A DNP PROJECT

Improving Operating Room Turnover Time Through Process Redesign

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by

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Abstract

Introduction: Operating room (OR) turnover time can be defined as the time from when one patient leaves the operating suite, to the time the next patient enters the operating suite (Cerfolio et al. 2019). This is also known as "wheels out to wheels in." Operating room turnover time is one way efficiency is measured. The current turnover times are just meeting the designated benchmark of 30 minutes. Currently there is no official policy or guideline regarding the turnover process. The lack of guidelines causes variability and leads to prolonged turnover times. The goal of this project was to reduce turnover time and to utilize the strategies deployed to formulate an official policy to guide the turnover process.

Methods: Average turnover times for general surgery for the previous three months were analyzed retrospectively. This quality improvement project aimed to reduce turnover times by eliminating inefficiencies, removing redundant tasks, designating specific team member roles, and standardizing the process. This was accomplished through parallel processing.

Results: The post-intervention analysis showed a statistically significant reduction in the average turnover time over the span of 100 operating room turnovers. Average turnover time went from 28 minutes to 26.5 minutes.

Conclusion: Turnover time can be improved through process redesign. Designated roles and parallel processing has broad implications to improve turnover time. Staff members must trust one another to complete their designated tasks. The framework used can be adopted to other settings.

Keywords: Efficiency, improving efficiency, turnover time, reduce turnover time, standardization

Improving Operating Room Turnover Time Through Process Redesign

Problem Significance

The operating room (OR) is a primary source of revenue and cost to a hospital. It has been estimated that the cost per minute of operating can be as high as $150 (Cerfolio, 2019). Facilities across the world are constantly improving and adapting processes in place to yield better outcomes and reduce costs, while maintaining patient safety. Since the OR is a key source of revenue, ensuring the maximum sustainable case volume is important. One way of achieving this is reduction in non-operative time, specifically room turnover time. This timeframe begins when the patient leaves the OR and ends when the next patient arrives to the surgical suite. Operative time, which is the time from incision to when surgical dressings are applied, involves several factors that the staff and surgeon are unable to control. These can include case complexity or patient specific factors, such as the extent of disease or prior procedures.

Turnover time is largely reliant on the operating room staff. The team members include the circulating nurse (CN), surgical technologist (ST), patient care technician (PCT), anesthesia technologist (AT), and anesthesia provider (AP). Since this is an aspect of the perioperative process that can be directly controlled by the staff, it is imperative that this process functions at the most efficient level. A streamlined process can result in a positive financial impact for the facility.

A primary issue regarding turnover time is there is no “gold standard” benchmark. The Association of Perioperative Registered Nurses (AORN) has not explicitly stated an acceptable turnover time. The facility benchmark for turnover time for general surgery is 30 minutes. The average turnover time from the February to April is 28 minutes. While this is under the benchmark of 30 minutes, there is opportunity for improvement. A realistic benchmark should be a turnover time of 23 minutes. This is a 25 percent reduction in the existing benchmark.

The current OR turnover process is as follows. Once the incision sites are closed, and the endotracheal tube is removed, the patient is moved from the OR table to the stretcher or hospital bed. The CN and AP then transport the patient to the Postoperative Anesthesia Care Unit (PACU). The CN and AP give handoff report to the PACU nurse. The CN deposits any specimens at pathology and return to the OR. Once the AP is finished giving report to the PACU nurse, they return to the OR to set up for the next case. While the CN and AP are out of the room, the PCT and ST are cleaning the room. This includes removing dirty instruments out of the OR, cleaning the bed, tables, equipment, and mopping the floor. The AT will replace the necessary anesthesia supplies as well. Once the room is cleaned the next case cart is brought into the OR. This task is not designated to a specific team member. The bed is then made, and trash bags are replaced. Supplies for the next case are then placed on to the bed to be opened. The ST and CN complete the set up. Once the ST has instruments, a count is completed. After the count, the CN and AP then leave the OR to go to holding. The necessary consents for surgery are reviewed and the patient is interviewed. The CN and AP transport the patient to the OR. Turnover time ends once the patient enters the room. Currently, there is poor coordination and communication on the specific roles of the CN, PCT, and ST. As a result, the stated tasks are often repeated. These inefficiencies lead to prolonged turnover times.

The objective of this quality improvement project was to improve turnover time through parallel processing of designated roles, improved communication among the perioperative team, and standardization of the turnover process. These factors ultimately reduced variability. Bhatt (2014) deployed a similar strategy which improved turnover times. Improving efficiency by reducing turnover time will result in cost reduction and increase in revenue for the facility.

Olson (2018) found that reduction in turnover time could ultimately lead to an addition of one more case per day, thus generating more revenue for the facility. As discussed throughout this section, OR utilization is important to the facility. An efficient turnover time can help lead to cost savings as well as an increase in revenue. A conservative estimate of costs savings could be as high as $10,000 per day. This accounts for both hospital and anesthesia expenses.

Available Knowledge

The project assessed the OR turnover process. A methodical and systematic approach was used utilized for data and evidence collection. The databases included the Biological Science Database (ProQuest), CINAHL® Complete (EBSCO), and Ovid. These were accessed through the Jacksonville University Library. Additional resources used included academic textbooks for research and statistics. Keywords included *operating room turnover time, improving operating room turnover time, reducing operating room turnover time, operating room efficiency, operating room turnover process, communication, barriers to efficiency and communication, and "improving communication.* More than 2,500 research articles and studies were generated from the search. Delimiters included a time frame from 2014-2021, the articles and studies used are peer reviewed. The final number of articles used for the project is 20.

Reasons for Delay

Turnover time is not considered "productive" time in the OR. However, turnover time is a large part of room utilization. The primary events that occur to turnover a room include cleaning and removing or replacing equipment for the next case. Kumar (2017) described poor performing turnover time as greater than 40 minutes, fair performing turnover time as 25-40 minutes, and high performing turnover time as less than 25 minutes. Kumar (2017) examined OR turnovers for 100 days from August 2015 to November 2015. Two categories were used.

Orthopedic surgery was one category, and the rest of the OR fell into the other category.

A total of 231 orthopedic surgeries and 273 other surgeries were completed, for a grand total of 504 surgeries. The results showed 79% of surgeries were within the benchmark of acceptable turnover times. Of the remaining 21%, over half of these were delayed because of hospital related problems. Upon review the common causes of delayed turnover times were, the surgeon was not available to see the patient, there was no informed consent, the patient was not transported to the pre-operative holding area on time, and the supporting staff such as cleaners were not available to help turnover the room Kumar (2017).

Further analysis revealed avoidable delays included surgeon unavailability, scheduling error, supporting staff unavailability, patient transport delay, poor communication among staff, and no consent. Recommendations for improving turnover time include designated roles for staff members, bloodless cases no longer need to have the entire floor mopped, development of procedure specific sets rather than surgeon specific sets, anesthesia technologists clean and replace equipment between cases, and displaying that a room is closing to communicate to the supporting staff than turnover will occur soon.

