QUALITY IMPROVEMENT PROJECT: REDUCING OPERATING ROOM TURNOVER TIME FOR ROBOTIC SURGERY

by

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ABSTRACT

Background: Institutional goals for the Operating Room (OR) aim to decrease time between surgical cases to support surgical demand while improving revenue and profit. Turnover time (TOT), defined as the time between one patient exiting surgery to the time the next patient enters the room for surgery, is considered non-productive, thus a standard target for efficiency.

Local Problem: Following TOT delays, surgeon time constraints, and staffing frustration, a Level III trauma center aimed to improve affordability and access within their OR.

Methods: This quality improvement project implemented evidence-based practices, to create a sustainable decrease in TOT. This project utilized the Plan-Do-Study-Act method to engage stakeholders, implement best practices, and evaluate outcomes.

Interventions: The project implemented role differentiation, parallel processing, and an assigned robot facilitator to achieve a 28-minute TOT. To accomplish this goal, we anticipated the primary nurse would retrieve the patient in the perioperative department 12 minutes after their return from PACU.

Results: Prior to implementing the QI project, the OR's TOT averaged 34 minutes. Implementation of the evidence-based interventions resulted in an average TOT of 28 minutes.

Conclusion: Results indicated the implementation of a secondary nurse with defined roles, along with adequate turnover assistance yielded an improvement in TOT. Staffing is a major contributor to implementing these changes and requires a motivated team to achieve positive outcomes.

Keywords: Operating Room, Turnover

CHAPTER ONE

REVIEW OF THE LITERATURE

Background

Time in the operating room (OR) is a large hospital expense, costing $36 to $37 per minute (Snachez et al., 2023). The OR is a significant contributor to a hospital's profitability, but also incurs substantial costs including equipment, supplies, personnel and facility resources (Souders, et al., 2017). Utilization in the OR is a key performance metric for perioperative services and is, therefore, monitored closely, with the above considerations in mind. Turn over times can have a considerable effect on utilization and profitability.

Turnover time (TOT) is defined as the time it takes to prepare an OR for the following case or the time between one patient leaving the OR to the next patient entering; time that is considered non-productive, yet it is crucial for patient safety. Interventions can be implemented decrease TOTs, improve OR efficiency, improve surgeon and patient satisfaction, all while reducing cost and maintaining safe, quality care.

Objectives

Nationally, institutional goals for the OR aim to minimize the time between surgical cases to support surgical demand while improving revenue and profit. Robotic surgery has increased the complexity and number of tasks required during an OR turnover, resulting in highly variable OR turnover times. The scoping literature review aimed to determine evidence-based interventions to decrease duration and streamline turnovers for consistency.

Methods

Peer-reviewed articles included in the scoping literature review were obtained from Montana State University's Library Catsearch, CINAHL, and Cochrane Library. CINAHL and Catsearch offered the majority of articles, yielding some duplicates. Search terms included the following: "Operating room turnovers" for the dates January 1, 2014- current. The Preferred Reporting Items for Systematic Reviews and Meta-analysis Statement Guidelines (PRISMA) flowchart helped the writer to identify articles to include in the Evidence Table.

Eligibility

Inclusion and Exclusion criteria

The PRISMA Statement was used as a systematic approach to finding relevant articles discussing methods to decrease or streamline operating room turnovers. The first inclusion criteria were peer-reviewed articles only, next was a date range, 2014 to current. Studies were included if methods for reducing operating room TOTs were discussed. Studies were excluded if the focus was on orthopedic, cardiac, or neurovascular surgeries. Studies identifying anesthesia effect, certain medications, or regional blocks on turnover times were also excluded.

Study Selection The electronic search with the specified inclusion criteria yielded 25 articles, 23 articles after duplicates were removed. The writer screened articles by title and or abstract for inclusion eligibility.

Quality Assessment The Joanna Briggs Institute (JBI) quality assessment tool was used to critically appraise articles within this literature review. The quality assessment tool aids in clinical decision-making to assess the "methodological quality" of

studies included in systematic reviews (Joanna Briggs Institute, 2017). All included articles had clearly defined objective, and were peer reviewed. Most articles included were Level 6, as they were single qualitative studies or QI projects. Two randomized control trials were included in this systematic review. Not all articles included biases, yet overall, articles included in the chart were appraised as overall sufficient.

Results

Training Requirements

Emphasizing communication, engagement, commitment, active participation and role definition are essential in reducing TOTs. Training and education ensure staff members can adapt these initiatives into practice. Goldhaber et al. (2023) encouraged documentation of events such as "cleanup" and "setup" to gain insight into reasons for delay and increase awareness and accountability of staff. Patient events are monitored at this facility, but not frequently used when the patient has not entered the OR and will require training to implement these tools into practice. Sanchez, et al., (2023) offered training not only to educate on new turnover procedures, but also to ensure surgical staff had necessary skills and knowledge to perform turnovers efficiently.

Identifying Cause of Delays

Many studies aimed to identify the cause of delays and prolonged turnovers. Cases with the same anesthesiologist and surgeon had the lowest TOTs (Cohen et al., 2020). Cleaning by environmental services (EVS) caused the most significant time delays related to: cleaning practices, alerting EVS staff members, awaiting EVS arrival, lack of incentives to work quickly,

and number of people assisting in cleaning the room. Cleaning time varied between 38 minutes (1 staff member) to 25.5 minutes (3 staff members) based on EVS staffing (Kumar & Malhorta, 2017). EVS is not responsible for cleaning rooms at this facility, but number of available staff members to assist with cleaning should be considered.

The greatest contributors in TOT delays were instrument set up (25.5 minutes) and cleaning (25 minutes) (Kumar & Malhorta, 2017). Interventions generated by human factor analysis improved TOTs by 26 minutes, and decreased major delays by over 50% (Cohen, et al., 2022). Documented delays are considered "hospital related problems" and are multifactorial and unpredictable. Problems easily addressed should be attended to save valuable time and keep surgical cases on schedule.

