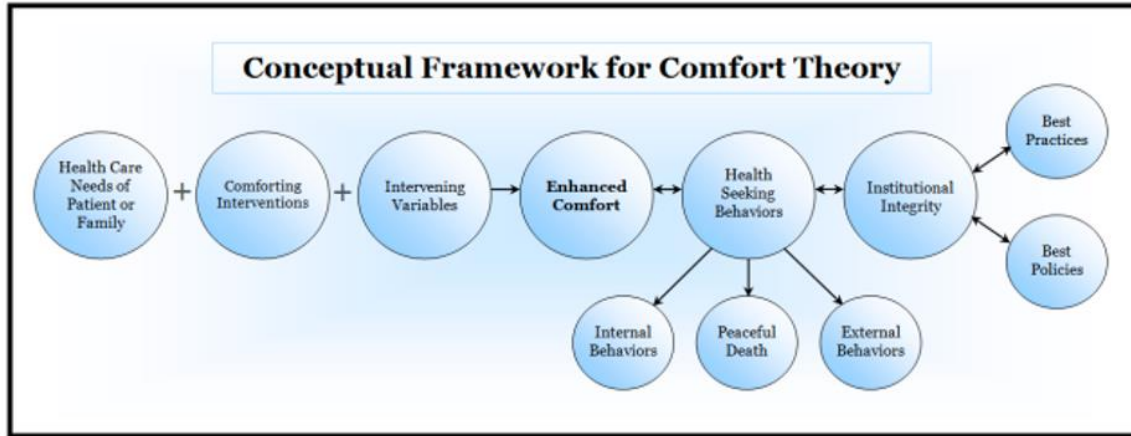
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Appendix C: Budget Table

Nature of Expenditure/Item	Cost per Unit	# Units	Total Estimated Cost
Direct Costs			
Project Leader's Salaries (RN)	$32/hour	2 Project Leaders X days x X hours a day = X hours	**$0 as project team leaders will not be paid**
Materials and Supplies			
Paper	$0.01	100	**$1.00**
Commercial Ink	$40	1	**$40**
Technology Hardware/Software			
SPSS	$100	1	**$100**
Workflow Assessment Tool	$0		**$0**
	$0		**$0**
TOTAL			**$141.00**

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Appendix D: Project Timeline

Task	May	June	July	August	September	October	November	December
Pre-intervention baseline PACU workflow observations obtained	x	x	x					
Evaluation of results of pre-intervention data				x				
Creation of educational document and distribution to staff					x			
Post-intervention PACU workflow observations collected and analyzed						x	x	
Analysis of outcomes							x	x
Results presented to key stakeholders								x

Appendix E: Determining Patient Discharge from PACU

	Time Spent in PACU (min)	Disposition		Patient leaves 15 minutes after anesthesiologist signs discharge orders		Most frequent reasons for delayed discharge
	M	*N* inpatient	*N* outpatient	Yes	No	
POD 1 – PVT	104	11	18	1	28	Mobile pharmacy Anesthesia attending availability
POD 4 – CAM	72	3	25	10	18	Waiting for ride/transport Sedation Surgery post-op orders not placed correctly
POD 2/3/5-Module B	148	33	1	5	29	Telemetry box delivery Contacting floor for handoff Boarding Surgery post-op orders not placed correctly Evening anesthesia coverage
POD 2/3/5-Module E and F	101	0	14	6	8	Mobile pharmacy Surgery post-op orders not placed correctly Anesthesia not placing post-op order Anesthesia or Surgical attending unable to be contacted

Note. Parkview Tower (PVT); Center for Advanced Medicine (CAM); Postanesthesia Care Unit (PACU)

Appendix F: PACU Workflow Analysis for all PACUs

	High Quality	Low Quality	
Meaningful Handoff OR to PACU	100%	(-)	
	Immediately Acknowledged	Slow to Acknowledge	Not Applicable
Detection of physiologic derangements	13.2%	(-)	86.8%
Adverse events requiring treatment	35.8%	1.9%	62.3%
Emergency Intervention	(-)	(-)	100%

Note. Operating room (OR); Postanesthesia care unit (PACU)