Effects of standardization

The OR room turnover process should become standardized. Variation exists among the specialties, as well as case complexity. The cleaning process should remain the same across specialties, however certain cases may require extra equipment. Bhatt et al (2014) examines a systems-based approach to improve turnover time. The study was conducted at a 500-bed facility, with 24 operating rooms. A horizontally structured, systems-based approach was used. It contained three major interventions: developing consistent criteria for OR readiness, utilizing parallel processing for patient and room readiness, and enhancing perioperative communication.

This is a multi-factorial approach, taking multiple aspects of the operating room into consideration. Results showed 35% reduction in turnover time (Bhatt et al. 2014).

Prior to implementation of the redesigned turnover process, factors effecting turnover time were high variability, nonlinear processing, and interaction lapses. High variability existed among staff members primarily in the call to order. Standardization and effective communication would eliminate this variability. Parallel processing occurs when the staff members are completing different roles simultaneously, thus improving efficiency. Interaction lapses are like the issues described in Kumar (2017). The day of surgery involves many different team members and locations. The patient interacts with the pre-operative nurse, the anesthesia provider, the surgeon, and the OR nurse. Additionally, they must be transported from the pre-operative area to the OR holding area. There are many moving parts to this process, potentially resulting in items getting missed such as the consents, or the surgeon not seeing the patient in a timely manner prior to surgery.

The redesigned turnover process used a two-tailed independent *t*-test. Using the 237 turnover times, the average turnover time decreased by 20 minutes which equates to a 46% reduction (Bhatt et al 2014). A reduction in turnover times can ultimately reduce the day-of wait times for patients. This can result in a lower level of anxiety, thus improving patient satisfaction. The study limited bias by using a single observer with a standard time keeping device.

Operating rooms are a large source of cost and income to a facility. A turnover time of 20 minutes or less is seen as desirable to surgeons. Efficient turnover time can lead to improved surgeon satisfaction as well as proper utilization of resources. Retrospective analysis found that surgeons spent less than half of their day from 0700 to 1500 operating. Cerfolio et al (2019) implemented Lean to remove inefficiencies and standardize the turnover process. The stakeholders involved that made up the PIT crew included general surgeons, anesthesiologists, Certified Registered Nurse Anesthetists (CNRA), perioperative nurses, circulating nurses, surgical technologists, and cleaning staff. This PIT crew reviewed the existing turnover process and determined which tasks were necessary or not. Of the necessary tasks, these were reviewed and streamlined further. The PIT crew was active from October 2017 to January 2018.

Selection criteria included general surgeons who completed up to eight elective surgeries per day. This resulted in two surgeons being selected for this study. One barrier discussed is that the OR staff such as nurses, surgical technologists, and anesthesia providers work a designated shift and are paid hourly. This differs from the surgeons, who are paid based on their case volume. The use of a CRNA proved effective at promoting quick turnover times. This allowed the anesthesiologist to assess and interview the following patient, while the CRNA was present for the current procedure. The cost of the staff members who made up the PIT crew cost $1298, yet the return on investment was around $19,500 per day. This small investment has profound implications for long-term return on investment.

Souders et al. (2017) also used a pit crew approach for room turnover specifically for robotic surgery. The average turnover time prior to implementation of the revised process was 99 minutes. A total of 45 procedures were analyzing prior to implementation. The model utilized strategies such as briefings at the beginning of the day, and specific role designation. A total of 41 turnovers were used for post-intervention analysis. The average turnover time decreased to 53 minutes three months after implementation of the updated turnover process. Upon conclusion of the study, key factors that had a positive impact included role designation, communication, and task sequencing.

Effects of benchmarking

The effect of Joint Commission credentialing standards on various times related to the operating room were analyzed retrospectively from December 2014 to April 2016. This included pre-anesthesia time, pre-induction time, total procedure time, post-anesthesia time, and turnover time. The study found that although pre-anesthesia time increased, total procedure time and turnover time were not affected. Since the Joint Commission is a leading credentialing body, this study shows that standardization, efficiency, and patient safety are all compatible. A total of 13,000 cases were analyzed, thus providing a high level of research and reliability (Inomata, 2018).

Pedron et al. (2017) examined the effects of a benchmarking program. The increase in documentation and tasks for the circulating nurse increased turnover time. Considerations from this study include having measures in place to standardize the turnover process. Other reasons for increased turnover time include complex cases requiring more equipment and no supporting staff is present.

Staff Morale

One factor that can affect OR efficiency is the satisfaction level of the staff members. Gorji (2018) examined the relationship between the quality of work life and efficiency within the OR. When staff feel supported and valued, the level of efficiency increased. Specifically, when the staff voiced concerns or ideas, and management listed, this increased quality of work life. Conversely, overall efficiency and productivity decreased when the staff felt burnt out.

Final synthesis of Findings

Overall, the quality of the evidence is strong. The levels of evidence are as follows, three sources are level 3, seven level 4, one level 5, and one level 6. The evidence used is at a moderate risk for bias as they were prospective studies that analyzed data retrospectively. The studies conducted were observational, therefore there was potential risk for observer bias. However, studies that employed similar strategies such as the PIT crew approach had similar results of improved turnover time. This is reassuring that the process is in fact reproducible, thus improving reliability.

The common limitations among the studies including Bhatt et al. (2014), Inomata (2018), Cerfolio et al. (2019), and McDowell et al. (2017) was each study was completed at a single facility. Multiple facilities employing the same strategy would provide broader implications and likely more reliable or accurate results.

Recommendations

Upon reviewing the available literature, two common themes present for improving OR turnover time. Promoting parallel processing optimizes the time spent among staff members, while a standardized process removes inefficiencies. Specifically, these strategies include designating tasks for each staff member, completing different tasks simultaneously, and clear and concise communication. Additionally, the staff member with the largest impact is the circulating nurse. The nurse must communicate with the anesthesia provider, as well as the surgical tech. The nurse can be seen as the team leader since they coordinate transferring the patients to and from the OR. Each staff member must trust that their team members will complete their designated tasks. Instilling a sense of teamwork through a shared common goal (Gorji, 2018) proved effective. However, the use of a benchmarking system as well as an updated EMR system had little to no effect on turnover. McDowell et al. (2017) found that the OR turnover process showed slight improvement after a period of six months. By the one-year mark, the turnover time had not improved much past baseline. Understanding strategies that are ineffective is just as important as understanding those that are effective.

Fit and Feasibility

The revised turnover process was implemented without much resistance. The participants were receptive to the changes in the process. Operating room turnover is a necessary process to any surgical area. The current infrastructure supports this process as the changes proposed are minor in nature. The key stakeholders have expressed their interest in optimizing the current process. The turnover process has been consistent for the past 10 years without any revision. There is an opportunity for improvement. There is no need for additional resources. Operating room turnover is a process driven task. There is no need for extra equipment as this project is centered around process redesign. Additionally, existing staff were used as it is not sustainable to continue to hire staff members.

The revised process was effective at improving turnover times. Further assessment into staff satisfaction could show improvement in moral, and costs to the OR would decrease. Unit operations became more efficient. The use of a PIT crew approach with designated roles could save upwards of $19,000 per day in operating costs (Cerfolio et al. 2019). Although anecdotal, conversations with surgeons thus far have revealed their dissatisfaction with prolonged turnover time as this leads to “sitting around and waiting”. Therefore, improved turnover time will allow them to complete cases faster. This would allow the staff members to end their shift early, which could potentially lead to increased satisfaction.