Many studies in the literature review identified causes of prolonged TOTs, but few identify specific interventions to improve outcomes. Additional studies are needed that focus on resources to improve TOTs. Specific interventions used LEAN frameworks to identify problems within the process and eliminate waste. Interventions focused on a variety of methods, from optimization of surgical trays to contain only necessary instruments, to assigning groups of people to facilitate turnovers by opening sterile supplies and preparing for the following case. Many studies looked at role differentiation to ensure all team members had specific jobs to expedite turnovers.

Studies identified prolonged TOT when assigned staff members took their breaks during turnovers. Staff assigned for breaks were less knowledgeable in regards of the case, surgeon preferences, and were less invested in proficiency of turnovers. Lee, et al., (2019) recommended

having standardized teams as this can reduce turnover times and operative times by approximately 9 to 47 minutes, due to familiarity.

Pit Crew Model

Practices to improve TOTs were identified through motor racing pit stops and many variations of this model were developed. Souders et al. (2017) used a "human factor approach" and applied concepts such as role definition, task allocation, briefings, and task sequencing to improve robotic TOT. These concepts reduced TOTs from 99.2 minutes to 53.2 minutes when measured three months after intervention (Souders, et al., 2017). A dedicated anesthesia team was used to assist with set up of the robot and removed unused disposable equipment at one facility (Souders, et al., (2017), where Cohen, et al. (2020) used patient care technicians (PCTs) and reduced time by 10 minutes to assist in supporting task overlap during turn over and standardizing practices of opening supplies. Interventions were identified by data collection and insight from a multi-profession OR team.

Li, et al., (2018) investigate a "Fastlane" model, for improving efficiency by increasing OR throughout but focused on lower risk patients with cases estimated to take less than one hour. Patients arrived earlier and had the same pre and post-operative nurses for continuity and to decrease hand off time. TOTs were decreased in the "Fastlane" group compared to the control group, with TOTs of 17 verses 26 minutes, which was statistically significant (Li, et al., 2018). The improvement is attributed to defined, committed team, and standardized OR handoff protocols. *ASC's "Pit Crew" Brings NASCAR Speed to Turnovers,*(2017) included specific roles differentiation such as the "kick starter" (pre-op nurse started all IVs), "pit boss" (charge nurse who directs staff and ensures cases are staged and prepared before next case), the "collector"

(surgical scrub that removes dirty instruments and transports to sterile processing), the "compressor" (anesthesia tech who handles anesthesia-related supplies) and the "sweeper", or the cleaner. Within the pit crew model, Li, et al. (2018), Souders, et al. (2017), and Cohen, et al. (2020) all focused on individual role definition to decrease TOTs. Goldhaber et al., (2023) focused on measurement and accountability of staff by dividing TOT into segments necessary to gain insight into the causes associated with delays, to increase awareness and improve accountability.

Communication

Many studies attributed delayed TOTs and cancelations to poor communication. Improved communication between perioperative team members, and the OR team has been shown to improve first-case start times (Lee et al., 2019). Bhatt, et al., 2014 used observation to identify current problems within TOTs and redesigned processes that focused on developing consistent criteria for OR readiness, using parallel processing for patient and room readiness, and enhancing perioperative communication. Stringer, et al., 2015 implemented a one-time personnel training session, surgeon led preoperative briefings at the beginning of each day to discuss unique concerns to each case, and postoperative debriefings at the end of each case to identify areas for improvement. Findings for this intervention were not statistically significant (41.48 minutes to 40.49 post intervention, $p=0.193$) (Stringer, et al., 2015). However, the mean surgical time decreased, thus OR efficiency was improved with improved communication. Data-driven approaches, including clear communication, improve efficiency and enables patient-centered, quality care (Lee, et al., 2019).

Parallel Processing

Sanchez, et al., 2023 introduced ‘parallel task execution” which involved the scrub technician set up the DaVinci Robotic System while the patient was being prepped for the procedure, which saved time at their facility. Multiple articles included the use of a separate room for induction of anesthesia, which was shown to reduce TOTs (Pimentel et al., 2015). Kumar & Malhorta (2017) encouraged parallel processing to save time while Cerfolio et al.,(2019) and Cohen et al., (2020) outlined multiple tasks which were streamlined and performed in parallel to decrease redundancy. Bhatt, et al., (2014) redesigned their TOT process with improved communication and parallel processing and reduced TOT greater than 35%.

Eliminating Waste

Olson et al. (2018) focused on three interventions to improve workflow and reduce waste. The three interventions included the circulating nurse-patient interview occurring in peri-operative services prior to OR room set up, spinal block initiation in pre-op, and the pre-operative nurse acting as transport to OR when ready (Olson, et al., 2018). Cerfolio, et al., 2019 used Lean and value stream mapping to identify non-valued steps in operating room turnover and found opportunities for improved efficiency. Eliminating waste, similarly to Sanchez, et al., 2023, not only eliminated unnecessary steps but also reduced turn overs from 37 minutes to 14 minutes. Value stream mapping was used to identify “valued” and “nonvalued” steps in a patients OR process, steps that were identified as “nonvalued” were eliminated from the process.

Discussion

Initiatives to enhance OR efficiency has a financial impact on hospital revenue, with extensive operational cost and revenue. Maximizing OR capacity by enhancing efficiency, especially during TOT, can be achieved by role differentiation, adequate support staff, parallel processing, eliminating waste, and effective communication. These outlined interventions have a positive effect on the cost of healthcare, staff satisfaction and patient care.

Lee, et al.'s (2019) objective was to evaluate OR costs, define metrics to evaluate OR efficiency, as well as examine techniques to improve value of surgical care. Surgical care accounts for approximately one third of all health are spending, and approximately one half of aggregate inpatient hospital costs (Lee, et al., 2019). First case start times, operating room utilization, and TOTs are all included on efficiency metrics, among others. The metrics were expanded on and cost saving innovations were identified. Prolonged OR turnover times lead to increased overtime staffing costs, wasted opportunity costs for potential revenue and decreased surgeon, staff, and patient satisfaction (Lee, et al., 2019). Another consideration mentioned in this study was post anesthesia care unit (PACU) availability. If there isn't enough staff to receive a patient, there will be a delay. Including all relevant stakeholders is necessary when eliminating wasteful steps, and incentivize efficient turn overs.

Cohen et al., 2020 and Cohen et al., 2022 used a human factor approach to investigate team members perception of why turn over times (specifically in the robotics service line) took longer than those cases that did not involve the robot. Physicians reported on a questionnaire, the greatest contribution to longer TOT was perceived as "time to set up the OR" while OR staff reported they felt the issue was related to "instrument availability" (Cohen et al., 2020). Findings

later indicated that the longest "phase" of turnover was cleaning the OR by EVS, which took on average 27.4 min (Cohen et al., 2020). This questionnaire, completed by 79 staff members, indicated that all staff members were "strongly dissatisfied" with TOTs in their facility, surgeons and anesthesiologist were more dissatisfied than OR staff (Cohen et al., 2020). Participants were asked to estimate how long average turn overs took, surgeons estimated the most amount of time, followed by residents, anesthesiologists, surgical technicians, and registered nurses.

Barriers

Documented barriers in literature include lack of nursing help during set, disagreements between staff on when the patient could be brought to OR, inaccurate preference cards, lack of contact information to notify surgeon that room was ready, EVS notifications to inform the need of cleaning, and lack of organization incentives to improve turnover times. Stringer, et al., 2015 notes the implementation of their intervention was difficult during a busy operative schedule. Findings were perceived to be a consequential adverse effect on efficiency, but this was not proven statistically. Leadership must be actively engaged to empower staff to work toward decreasing TOTs.

Cohen, et al., 2020 mentions that robotic specific set up (room layout, bed configurations, etc.) can add more complexity, increasing TOT causing barriers to efficiency. Some studies identified improved turnover times by assessing current workflow in the OR while addressing the tasks performed by the circulating nurse, and notifying support staff of needs, but results could not be attributed to a specific metric.

Strengths and Limitations

Many of the studies included in the literature review took place in single institutions, with small sample sizes, limiting generalizability. Observational studies acknowledge the Hawthorne Effect affecting turn over times, as OR staff knew that they were being observed to identify turn over time frames, activities, and delays (Kumar & Malhotra, 2017 & Cohen et al., 2020).

Conclusion

Evidence shows a variety of interventions can be implemented to reduce non-productive time in the operating room. Well defined roles, along with necessary support staff assistance during turnovers with standardized practices to improve OR efficiency, surgeon and patient satisfaction, by reducing cost and maintaining safe, quality care.

CHAPTER TWO

QUALITY IMPROVEMENT PROPOSAL

Introduction and Problem

Introduction

Utilization and efficiency in the OR are key performance metrics, influencing cost and revenue. The definition of TOT is the time it takes to prepare an OR for the next surgery, after the conclusion of the previous case. Prolonged TOT decreases efficiency, increases costs, and is associated with decreased staff motivation and patient satisfaction. Efficient time management in the OR saves health systems money and avoids additional costs, and significantly impacts OR efficiency, hospital revenue, and patient and staff satisfaction.

Robotic surgery offers undeniable advantages for minimally invasive procedures yet adds complexity for OR configuration. Procedures such as draping the robot arms with sterile drapes, opening additional instrumentation and supplies, and ensuring the robot and bed are in the proper position for docking can all add to TOT. To maximize the benefits of robotic surgeries, while minimizing time and cost, organizations must implement evidence-based strategies to decrease TOT.

Problem Statement

Prolonged TOT decreases efficiency, increases health care costs, and is associated with decreased staff motivation and patient satisfaction. Well defined roles for assigned OR staff and sufficient support staff assistance during turnovers with standardized practices to improve OR efficiency by reducing cost and maintaining safe, quality care.

Following 12-weeks of implementing defined OR roles and adequate support staff, the quality improvement (QI) project aims to:

(a) reduce average TOT to less them 28 minutes

(b) reduce the time between taking one patient to the post-anesthesia care unit (PACU) and retrieving the next patient from perioperative services to 12 minutes

(c) increase surgeon and OR staff satisfaction

Organizational Microsystem Assessment

The site chose the QI project to improve operating room utilization and patient and provider satisfaction. TOTs vary in published data between 17 and 99 minutes. Pre-implementation turnover times at this facility was an average of 34 minutes between April 2023 and September 2023. There are no documented policies or procedures regarding expediting turnovers, nor defined roles or designated facilitators.

Implementation of this QI I project will occur at a Level III trauma center with nine operating rooms. The facility has one DaVinci Si Robot, which is used for general, gynecology, urogynecology, and urology specialties. Block time can be difficult to obtain, due to high demand. The charge nurse assigns designated staff, typically one or two nurses and one certified surgical technician, to facilitate that room each day. There are a group of 5-6 nurses and 5-6 technicians who are efficient in the robotic specialty, these are the individuals assigned to the room each day. Other stakeholders include the surgeon and anesthesiologist assigned to the robot-designated OR, ancillary staff including patient care technicians (PCTs), RNs, and certified scrub technicians (CSTs) and the patients who are coming for surgery.

Quality Improvement Framework

The Institute for Healthcare Improvement Quality Improvement toolkit will be used to improve workflow and cost effectiveness in the OR. The framework uses the Plan-Do-Study-Act (PDSA) cycle to develop a plan, implement, observe, analyze, and learn from the test to determine modifications for the next cycle. The PDSA cycle is an ongoing, frequent process to inform this QI project, to ensure that multiple considerations occurred prior to the implementation in different OR specialties within this facility.

Step one of the framework is planning, not only for the QI project, but also for collecting data. A data collection tool was used for October 2023 to November 2023 to differentiate the amount of time it takes to complete each task within the turnover, and included variables which could increase or decrease the room turnover. An Epic Dashboard was also developed to track turnovers by surgeons and procedures in attempt to identity variations. Access was given from Epic Developers to the author of the QI project, the OR Manager, and the robotic team leads.

Next is “Do”, run the test on a small scale. Charge nurses were asked to assign two RNs to the robot room daily. Nursing staff were oriented to a list of duties for the ‘primary” and “secondary” nursing staff. The role differentiation table, designed by the robotic team leads, was also posted in the OR for reference. The primary nurse focused on patient specific duties like retrieving the patient from perioperative services and assisting anesthesia, while the secondary nurse focuses on retrieving medications, dispensing them to the sterile field, counting sharps, sponges, and instruments when necessary. Information continues to be collected on the same data collection tool as pre-implementation.