The literature did provide consistent evidence on effective strategies to improve turnover time. As stated in the literature review and recommendations, Bhatt et al (2014) and Cerfolio et al. (2019) implemented the PIT crew approach which was consistently effective. The findings are applicable to the current setting. Although each operating room has their unique characteristics, the turnover process remains consistent regardless of setting or surgical specialty.

Conceptual Framework

Kurt Lewin is considered the pioneer of social psychology. The conceptual framework chosen is Lewin’s Change Theory. This theory is centered around three stages. These include unfreezing, change, refreezing. Unfreezing is when staff is encouraged to welcome the proposed change. Effective strategies to promote unfreezing are to increase driving forces or reduce restraining forces. The refreezing stage is when the staff adopts the change as habit. This change then becomes the new standard practice.

Specifically related to this project, the unfreezing stage occurred when the participants were introduced to the revised turnover process and informed of the objective to improve turnover time. The change phase involved the implementation of the revised turnover process and concluded with data analysis. Refreezing occurred after analysis when the revised turnover process was proven to be effective. Figure 1 illustrates how the change theory was applied.

Additionally, three concepts exist. These include driving forces, restraining forces, and equilibrium. Driving forces are responsible for promoting change. Restraining forces are the antithesis of driving forces. Equilibrium occurs when both forces equal one another, and there is no change.

Wojciechowski et al (2016) examined how Lewin's theory can be used with Lean methodology. This has direct implications for the proposed project as PDSA is a form of Lean. Similarities between Lewin's theory and Lean came to light as the project progressed and team members collaborated. The use of lean provides a systematic and continuous structure to provide change. The Lean methodology is effective at building trust, promoting staff to try new things, and measure improvement. Sustainability is the end goal.

This proposed project relies on the relationships among staff members, such as the surgeons, anesthesia providers, nurses, and surgical technologists. As the evidence has shown, communication among staff and healthy relationships improves efficiency (Gorji, 2018). The OR can be compared to a team sport. All team members must work as a cohesive unit to function at the most efficient level. Daily workflow is a result of the culmination of individual roles and responsibilities.

Figure 1

Lewin's Change Theory

Quality Improvement Model

The model that was utilized was plan, do study, act or PDSA. This quality improvement model is effective for testing and documenting change in a designated area. The model provides a systematic framework for assessing the effectiveness of a process (PDSA cycle, 2021). PDSA falls under Six Sigma, which strives to reduce variations while promoting standardization. Additionally, PDSA will provide systematic and methodical guidelines for the room turnover process. As a result, repetitive tasks will be eliminated and inefficiencies will be identified, allowing for a more streamlined process.

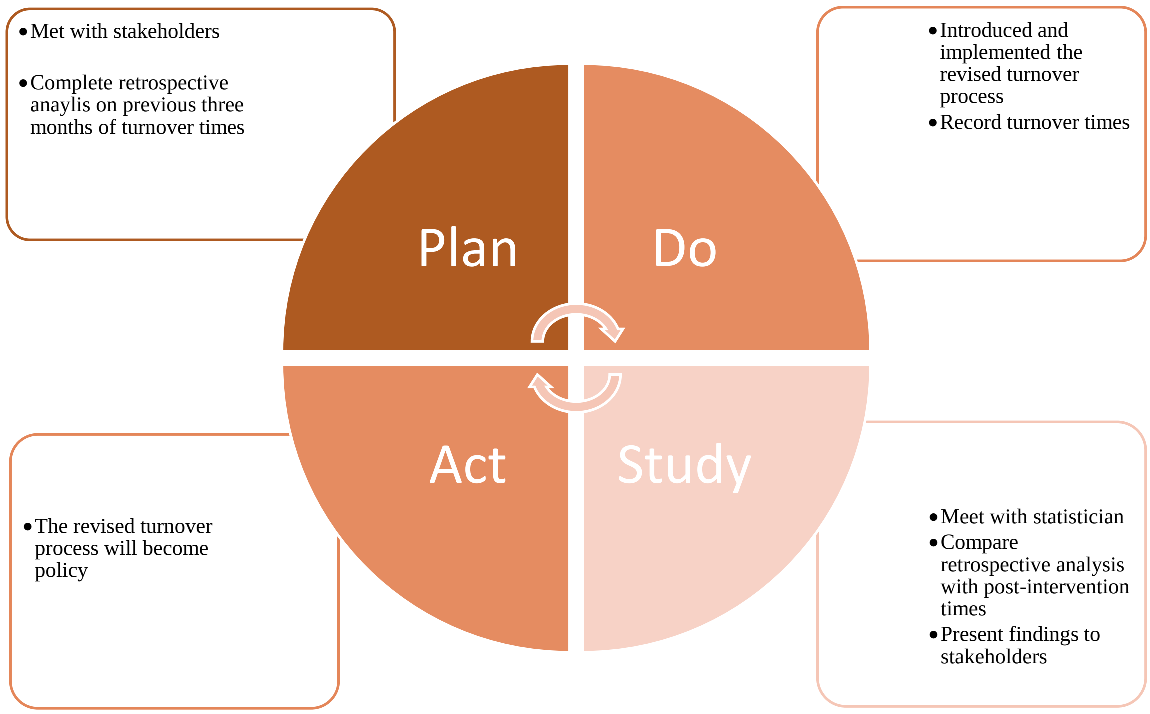
The first step of the model is the planning phase. This phase includes identifying a problem, assembling a team with the appropriate knowledge and ability, and determining a prospective goal. Next comes the doing phase. This is the action or implementation phase of the cycle; this is when the intervention is introduced. In the study phase, results are analyzed. Questions that are answered include was the projected goal achieved or were there any unintended consequences? The last part of the cycle is the act phase. Here, the researcher reflects on the plan and outcomes of the project. The process may be adopted and implemented or revised and improved upon. There is no true conclusion to this cycle as it is ongoing and dynamic.

The PDSA cycle for the proposed project began when the surgeons and management met regarding OR utilization and efficiency. These key stakeholders were immediately supportive of the idea to improve turnover time. The idea of cost-savings with increased utilization were convincing arguments for implementation of a new turnover process. The director of surgical services, nurse manager, as well as the chief of surgery have all given their support. The do phase occurred once the general surgery team was informed of the revised turnover process. Results were analyzed in the study phased. This determined that the intervention was successful. The act phase began once the desired outcomes were reached. The act phase included dissemination of the revised turnover process to other surgical specialties. One goal of this project was to standardize the process; therefore, dissemination and application were straightforward.

Multiple benefits of the PDSA model exist. The change that occurs has a higher level of sustainability and the implementation is streamlined (NICHQ, 2021). Additionally, the PDSA cycle provides evidence of success and improvement. The PDSA process allows for identification of unintended consequences. Any changes can cause a butterfly effect. One improvement may lead to a negative impact in a different part of the OR. This QI model provides tangible evidence of an outcome. This can help combat any resistance to change. Likewise, the model allows for visualization on what can be improved if not effective. The transparency can help aid in better teamwork. The PDSA model was most appropriate for this project as it analyzed pre- and post-intervention. The project was straightforward with a clear objective.