The “study” phase will involve analyzing the results before and during implementation and comparing them to predictions. The final step in PDSA is “act”, based on what you learned from the previous steps and determine what modifications should be adapted, adopted, or abandoned.

Specific Aims

The QI project aims to examine the effectiveness of integrating defined roles and designated turnover facilitating staff for reducing turnover times and maintaining consistency, regardless of assigned robotic staff on a specific day. By achieving this goal, satisfaction amongst team members, surgeons and patients will increase, productivity will increase, and OR cost will decrease.

Short term goals for this project will include 90% staff education amongst robotics team members regarding defined roles of primary and support staff. Mid-term goals include an average TOT of 28 minutes (17.6% reduction), and RN leaves for retrieval of patient within 12 minutes after wheels-out of OR with last patient. Long term goals for this project include sustaining gains made and improved perception of turnovers amongst team members.

Methods

Intervention and Implementation

Implementing defined roles and assigning a team-member facilitator at a level III hospital with 9 operating rooms will decrease TOTs. The project will focus on the staff within the operating room, as these new processes are to improve workflow for more consistent, proficient turnovers. The implementation will take education for staff, and constant use of the PDSA cycle

to ensure best practice. Staff buy in and open communication at quarterly meetings, along with day-to-day, will help promote staff engagement and aide in sustainability. Turnover time will be measured in minutes bi-weekly, but reports will be run to identify efficiency in March, 2024.

Facilitator Role: Assigning a team member to the Robot room is crucial for proficient turnovers. For this project, two nurses will be assigned to the robotic OR. Well defined, differentiated expectations for these RNs will help to streamline the turnover process. Implementation of these roles will require education for staff members on the goal and expectations, as well as discussion with all charge nurses, who make staff assignments. The scheduling team at this facility schedules ten nurses to start each day. There are typically seven operating rooms to be staffed, thus leaving nurses available to accommodate this QI project.

Timeline

The introduction of the QI project to OR staff members took place at the September quarterly staff meeting. Data collection on the organization's TOT, started in October, as well as a literature review to identify evidence based practice interventions. Submission to the MSU IRB for review will take place in December 2023 with implementation beginning in January. Implementation will begin with re-orientation at an OR staff meeting and QI team members working closely with charge nurses to ensure appropriate staffing and robotics team role clarity. A three month process analysis will occur in March to ensure staffing is sufficient to achieve our goal, to assess TOTs, and to share findings with stakeholders. Findings and future recommendations will be presented at the staff meeting in March. The final assessment of data will occur in April 2024 and will be the final assessment. A final project defense to facility committee will take place at the conclusion of the project.

Budget

Because of the current staffing at this time, no additional budget is required for implementation. If this QI project is effective in decreasing nonproductive time in the OR, the facility may be interested in considering increasing their full-time equivalent (FTE) to ensure facilitators are available for multiple specialties.

Barriers to Implementation

Barriers to implementation will be staffing constraints. Multiple ORs and procedures benefit from two nurses, technicians, or additional hands, either for patient positioning, flip rooms, patient acuity, room set up, or opening help. This barrier can be addressed by outlining a facilitator role for RNs, CSTs and PCTs.

Evaluation and Analysis

Figure 1: SMART Goal #1

SMART Goal #1: TOT less than 28 minutes for minor robotic cases.		
Decrease TOTs from an average of 34 to 28 minutes, by establishing clear role differentiation and assigning a robot facilitator, in order to increase staff and patient satisfaction		
Data to be collected	Methods of collection and who is responsible	Planned data analysis
TOTs per case (in minutes)	EMR system/ project lead	EMR system/ average (in minutes)
Number of days staffing allowed for facilitator	Charge nurse/ project lead/ robotics team leads	

Figure #2: SMART Goal #2

SMART Goal #2: Primary RN goes to periop for next patient 12 minutes after wheels out time of previous case		
Primary RN goes to retrieve patient 12 minutes after wheels out time with previous patient by relying on facilitator, preparing/ locating necessary meds/positioning supplies for case prior to turnover, to expedite TOTs.		
Data to be collected	Methods of collection and who is responsible	Planned data analysis
Wheels out of OR	EMR system/ project lead/ assigned RN	EMR system/ average (in minutes)
RN leaves for periop for patient retrieval	Documented on events sheet in OR by assigned RN	Average time (in minutes) calculated by project lead

Turnover times will be assessed by the author of the project bi-weekly with use of the epic Robot dashboard to obtain quantitative data. These findings will be shared at the quarterly staff meetings, where OR team members will be encouraged to share feedback and ask questions. Quantitative data collection will be ongoing via the EMR and will be evaluated weekly by the QI team. The project coordinator and author of the project will ensure completeness and accuracy of the data by using the EMR dashboard frequently and reviewing staffing to ensure the facilitator role was assigned, which is documented on the data collection tool and a daily staffing assignment sheet. The project coordinator will monitor the frequency of assigned robot OR facilitator role, along with the average turnover time that day. A further breakdown will be available to show the average turnover for each surgical case, and each surgeon who operates robotically. An ongoing data collection tool will be used through the pre-implementation and implementation process so that multiple variables can be considered.

Safety and Confidentiality

Average TOTs will be accessible EPIC, an electronic, password protected medical record along with a written breakdown via the data collection tool. The data collection tool gives a more detailed explanation of which events within the turnover are the most time consuming. This data will be collected at every case, by the primary robot RN and will be secured in a cabinet located in the OR within a locked department. TOTs will be viewed periodically throughout implementation, secured in the Epic robotics-specific dashboard. The interactive dashboard is accessible by the OR manager, Robotic Team Leads, and the writer of this QI project, and is password protected. Data will be stored in Epic and transcribed in a password-protected computer for sake of writing this QI.

This study did not involve human participants. No data inclusive of personal identifiable information (PI) or protected health information (PHI) was obtained for this study. Risk associated with this QI project includes no more than what OR staff members are exposed to in their normal work day. To ensure the rights, welfare, and privacy of human subjects for this QI project, IRB will review, and Montana State University site committee approval will be obtained prior to project implementation.

CHAPTER THREE

QUALITY IMPROVEMENT MANUSCRIPT

Contribution of Authors and Co-Authors

Manuscript in Chapter 3

Author: Shelby Anne Stier

Contributions: Review of literature, data analysis, first draft of entire manuscript

Co-Author: Lindsay Benes, PhD, RN

Contributions: Continuous collaboration, QI conception & execution, interpretation of data, manuscript writing, constructive feedback on written drafts

Co-Author: Stacy Stellflug, PhD, APRN, FNP-BC

Contributions: Collaboration with co-authors, manuscript writing, constructive feedback on written drafts

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Abstract

Background: Institutional goals for the Operating Room (OR) aim to decrease time between surgical cases to support surgical demand while improving revenue and profit. Turnover time (TOT) is considered non-productive, thus a standard target for efficiency.

Local Problem: Following TOT delays, surgeon time constraints, and staffing frustration, a Level III trauma center aimed to improve affordability and access within their OR.

Methods: This quality improvement project implemented evidence-based practices like role differentiation, parallel processing, and an assigned robot facilitator, to create a sustainable decrease in TOT. This project utilized the Plan-Do-Study-Act method to engage stakeholders, implement best practices, and evaluate outcomes.

Interventions: The project implemented role differentiation, parallel processing, and an assigned robot facilitator, to expedite TOTs. With these interventions, we aimed to achieve a 28-minute TOT, defined as out of room time of previous case to arrival time for next patient. To accomplish this goal, we anticipated the primary nurse would retrieve the patient in the periop department 12 minutes after their return from PACU.

Results: Prior to implementing the QI project, the OR's TOT averaged 34 minutes. Implementation of the above interventions resulted in an average TOT of 28 minutes.

Conclusion: Results indicated the implementation of a secondary nurse with defined roles, along with adequate turnover assistance yielded an improvement in TOT. Staffing is a major contributor to implementing these changes and requires a motivated team to achieve positive outcomes.

Keywords: Operating Room, Turnover

Clinical Problem

OR utilization and efficiency is a key performance metric, influencing cost and revenue. Turn over times (TOT) can have a considerable impact on utilization and profitability. TOT is defined as the time it takes between one patient leaving the OR to the next patient entering. TOTs are considered non-productive, as it does not yield profit for organizations. Lengthy TOTs also leave less time for surgeons to operate, disrupting the surgery schedule and frustrating patients, surgeons, and OR staff.

This Quality Improvement (QI) project aimed to improve OR efficiency and staff and patient satisfaction, while reducing costs at a 125-bed facility, DNV GL-accredited, certified Level III trauma center. Interventions identified in a literature review included well-defined staff roles, support staff assistance during turnovers, and standardized practices to improve OR efficiency.

Review of the Literature

To identify targets for improvement, we must understand the factors contributing to TOT delays. Cause of TOT delays found in the literature varied from room cleaning to instrument set up, staff meal breaks, as well as specific patient and hospital related causes. Once causes were identified, evidence-based solutions to alleviate delays and reduce TOTs were further investigated.

A "pit crew model" implements concepts like role definition, task allocation, briefings, and task sequencing to improve robotic TOTs (*ASC's "Pit Crew" Brings NASCAR Speed to Turnovers,* 2017; Li, et al., 2018; Souders, et al., 2017). Improved communication between

perioperative team members, and the OR team has shown to improve first-case start times, as well as TOTs (Lee et al., 2019). A method called "parallel processing" or "parallel task execution" can be used to outline multiple tasks, then streamlined and performed in parallel to decrease redundancy (Cerfolio et al., 2019; Cohen et al., 2020; Kumar & Malhorta, 2017). Lean methods, like value stream mapping can be used to identify and eliminate steps deemed nonproductive (Cerfolio, et al., 2019).

This quality improvement project implemented evidence-based practices including role differentiation, parallel processing, and an assigned robot facilitator, to create a sustainable decrease in TOT. Two nurses were assigned to the robotic OR each day. The nurses had defined roles, with specific tasks to accomplish in parallel to ensure no steps were repeated or time was wasted. This second nurse helped to facilitate the room and ensure necessary items were ready for the following cases, decreasing the risk for delays.

Conceptual Framework

This QI project utilized The Institute for Healthcare Improvement Quality Improvement toolkit to improve workflow and cost effectiveness in the OR (Institute for Healthcare Improvement, n.d.). This toolkit utilizes the Plan-Do-Study-Act (PDSA) method to develop a plan, implement, observe, analyze, and learn from the test to determine modifications for the next cycle.

The planning phase allowed the team to look at the current state to identify necessary changes. Data was collected from October to November 2023 to differentiate the time taken to complete each task within the turnover and variables that could increase or decrease TOT.

Interventions were implemented in the “do” phase. Two nurses were assigned to the robotic OR with a role differentiation table using parallel processing, so steps were not duplicated, and nursing staff had clear expectations of the roles.

The “study” phase allowed the QI team to identify that staffing did not always allow for a second nurse to be assigned to the room, so a Certified Surgical Technician (CST) facilitator role was developed. This adaptation took place in the “act” phase. On days without available nurses, surgical technicians were assigned the facilitator role. When neither a nurse or CST was available, patient care technicians (PCT) help facilitate all ORs. A PCT may have also be assigned to this room to help open sterile supplies, drape the robot, and be available to the CST while the RN retrieves the patient in a timely fashion. The facilitator will be responsible for monitoring the OR status board and chooses a break times accordingly so that they can be available to expedite turnovers. Defined roles, within their scope of practice, help that individual see the expectations of the robot facilitator.

Purpose of Project

This quality improvement (QI) project aimed to examine the effectiveness of integrating defined roles, designating turnover staff, and maintaining consistency regardless of assigned robotic staff on a specific day. Through these interventions, we aimed to reduce TOT; increase satisfaction amongst team members, surgeons and patients; improve productivity; and reduce OR cost.