Figure 2

PDSA diagram



Specific Aims

As stated previously, the current benchmark is 30 minutes. The purpose of this project was to reduce the average operating room turnover time by 25 percent. This would result in an average turnover time of 22 and a half minutes. For this project, an average turnover time less than 23 minutes would be considered successful.

The primary objective of improved turnover time was broken down into multiple objectives. The culmination of these small objectives determined the success of the project. Various staff members were required to work together and trust each other to complete their designated tasks. One small objective was the readiness of turnover packs for every case. The primary investigator observed the PCT each morning. This objective was accomplished because the PCT gathered the supplies for turnover packs. This included two bedsheets, four towels, a clear bag for normal trash, a red biohazard waste bag, a dirty linen bag, and a safety strap for the bed. Another smaller aim was the participants to follow the revised process. This was also observed by the primary investigator. The turnover process could be compared to a checklist. Therefore, if a breakdown occurred, it would be clearly evident. The last objective was to achieve parallel processing. This occurred when all participants completed their designated tasks simultaneously. Although there was no formal tool to assess each turnover, the primary investigator observed each turnover process. Additionally, the participants could refer to the visual aid in the room for the recommendations provided.

Context

The location where the project was completed was at a 489-bed facility. The facility contains three operating departments. These include the Main OR, Neurosurgery OR, and Cardiovascular OR. This project will examine the Main OR specifically. The Main OR performs a variety of surgeries ranging from general, orthopedic, gynecologic, urology, head and neck, and plastic specialties. There are a total of 16 operating suites, which are divided among the various specialties. There are four dedicated orthopedic rooms, three dedicated robotic rooms for general and gynecology, one dedicated otorhinolaryngology room, two dedicated urology rooms, and five dedicated general surgery rooms. The facility utilizes the DaVinci robot system from Intuitive Surgical, which has strong evidence of improved surgical outcomes. The average case volume is 40-55 surgeries per day depending on add-ons and emergencies.

The population that was included are the operating room staff, surgeons, and anesthesia providers. More specifically, the primary participants were the anesthesia provider, anesthesia technologist, circulating nurse, surgical technologists, and the patient care technologists. These team members responsible for the turnover process include the AT, CN, ST, and PCT. The surgeon and the anesthesia provider are important to the turnover process because they must see and assess the patient prior to the surgery. However, they are not directly involved in room turnover. The total number of eligible participants was 98. However, the number of participants used was 20. This was broken down into the general surgery team which consisted of 17 people, the addition of two PCTs, and one anesthesia technologist.. This included the general surgery staff. It was not feasible to include every staff member of the operating room. Therefore, staff members volunteered or were randomly selected. Surgeons do not have the same staff members or team each time they operate. Randomly selecting participants, as well as randomly assigning teams ensured the most accurate conditions and limit bias. Results would likely be skewed if the most capable nurse and surgical tech work together consistently.

A stakeholder can be defined as a person or group that may be affected by an organization's actions and success (Pelletier, 2018). Key stakeholders were management both locally in the operating room and at the executive level, surgeons, and the OR staff such as nurses and surgical techs, surgeons, and anesthesia providers. Leadership and surgeons will also play a role in sustainability. Potentially the most important are the nurses. Nurses are the engine of the surgical team, and control when to go get the next patient from the holding area.

There were no additional costs or need for funding to complete this project. Process redesign is not a financial burden top the facility. The room turnover process did not require any additional instruments or devices. Existing staff members, surgeons, and anesthesia providers were the participants. The project was submitted to the nursing scientific review committee at the proposed site, the project was well received. The chief of surgery was impressed and eager to begin the project. This support and backing proved to be a critical role in the success of the project. The preoperative and postoperative processes remained unchanged.

Turnover time is largely dependent on the staff involved. There was little resistance from the participants, which allowed for a streamlined transition to the new process. The process could be highly optimized and streamlined, however, if the staff is not motivated then turnover time will likely be slow. Therefore, staff satisfaction and motivation needed to be high. Ideally, only motivated staff members would be chosen for the project, however, this would lead to skewed and inaccurate results. Key stakeholders such as leadership and surgeons could prove to be a large driving force. The staff members benefit from improved turnover time by finishing cases early for the day. A conservative estimate of cost savings from staff going home early is about $450 per day. However, this would likely be a short-term benefit as surgeons would increase their case volume eventually. The revenue generated from an increase in case volume outweighs the benefit of sending staff home early. Leadership and surgeons will see the broad impact of improved turnover time such as cost savings or an increase in revenue from increased case volume.

Intervention

The intervention of the project was the revised OR turnover process. The timeline of the intervention was 100 room turnovers. The OR staff that perform general surgery were asked to voluntarily participate in the project. All circulating nurses and surgical technologists that work in this specialty were used. The surgical teams for the day were randomly assigned. The surgeons do not have the same team every day. This helped to ensure reproducibility, and the randomization of staff assignments helped to reduce bias or skewness. Consistently pairing two strong team members could have potentially affect the accuracy of the results.

The revised process included strategies such as parallel processing, a PIT crew mentality, as well as a change in the order of events. Parallel processing involves multiple staff members completing different tasks simultaneously. Figure 3 below details how this occurred. This maximized efficiency and removed redundant tasks. Another intervention was to develop a consistent “room ready” designation. The redesigned process educated and empowered both the circulating nurse and anesthesia personnel on a single, consistent definition of room ready to reduce variability. Criteria will consist of when the room is clean and when the accurate case cart is in the OR. Having two parties engaged in a common definition limits the subjectivity that drove significant delays (Bhatt, 2014).

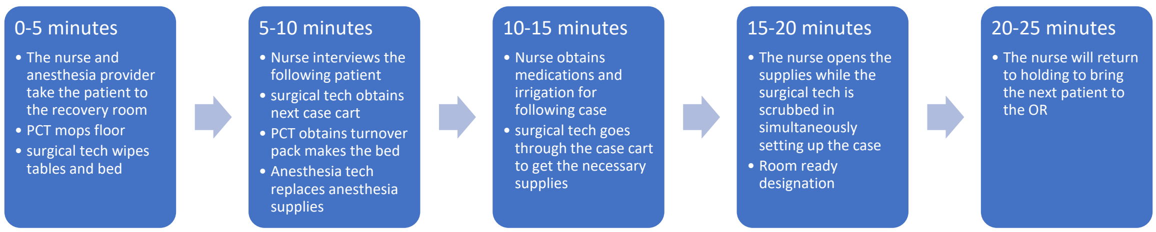
Lastly, the revised process followed this order. The patient was taken from the OR to the recovery room, the nurse then goes back to the OR to help clean and open the next case. Then the nurse returned to the holding area and interviews the next patient, and then the nurse and anesthesia provider bring the next patient to the OR. The revised process had the nurse interview the next patient immediately after the previous patient reaches the recovery room. While this occurred, the surgical tech and patient care tech continued to clean the operating room. The surgical tech wiped the tables, bed, and ring stands. The PCT cleaned the floor and removed the trash and dirty linen bags. The anesthesia tech replaced the anesthesia supplies. The surgical tech retrieved the next case cart. The PCT obtained a turnover pack and made the bed. The nurse checked the necessary documentation and interviewed the following patient. The nurse obtained the required medications and irrigation needed for the following surgery. While this is occurred, the surgical tech pulled the supplies that were needed from the case cart. The surgical tech scrubbed in while the nurse opened these items. Once the surgical team determined that the room is ready, the nurse returned to the holding area and brought the patient to the OR.