Methods

Context

This QI project was implemented at a Level III trauma center with nine operating rooms. This facility has one DaVinci Si Robot, which is utilized for general, gynecology, urogynecology, and urology specialties. Interventions were implemented in the robotic-specific OR. Procedures included in the data collection included robot assisted ventral, umbilical, and inguinal hernias, hysterectomies, sacrocolpopexies, colectomies, colostomy takedowns, hysteropexies, prostatectomies, cholecystectomies, and diagnostic laparoscopies. Surgical cases included in the data were elective and occurred during normal business hours. This hospital performs approximately XX robotic cases per month. Eleven surgeons were included and performed robotic cases during the data collection timeframe. Difficulty to obtain block time has become more challenging within the OR, especially in the robot room, due to its high demand and increase in robotically trained surgeons.

Intervention

This project was introduced to OR team members at a staff meeting after hospital administrators identified a need to improve TOT. The OR Manager recruited the author of this paper, robotics specialty team leaders, a surgical technician, and a registered nurse. After a literature review and discussion amongst QI team members, robot team leaders established a role differentiation table to assist with parallel processing. In order to gain buy-in from robotically trained staff, education and discussion took place informing them of the benefits of this role. An emphasis was placed on the fact that “non-productive” (TOT) is costly and negatively impacts

patients. The goal and expectations of this facilitator role were discussed and questions were answered.

Charge nurses were advised to assign two nurses to robotic surgical cases when staffing allowed. Staffing requirements to allow for implementation of this QI project was discussed with the scheduling committee. Ideally ten nurses were staffed to accommodate seven operating rooms with nurses available for breaks, turnover support, or add on surgical cases.

Robotic team leaders considered all required actions that take place prior to surgical procedures and divided them amongst two RNs. Nursing staff were oriented to a list of duties for the ‘primary” and “secondary” nursing staff. This role differentiation table, designed by the robotic team leads and seen in Figure 1, was also posted in the OR for reference. The primary nurse focused on patient specific duties like retrieving the patient from perioperative services and assisting with anesthesia, while the secondary nurse focused on retrieving medications, dispensing them to the sterile field, counting sharps, sponges, and instruments when necessary.

Figure 1: Role Differentiation Table

Process	Primary RN	Facilitating RN	Other
Room Set-up **"Wheels out to wheels in"**	• Time-out board • Patient history • Obtains versed / abx • Interviews • Patient transport • Vocera periop RN for handoff / have pt void	• Room prep (positioning, equipment etc.) • Intra-op meds • Opening assist- robot arms, drape, etc • Counts with CST (RN) • Additional lines if no anesthesia tech • Prepare prep stand	• Morning breaks for all rooms assigned *not during turnover* • Lunches for all rooms assigned *tech comes to help close* • Afternoon breaks • Room stocking if downtime GOAL: Primary RN goes to periop for next pt 12 minutes after wheels out time of previous case Team Leads: AU & EL Team members: LH, AW, SS, HC, LS
Patient Prep **"Wheels in to procedure start"**	• Transfers pt to bed • Positions • Calls surgeon when prepping	• Assists with transfer / positioning • Assists anesthesia • Positioning / Prepping	
INTRA-OP	• Specimen management • Charting / Circulating RN • Meets / assess next patient (if appropriate)	• Prep for next case (supplies, equipment) • Gets meds for next case (RN)	
Wrap up **"Procedure stop to wheels out"**	• Call facilitator to room when closing • Broadcast turnover for PCTs and PACU • Verifies specimens / plan with surgeon • Transports to PACU / Phase I	• Assists anesthesia • Assists with transfer to gurney • Undrape arms, flush instruments • Begins turnover / cleaning	
Turnover **"Wheels out to wheels in"**	• Quick cases- RN goes straight to periop and interviews next pt. while second RN readies room • Try to interview next pt during breaks • Longer / more complex cases- RN returns to room to help with turnover and set-up (return to steps in top box)	• Room turnover / cleaning • Gets room ready (meds, positioning, equipment) • Assists CST open • Counts (RN) • Gathers equipment for next case (RN or CST)	

In addition to daily room assignments of two RNs and one CST, ancillary staff (available RNs, CSTs, and PCTs) would come to help remove garbage, clean rooms, and turnover for the following case, which was standard practice prior to implantation. Staff availability significantly influences TOT and is influenced by time of day, other surgeries, and training of support staff. Traditionally staff breaks in the OR are issued during TOT, for continuity, infection risk, and decreased use of sterile gown and gloves. However, when considering TOT, meal breaks during turnovers is less productive. Assigned staff are more familiar with preferences of the surgeon. Assigned staff are also typically more motivated to accomplish timely turnovers than relief staff. For these reasons, robotic team leads hoped that breaks could be issued nearing the end of cases, so that they may be back from break to open only necessary items for the following case, in a timely fashion.

Once staff were aware of goals and buy-in was achieved, data collection began. The chart in Figure 2 was developed after discussing variables which can delay or expedite TOTs. This tool was kept in the robotic OR and was completed by assigned RNs. Data was collected between November 7th and January 31st.

Figure 2: Data Collection tool

Date/ case of day	Surgeon / procedure	OR staff	In OR	stop time	OOR	# of TO help	RN back from PACU	set up (case cart in room)	RN to periop/ versed?	OOR to periop time	TOT
10/20/23 1.	Dr. X Robotic assisted Bilateral Inguinal Hernia repair	Primary RN: S Second RN: E CST: A	0707	0844	0855	2	0900	0905	0910/ N	10	20
10/20/23 2.	Dr. X Robotic assisted Right inguinal Hernia repair	Primary RN: S Second RN: E CST: A	0915	1010	1020	6	1030	1028	1045	15	30

The introduction of this QI project to OR staff members took place at the September quarterly staff meeting, followed by a literature review in October to identify evidence-based practice interventions. IRB submission occurred in December 2023 with implementation beginning in January 2024. Implementation began with re-orientation at an OR staff meeting and QI team members working closely with charge nurses to ensure appropriate staffing and robotics team role clarity. TOTs were assessed weekly along with data review by the author of this QI project. Data analysis was completed in March, marking 3-month post implementation.