Prior to implementation, the general surgery staff were introduced to the revised turnover process. The project lead presented the turnover process detailed below. The OR staff attends morning huddle every morning at 0650. During huddle, the nurse manager informs the staff of any changes or updates within the OR and facility. The visual guide was printed out and posted in the relevant operating room to be used as a resource and reminder. The week prior to implementation, the project lead informed the staff of the revised process at each huddle. Each role was explained. Informed consent was not obtained due to the nature of this project. Less than minimal risk was present and no protected health information was collected.

The first strategy deployed was the consistent readiness of the described turnover packs. The turnover packs were assembled by a PCT before 0700. The observer counted the turnover packs prior to when the first procedures started. The observer ensured there were the required number of turnover packs each morning. These packs compiled necessary supplies into one location. This reduced the amount of time spent gathering supplies. As a result, turnover time decreased. A second strategy was ensuring the circulator interviewed the next patient after transporting the current patient to the recovery room, prior to returning to the OR to assist in the room turnover process. This is detailed in the revised turnover process, and the observer was present to witness this. This process measure relied on parallel processing. The reliability of this was trivial as it is based on the honor system. The primary investigator could not observe both the turnover process and when the nurse interviewed the following patient.

Figure 3

Revised turnover process



Study of the Intervention

The impact of the revised turnover process was clear. No formal tool was used to assess the intervention. The primary investigator directly observed the room turnover process. The turnover packs allowed for timely acquisition of the necessary supplies, each staff member completed their tasks, and the nurses reported following the new process of interviewing patients. Both the turnover packs and room turnover process by the ST and PCT were directly visualized. The nurses were not observed following the process of interviewing the following patient prior to returning to the OR. Therefore, the reliability of this intervention is trivial.

The observed outcomes were the result of the QI interventions. The staff remained the same prior to and for the duration of intervention. The OR is systematic in nature. This process was altered, resulting in immediate positive effects. There is no other explanation for the improvement in the turnover time. The intervention was assessed from the statistical analysis detailed later.

Measures

A process measure shows the effectiveness of a provider in maintaining or improving health of a patient (AHRQ, 2021). For purposes of this project, the process measures were examining the turnover process, instead of patient care. This project was reliant on process measures. Due to the multitude of tasks during turnover, a breakdown in the process may not be easily identifiable. Outcome measures reflect the impact of health care service on a patient or organization. These can be seen as the gold standard (AHRQ, 2021). Many factors contribute to one outcome. The outcome of improved turnover time relies on several factors discussed throughout this paper.

There were no formal process measures for this project. As detailed in the intervention section, turnover packs were assembled and counted daily prior to the first case starting. However, this was not formally documented or recorded for the project. Additionally, the circulating nurse was not observed interviewing the following patient immediately after leaving the recovery room. Therefore, these were not able to be measured.

The primary outcome measure was the reduction of turnover time. As described previously, turnover time is the time when one patient leaves to the time the next patient arrives to the OR. This was recorded by both the single observer, as well as the nurses' documentation in the EMR. Comparing both the observed room times, as well as the documentation in the EMR was an effective strategy to verify the correct time, thus improving the reliability of the data collected. This outcome measure was the culmination of all process measures for this project.

The PDSA framework in conjunction with the literature reviewed assisted the OR team in improving turnover time. The revised turnover process was based loosely from Bhatt (2019). A meeting occurred with key stakeholders to determine the most appropriate modifications for the facility. The initial timeline for the project was three months. However, The statistician at Jacksonville University was consulted to determine an adequate sample size. Post-implementation data collection would occur over the course of one month. After discussion with the statistician, a sample size of 100 turnover times should be effective if the effect size is appropriate. Analysis was conducted at 100 turnover times. This provided statistically significant results, and data collection concluded.

This sample size provided enough data to assess the difference in the pre-intervention versus the post-intervention results. Data was collected daily, Monday-Friday. Benchmarks were analyzed at the end of the week. A single observer with a standard time keeping device was notified when a room was closing. This allowed the observer enough time to reach the specific room that was closing. The observer made note at what time the patient left the OR and started the timekeeping device. The observer was present until the circulating nurse returned to the OR with the following patient. The observer noted the time this patient “rolled into” the OR. The observer stopped the time keeping device once the following patient arrived. The observer compared the recorded times to the time the nurse entered in the Surginet EMR to ensure there were no discrepancies. The use of a single observer reduced the risk for observer bias. The use of a standard time keeping device ensured accuracy. This time keeping device was a simple stopwatch.

In addition to post intervention data collection, retrospective analysis was conducted on operating room turnover for the surgeries three months prior to implementation. This analysis was completed in one day. All data that was collected was entered into SPSS and descriptive statistics were examined.

Analysis

Initially, data was collected retrospectively for pre-intervention analysis. Final data analysis determined that the revised turnover process improved turnover times. Descriptive statistics were analyzed, and an average turnover time was obtained. The confidence interval was 95%. These results showed the effectiveness of the revised turnover status. Data was transferred to a bar graph to provide a visual representation of the results. The graph is separated into five-minute increments.

Work experience was not relevant to the project. The turnover process was standardized and is easily reproducible regardless of experience. Turnover time was the dependent variable. A run chart was utilized throughout the project. This was most appropriate because data was collected continuously, and a process was analyzed. To help ensure statistically significant results were obtained, a sample of size of 100 was used. The facility averaged 75 general surgery procedures per week.

Ethical Considerations

Prior to participant selection the project gained approval from the Institutional Review Board at Jacksonville University. After that, the project was submitted to the Institutional Review Board at Baptist Medical Center. Once approved, the selected participants were informed of the new turnover process. The revised IRB process at Jacksonville University states that projects and studies with face-to-face interaction with no drug or therapeutic interventions are to be postponed until further notice. Data collection and analysis were not affected due to the new guidelines.

The American Code of Ethics from the American Nurses Association (ANA) present guidelines for research including beneficence, nonmaleficence, autonomy and justice (Grove, 2013). These were maintained for the duration of the project. Participants, who include the team members stated above remained anonymous. Additionally, the intervention did not involve a patient or staff outcome. There was no increased risk for harm or injury. Due to less than minimal risk, no informed consent was required. This is summarized by the human rights that are required for protection during any research. This includes the right to fair treatment, the right for protection from discomfort or harm, the right to privacy, the right to self-determination the right to anonymity and confidently (Grove, 2013). Facility policies were adhered to, as well as state and federal regulations. Although the staff members were not the subject to this project, the outcome relied on their actions. Patients will not be informed of the QI project, as it does not directly impact patient care.

Patient information such as age or gender was not relevant nor utilized, as this has no relevance to the project. Since this project did not directly involve patients or their protected health information, or pose any harm to their safety, they were not informed of the QI project. Data was kept on a secure drive within the sever, only accessible with the correct login credentials. The data gathered will be kept for five years before it is discarded. The results will not be reanalyzed. The project leader is currently employed at the site of the project. To avoid conflict of interest, the project leader did not perform any room turnovers. This helped to mitigate any bias or falsification of data.