Measures

Figure 2 shows the data collection tool utilized to obtain data on pertinent variables. Staff within the robotic OR were asked to complete the table for every back-to-back robot surgical procedure. The surgeon and procedure were documented to show variability from case to case. While supplies are similar across cases, surgeons' preferences do impact number of items requested to open, as well as sorting through items available in the room on an "as needed" basis. OR staff members were asked to identify if staffing allowed for two RNs as the project intended, if a CST was assigned to facilitate, or if no additional support was assigned. Times documented on the tool included in room time, stop time, out of room time, when the nurse returned from PACU, when they left for perioperative to retrieve the next patient, and when they returned back in the OR with the next patient. The number of available staff members who came to assist in the turnover was also monitored and was a major contributor to delayed TOTs both in the literature review and staff feedback. The other variable documented was anesthesiologist us of Versed in perioperative area, as this adds time for the primary RN. Staff members grew dedicated to this

project early on, thus added reason for delay, if applicable. This feedback was helpful to determine what common delays occurred most frequently.

An EPIC dashboard was created to monitor TOTs for this QI project. While this was thought to be a useful tool, end results determined that certain delays like surgeon availability could not be filtered out, drastically skewing data. The EPIC data interpretation considered all TOTs, unless over 110 minutes. This includes delays such as surgeon availability, meaning if the following surgeon is not available for an hour to start their case, that additional time is factored in the average TOT, which is the primary outcome measure considered for this QI project.

Analysis

Descriptive statistics were used to assess the effectiveness of this QI implementation. The first goal was to decrease TOTs from an average of 34 to 28 minutes. This TOT duration was calculated by the number of minutes between one patient leaving the operating room ("wheels out") to the next patient entering the or ("wheels in"). The second smart goal was to Primary RN goes to retrieve patient 12 minutes after wheels out time with previous patient by relying on the secondary nurse to preparing necessary medications and positioning equipment.

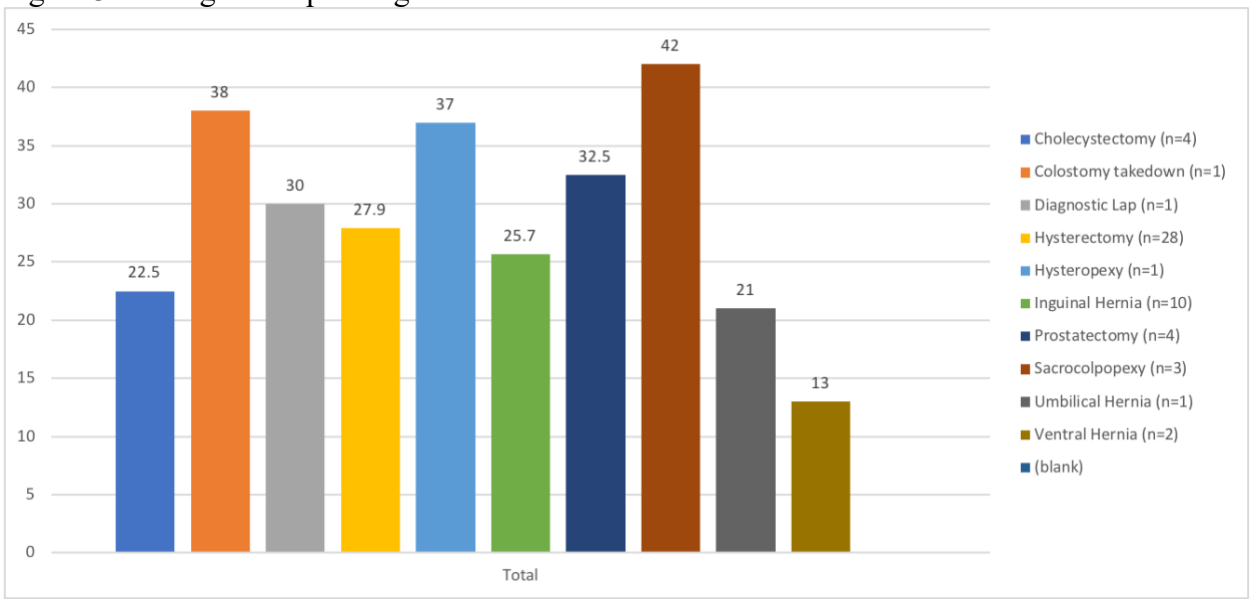
Team satisfaction was analyzed with use of a satisfaction survey post implementation. Paper copies of surveys were printed, along with a folder to submit the survey. All staff members were encouraged to participate. No formal tool was issued pre-implementation, but concerns were verbalized to the OR manager, regarding inconsistencies of TOTs based on assigned staffing. This was a major contributing factor in the OR managers desire to implement change.

Results

Results indicated an average TOTs post implementation (n= 55) of 28.0 minutes. This is a 18% reduction from the average TOT from September 2023, according to EPIC compiled data. There was a small (n=4) number of cases that were documented prior to implementation which showed an average of 27.29 minutes, although, there were 2 RNs assigned to the room 7 out of the 14 cases. Operations that did not did not have this facilitator role (n=7) yielded a TOT of 26.14 minutes, which further displays skewed data related to sample size.

The average "RN to periop" time pre implementation (n=14) 15.79 minutes while post implementation (n=55) 15.79 minutes. We also considered number of ancillary staff who were available for turnover help which included cleaning help and opening of sterile supplies. Similarly, the number of TO help pre implementation (2.93 people) and post implementation (2.96 people) were similar. Average TOT based on surgical case can be found below in figure 3 indicating the shortest TOT for ventral hernias (n-2) of 13 minutes, and the longest TOT for a sacrocolpopexy (n=3) of 42 minutes, which requires many supplies opened, two sterile tables, and a different set up than most cases performed in the robotic OR. The procedures done most frequently include inguinal hernias (n=10) and hysterectomies (n=28) which were both within goal of 28 minutes.

Figure 3: Average TOT per surgical case



An anonymous satisfaction survey was completed by 15 staff members; 46% of staff were RNs, 53% were CSTs, there were no anesthesiologist or surgeons who participated. 92% of the staff who participated in the survey, are involved in robotic cases, meaning they have seen the implementation of this project first hand. Of the robotically trained staff who participated in the study (n=13), 53.8% (n=7) either “agreed” or “strongly agreed” that they were satisfied with the efficiency of TOT at this facility, 30.7% (n=4) “neither agreed or disagreed”, leaving 15.4% (n=2) who ‘disagreed” with the statement of being satisfied with TOTs. Those who do not participate in robotics cases and completed the survey (n=2) 100% “disagreed” with the statement. The satisfaction survey allowed for employees to not only rate satisfaction, but identify areas they felt were the most time consuming, and offer suggestions that they felt would decrease TOT, which were reviewed and shared with the OR manager.