Data was entered to a secure server at the facility. The necessary credentials and log-in information were given to those directly involved with the project. Additionally, the secure server within the Jacksonville University portal was used for data storage. This was also password protected. Participants did not have access, however, the nurse manager had access to the data. Patient identifiers as well as information such as age or gender were not relevant, nor was this information collected. Due to the anonymity of the project, encryption was not necessary.   A smartphone was not used due to the potential for a security breach. The observer used an approved electronic device that is connected to the secure server and approved by the facility. The data collected will be kept for five years.

Results

The revised TT process was implemented on Friday May 13, 2022. A total of 100 TT were collected over the course of the following week until Friday May 20, 2022. A total of 76% of the turnover times were less than 30 minutes. The pre-intervention average turnover time for the previous three months was 28 minutes. The average TT post-intervention was 26.59 minutes (95% confidence interval for the average time is 25.42 to 27.76 minutes). With a 95% confidence 90% of T-times are between 15.5 and 37.6 minutes (this is a tolerance interval). The estimated percentage of times less than or equal to 20 minutes is 14% (95% confidence interval 8.53% to 22.14%). The project was successful. This is supported by the fact that the 95% confidence interval of 25.42, 27.76 has an upper bound lower than 28, which was the pre-intervention turnover time. These results are detailed below.

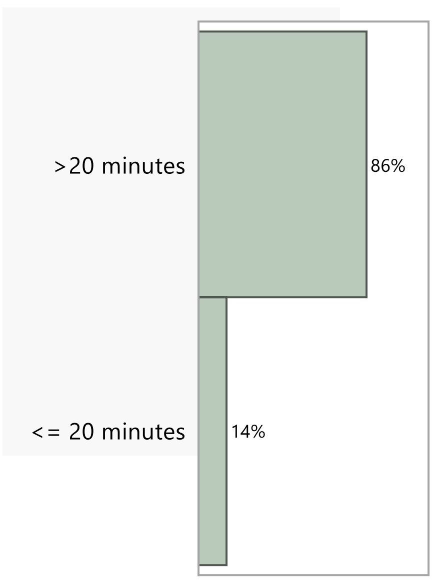
Various associations were observed. One anecdotal association was the length of turnover time when the following patient was not present in holding. However, no data was formally collected. The nurse would report the delay reason in the EMR. This delayed the turnover time since the nurse could not complete the primary process measure. Although this negatively affected the results, this occurs regularly throughout the day. Therefore, this imperfection in the process is a realistic aspect of the OR. An anecdotal observation was the work ethic among the participants. Some participants naturally completed their tasks in a timelier manner than other participants. Those who completed the tasks faster, had faster turnover times. There were no unintended consequences from this project. No missing data exists.

Although the goal of 23 minutes was not met, the time of 26.59 minutes was statistically significant. Therefore, the project is considered successful as there was still an improvement in turnover time. One outcome would be the revised turnover process will become a guideline for the turnover process. The process will become sustained in the form of policy.

Figure 4

Distributions

TTle20minutes



This figure displays the distribution of turnover times. A total of 86 turnovers were 20 minutes or longer. Achieving a turnover time less than 20 minutes is not likely.

Table 1

Frequencies

Level	Count	Prob
<= 20 minutes	14	0.14000
>20 minutes	86	0.86000
Total	100	1.00000

N Missing0
2 Levels

This table displays the same information as figure 4.

Table 2

Confidence Intervals

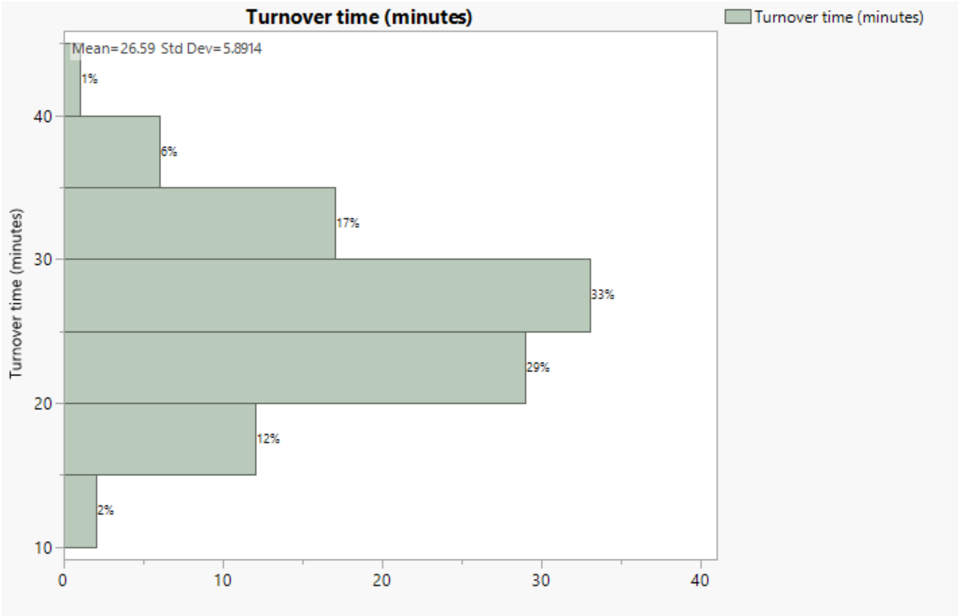
Level	Count	Prob	Lower CI	Upper CI	1-Alpha
<= 20 minutes	14	0.14000	0.085263	0.221372	0.950
>20 minutes	86	0.86000	0.778628	0.914737	0.950
Total	100				

Note: Computed using score confidence intervals.

A confidence interval indicates the probability that a parameter will fall between two values around the average.

Figure 5

Turnover time

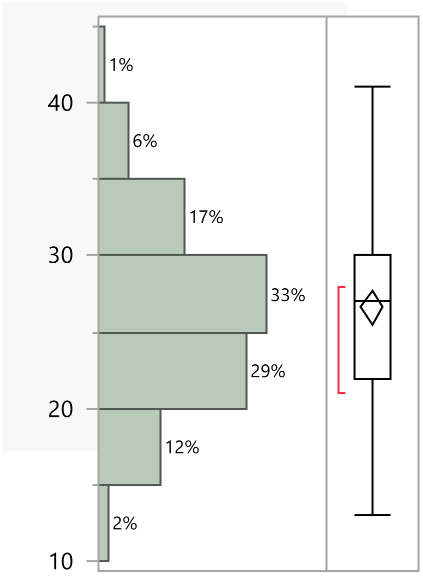


This figure displays the turnover time in minutes. 62 percent of turnovers lasted between 20 to 30 minutes. 43 percent of turnovers required less than 25 minutes.

Figure 6

Distributions

Turnover time (minutes)



This figure indicates a majority of the turnovers occurred between 20 and 30 minutes with the average time just above 25 minutes.

Table 3

Quantiles

100.0%	maximum	41
99.5%		41
97.5%		40
90.0%		34.9
75.0%	quartile	30
50.0%	median	27
25.0%	quartile	22
10.0%		19.1
2.5%		15.525
0.5%		13
0.0%	minimum	13

This table shows at which percentage the data is a lesser value. For example, 90 percent of the turnover times were less than 34.9 minutes. 50 percent of the turnovers were less than 27 minutes. Half of the turnovers completed were less than the pre-intervention average.