Discussion

Summary and Interpretation

The implementation of a secondary nurse and defined roles of this facilitator resulted in a decreased average TOT. These findings align with similar studies which implemented interventions to improve affordability and accessibility within the OR setting.

The goal of patient retrieval within 12 minutes after returning from PACU was determined by Robotic Team leaders. This goal was developed with the consideration that patient specific delays are often identified in the Perioperative department , where the circulating nurse gets report from the admitting nurse. These patients specific variables can occur during TOT and are unavoidable based of patient's needs or situation. This goal helps to prioritize needs within the OR nurses' jurisdiction and retrieving the patient from perioperative department with enough time to get report, interview the patient, and identify any patient specific delays. While this goal was not met, the primary circulating RN was still able to maintain a TOT of 28 minutes.

Limitations Limitations of this project include a short time frame and a single site, which limits generalizability of findings. Pre implementation data had a smaller sample size, which does not give a clear representation of pre and post implementation. The EPIC robot dashboard was initially going to be used for data collection, but results were skewed as this system included all TOTs less than 110 minutes. This included cases that were delayed due to surgeon availability, which alters average TOT significantly and does not represent the implementation and hard work of the staff.

Recommendations According to literature, there are many effective tools which can be implemented to improve TOTs in the OR. This QI project indicates defined roles and a facilitator

are interventions that decrease TOTs and improve OR accessibility. Staff buy in is critical for an effective implementation, as well as appropriate staffing for number of ORs.

Conclusion This project aimed decrease time between surgical cases to support surgical demand while improving revenue and profit. The overarching goal of TOT less than 28 minutes was accomplished with implemented role differentiation, parallel processing, and an assigned robot facilitator. Sufficient staffing is crucial in order to successfully implement the interventions. Staff Satisfaction was difficult to portray, as these interventions were implemented in Robotic cases only, but may be appreciated if implemented on an OR department basis.

CHAPTER FOUR

ADVANCED NURSING ESSENTIALS REFLECTION

DNP Reflection

DNP Essential #1: Scientific Underpinnings for Practice

Prior course work allowed me to critically appraise and include appropriate, peer reviewed articles throughout my literature review. I also felt confident identifying critically appraised interventions that could be implemented at the project facility. As a circulating nurse in an OR, when I initially heard of the desire for this project my mentality was "if people want to work hard to achieve short TOTs, they will". This thought was made prior to considering the interventions to make this process more proficient. I learned the importance of "non-productive" time in the OR, a very lucrative and costly department. This is not only a consideration for the hospital, but for the patient and health care costs overall. A more comprehensive picture of the underpinnings of practice, helped not only my outlook on QI projects, but also helped me to advocate for the project to OR staff. Clinical hours helped me further demonstrate fulfillment of this essential with the use of guidelines to inform decisions.

DNP Essential #2: Organizational and Systems Leadership for Quality Improvement and Systems Thinking

Essential two emphasizes improved patient healthcare outcomes to promote results and reduce healthcare disparities. This was reiterated in multiple courses and reinforced with implementation of my QI project. Because of courses like Design of Healthcare Systems (N608) I was able to crease process maps, and logic models to identify waste and ensure my project

implementation would align with the goals of the organization. Healthcare access and accessibility are major concerns, including the facility where this QI project was implemented. An introduction of this essential occurred in Ethics, Law and Policy (N612) and allowed us to discuss strategies to address ethical issues like cost, availability, and disparities within Healthcare.

DNP Essential #3: Clinical Scholarship and Analytical Methods for Evidence-Based Practice

This essential is the epitome of this DNP project. As mentioned above, I utilized and referred to evidence-based practices continuously and will continue to do so as a new Nurse Practitioner. These tools will continue to inform my actions for safe, quality care for patients. In the literature reviews completed in coursework and for this project, I was able to utilize peer-reviewed, scholarly journals to identify best practice. This invaluable information will help the future of others, which is what healthcare is all about. Evidence-based practice promotes safe, quality care.

DNP Essential #4: Information Systems/Technology and Patient Care Technology for the Improvement and Transformation of Health Care

Through Healthcare Informatics (N610) and Design of Healthcare Delivery System (N608), I was able to explore informatic systems and identify both the benefits and risks of technology within healthcare. I was able to utilize multiple electronic medical records throughout my clinical rotations. Technology helped me to collect data, interpret data, as well as present my data to stakeholders for not only this QI project, but all assignments through the DNP program.

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APPENDIX

FIGURES

Figure 1: Role Differentiation Table

Process	Primary RN	Facilitating RN	Other
Room Set-up "Wheels out to wheels in"	• Time-out board • Patient history • Obtains versed / abx • Interviews • Patient transport • Vocera periop RN for handoff / have pt void	• Room prep (positioning, equipment etc.) • Intra-op meds • Opening assist- robot arms, drape, etc • Counts with CST (RN) • Additional lines if no anesthesia tech • Prepare prep stand	• Morning breaks for all rooms assigned *not during turnover* • Lunches for all rooms assigned *tech comes to help close* • Afternoon breaks • Room stocking if downtime GOAL: Primary RN goes to periop for next pt 12 minutes after wheels out time of previous case Team Leads: AU & EL Team members: LH, AW, SS, HC, LS
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INTRA-OP	• Specimen management • Charting / Circulating RN • Meets / assess next patient (if appropriate)	• Prep for next case (supplies, equipment) • Gets meds for next case (RN)	
Wrap up "Procedure stop to wheels out"	• Call facilitator to room when closing • Broadcast turnover for PCTs and PACU • Verifies specimens / plan with surgeon • Transports to PACU / Phase I	• Assists anesthesia • Assists with transfer to gurney • Undrape arms, flush instruments • Begins turnover / cleaning	
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Figure 2: Data Collection tool

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Figure 3: Average TOT per surgical case