Table 4

Summary Statistics

Mean	26.59
Std Dev	5.8914336
Std Err Mean	0.5891434
Upper 95% Mean	27.758988
Lower 95% Mean	25.421012
N	100

This table displays the mean, or average turnover time as well as the upper and lower bounds. The upper bound was less than 28 minutes, which was the pre-intervention time. Therefore, the project was successful.

Table 5

Tolerance Intervals

Proportion	Lower TI	Upper TI	1-Alpha
0.900	15.5447	37.6353	0.950

This table indicates how likely a range of values will occur between two data points. Therefore, turnover time was likely to fall between 15.5 and 37.6 minutes.

Summary

As stated previously, a realistic benchmark should be a turnover time of 25 minutes. The results showed an average reduction in turnover time of 1.5 minutes. Although the specific aim of 23 minutes was not met, the project was still a success. The local problem was solved. The average turnover time improved to 26.5 minutes. The process became more streamlined and efficient. A strength of this project is how quickly results were seen. An improvement occurred within the week of implementation. Additionally, the ease in which the project was implemented is another strength. There was a seamless transition in the process. This is reassuring for future use in other settings. The ST and PCT collaborated effectively to complete their designated tasks. Fortunately, no modifications were required for the duration of data collection.

Interpretation

The QI interventions that were implemented directly related to the outcomes of the project. The consistent use of the turnover packs, as well as the circulator interviewing the following patient prior to helping with room turnover had a direct positive impact on the outcomes. The results obtained were similar to the results found in the literature. Although the TT did not improve as drastically as some of the articles reviewed, there was still an improvement. Designated roles and parallel processing have proven to be an effective way to improve OR turnover time. The sample size and timeframe used were smaller than what was commonly found in the literature. The surgeons involved commented that TT felt improved. They report spending less time waiting to start the following procedure. Currently, management is discussing the use of the turnover process as official recommendation for the turnover process.

The primary objective of a 25 percent reduction was not met; however, the project was still successful. The average turnover time for general surgery went from 28 to 26.59 minutes. The revised process was implemented effectively. Each of the smaller objectives were met. Cost savings and OR utilization have not yet been assessed for at this time.

The anticipated outcomes and observed outcomes were congruent. The revised turnover process was a result of systematic and methodical redesign. Anecdotally, the most common cause of a delayed turnover time was a patient transport delay. Ensuring the next patient is in the holding area is important for an efficient turnover. Patient transport is initiated by the front desk coordinator, who was not involved for this project. Moving forward, the circulating nurse should be in contact with the desk coordinator to ensure the following patient is in the holding area prior to the current patient leaving the OR. No cost trade-off is present as this project did not require any additional financial resources.

Limitations

The primary limitations of this project include the lack of existing literature or research, and the size of the project. There were no limitations in validity, implementation, and measurement. The TT was directly observed and recorded, and the participants welcomed the changes of the revised process. However, the OR is a niche environment. Turnover time is not as well studied as hypertension, diabetes, lung disease, or alarm fatigue. A lack of TT literature exists; the databases used became exhausted quickly when looking for high level literature to support the project. While the project was a success, only TT associated with general surgery was examined. Another limitation was the lack of ability to assess and record the reason for delays in the turnover process.

Recommendations for future projects examining turnover time include broad implementation. The results were statistically significant, however, including more specialties would likely provide a more accurate picture for OR utilization. Additionally, the project could have been extended past 100 turnover times. A larger sample size could reduce the chance of outliers that could skew the data. The larger sample size could also lead to a more accurate representation of TT efficiency. Future studies should examine reasons for delays in the turnover process. Preventing or managing delays would have a positive impact on turnover time. A longer period of implementation could also result in a further reduction in turnover time. A minute and a half reduction in turnover time may not seem like much, however, this project was implemented over a period of 100 cases, compared to the pre-intervention sample size of 905 turnover times.

Conclusions

This project has proven to have a positive impact on improving turnover time. Moving forward, it could prove to be useful long term. The project is significant because TT improved by over in a minute within one week of implementing a revised turnover process. A standardized process is easily reproducible among the surgical specialties including, general, orthopedic, gynecologic, genitourinary, and otolaryngology within a facility. Each specialty utilizes the same core equipment such as electrocautery, suction, forced air warming devices, back tables, ring stands, fluid warmers, and mayo stands. Unique equipment and supplies specific to that surgery. Additionally, the cardiovascular and neurosurgery ORs could utilize the revised turnover process. The foundations of this project, standardization and removing inefficiencies, can be applied to other settings in the facility. Other procedural areas, the lab, or even the nursing units could implement a version of the process. The facility could become more efficient, improve efficiency, and improve metrics.

Multiple strategies exist to help maintain sustainability. Obtaining buy-in and selecting champions was effective. When the staff agree on a common goal this improves motivation as well as reduces the resistance to change. Sharing results with the staff can help increase motivation moving forward. The project leader was a resource for staff members and helped to facilitate change.

The results of the proposed project could lead to profound changes to the facility. Since the project was successful, the workflow became streamlined. Each staff members' role was optimized for efficiency. Redundant and overlapping tasks were eliminated. A sense of independence and empowerment was instilled into staff members to complete their designated tasks. As mentioned previously, there is no current policy in place. The project was successful, this revised process could become official policy for the facility. This policy would serve as a guide for the staff members. At this time, the electronic medical record (EMR) has remained unchanged. There is no formal documentation related to the turnover process, therefore no impact would be made. Improved turnover time did not have any negative effects on the workflow or policy. Patient and staff safety are still a top priority.

The goal of the QI project was to reduce the turnover time in the operating room. This was achieved by a redesigned turnover process with no additional financial costs. The results directly apply to operating rooms within hospitals and potentially surgery centers. Surgeons, anesthesia providers, nurses, and surgical technologists were responsible for implementing the process. The hospital will indirectly benefit from improved efficiency and potential increased case volume, leading to a reduction in costs and an increase in revenue. At the time of writing this, OR leadership is discussing the possibility of transitioning the revised turnover process to become formal recommendations for all room turnovers in the Main OR.

Once the QI project is presented and orally defended, it will be submitted to The *Association of Perioperative Registered Nurses Journal* (AORN). The AORN contains 41,000 nurses who are members. This would be the primary way to reach users since the circulating nurse is the driving force of the turnover process. Additionally, the American Surgical Association (ASA) is the oldest surgical organization in the United States, it was established in 1880. Using their journals and network of members would likely reach a large audience. The Chief Nursing Officer at the facility would be an effective dissemination partner. This person is important regarding policy formation and revision.

The results of the project were presented to the nurse manager, director of surgical services, and executive leadership. Informally, the surgeons who participate in the project can discuss the findings with their colleagues. The project will be submitted to Jacksonville University for defense.

Project Funding

No external funding was required to complete this project.

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Appendix A. Figures

Figure 1

Lewin's Change Theory

Figure 2

PDSA Diagram

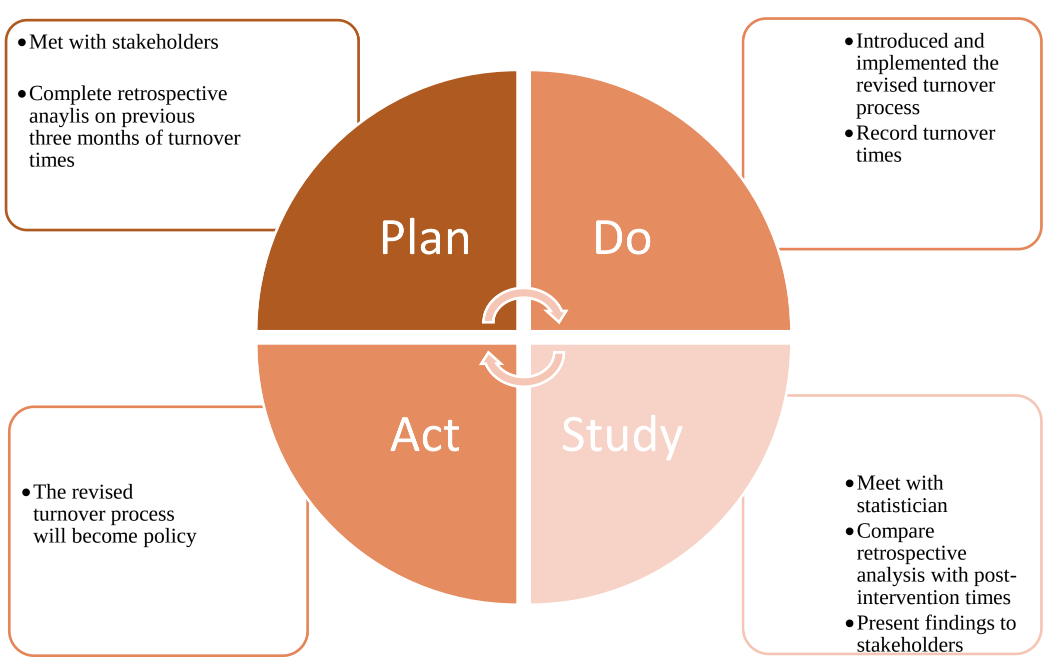


Figure 3

Revised Turnover Process

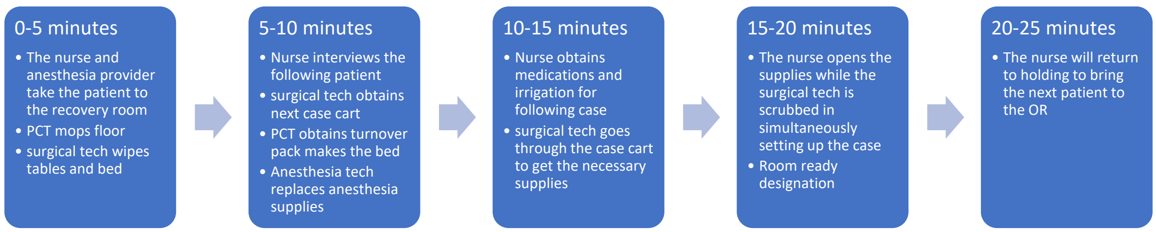


Figure 4

Distributions

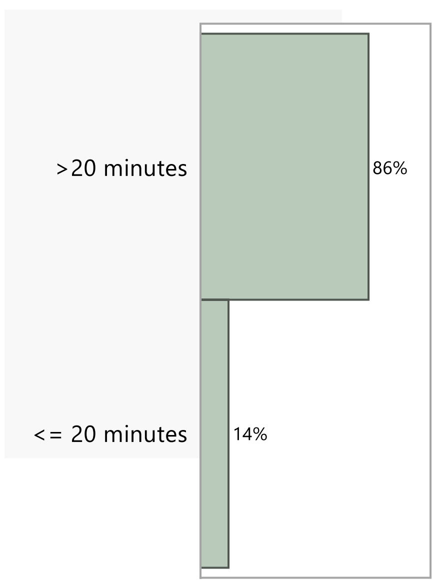


Figure 5

Turnover time

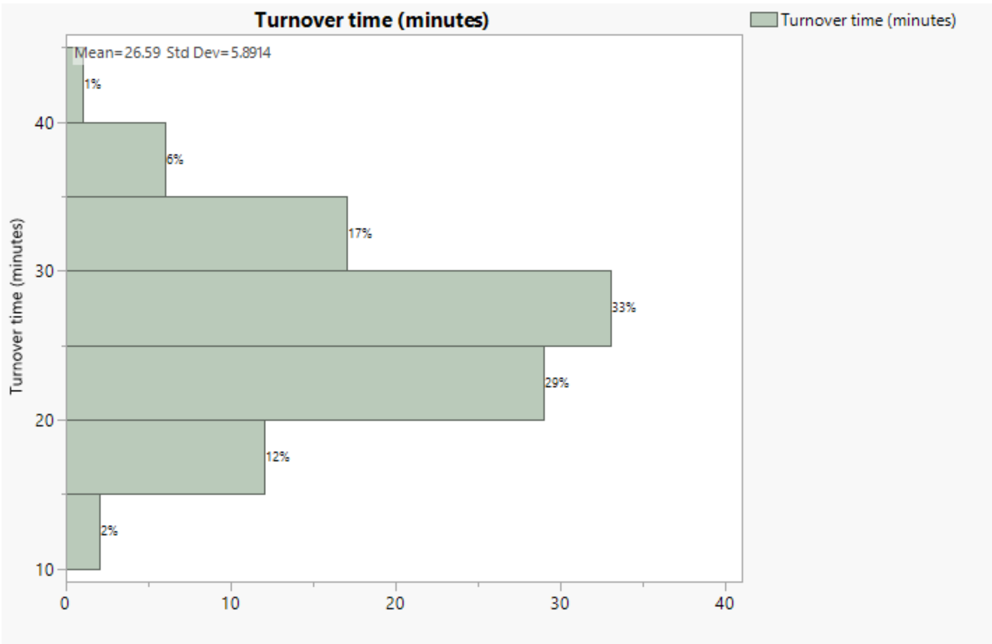
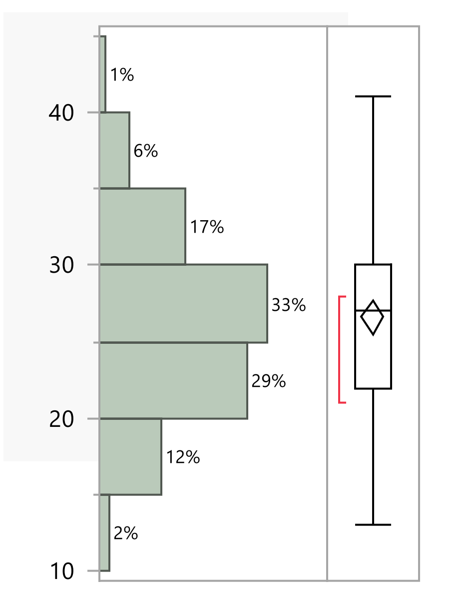


Figure 6

Distributions



Appendix B. Tables

Table 1

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Total	100	1.00000

N Missing0
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Confidence Intervals

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