OPERATING ROOM TRAFFIC AND SURGICAL SITE INFECTIONS: A QUALITY IMPROVEMENT PROJECT

by

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Abstract

The gap in practice was the excessive movement through the sub-sterile doors of the operating room. The Association of Perioperative Registered Nurses Guidelines for perioperative practice (2018) was used to guide the project aim; limiting personnel and equipment; patient and large equipment, and door openings at the appropriate times. The PICOT question was as follows: In orthopedic operating rooms’ personnel, how does implementing an OR traffic protocol compared to current practice, affect OR traffic and surgical infection rates (SIRs) in a 10-week timeframe? The frameworks used were Lewin’s Theory of change and the Plan/Study/Do/Act cycle developed by the Institute for Healthcare Improvement. The project aimed to decrease the amount of OR traffic through three main interventions: review of preference cards, use of a physical barrier and direct observation of traffic. Results showed a decrease in the number of reported surgical site infections for all orthopedic cases to zero in a 6-week period and SIR decreased to 0 in 10 weeks. The traffic also decreased after the implementation by 50%. The number of door openings per minute went from 1.95/minute to 1.06 at the end of the project. The findings showed an increase in awareness of OR traffic that spilled over to the other rooms. The project recommendation is to extend the interventions to different services throughout the Operating Room for continued improvement in reducing OR traffic. The project limitations included the small sample size, potential bias related to the direct observation of staff and push back by the anesthesia group and the vendors.

Key words: Operating room traffic, surgical site infections, surgical infection rate, quality improvement
Operating Room Traffic and Surgical Site Infections: A Quality Improvement Project

Operating Rooms (ORs) are dynamic places with lots of movement and people working as a concerted team. People moving in and out of the OR (OR traffic) can be necessary or unnecessary. Necessary movement includes getting an unusual supply or staff relief. Unnecessary movement can be vendors constantly entering and leaving the room, uncoordinated staff relief, and going to get routine supplies. Operating room traffic has been associated with a potential increase in surgical site infections (SSI) according to Bedard et al., 2015.

This quality improvement project aimed to reduce the amount of OR traffic to just necessary traffic and to reduce the SSI rates for the main operating room. There were three principle interventions, which were implemented following the PDSA model. The staff helped evaluate the success of the interventions. There was much work already being done at the facility on SSI rates. Thus, it would have been difficult to determine if the interventions had any direct effect on the SSI rate or if any decrease could have been directly attributed to the decrease in OR traffic. However, improving the process by decreasing OR traffic has been shown to reduce SSI rates (Rovaldi & King, 2016).

The PICOT question was developed with specific aims in mind. First to decrease OR traffic by implementing the interventions outlined and second, have an effect on the infection rate. The project question was as follows: In orthopedic operating rooms’ personnel (P), how does implementing an OR traffic protocol (I) compared to current practice (C) affect OR traffic and surgical infection rates (SIRs) (O) in a 10-week timeframe.

Relevance to Nursing

Protecting the patient from harm is one of the primary goals of nursing (American Nurses’ Association, 2015). Part of the responsibilities of the OR nurse is to monitor and help
maintain the sterile field. Constant traffic in and out of the OR is a direct threat to the sterile field and has been shown to increase the risk of SSI (Rovaldi & King, 2015). However, traffic monitoring would take up too much of the nurse circulator’s time, thus it becomes important that other interventions be used to decrease the amount of traffic in and out of the OR.

**Problem Description**

The identified gap in practice was the excessive movement through the sub-sterile doors of the operating room that could contribute to Standard Infection Rates (SIRs). While some movement was expected, the Association of Perioperative Registered Nurses (AORN) Guidelines for perioperative practice (2018) recommended that movement should be limited to only essential personnel and equipment. The main doors should only be used for the movement of the patient and large equipment at the appropriate times. All unnecessary movement should be avoided.

The AORN (2018) recommended limiting movement in and out of the OR suite due to the potential for contamination based on shedding of skin cells from the body as well as respiratory droplets (AORN, 2018). Increased traffic in the operating room (OR) increased the risk of SSIs (Bédard et al., 2015). Professional guidelines published annually by AORN (2018) recommended that the OR traffic be kept to a minimum during the surgical procedure. At the time of the project, there was no standard procedure or policy in place at the practice site, which governed OR traffic. When asked, the staff were aware of the national guideline keeping traffic to a minimum, but the reality of their OR practice was that traffic was unrestricted and unregulated.
Current Practice

At the time of the project, there was no standard policy in place at the hospital to regulate OR traffic. The hospital did, and continues to subscribe to the AORN guidelines, however, not all the guidelines were applied with the same amount of influence or consistency. Unfortunately, OR traffic was one which received little to no attention to date. At the site, there was inconsistency on when movement was conducted in and out of the OR. The baseline data showed much movement by staff during the period between the opening of the case and incision. This is the period where the room is readied for surgery. Traffic dropped off once incision was made but depending on the time of the surgery, would pick up again as the time for staff breaks occurred.

Gap Data

The surgical infection rate (SIR) for the site was higher than desired. The SIR is defined as the number of actual hospital acquired infections (HAI) divided by the predicted number of HAIs. The predicted number of HAIs is determined by historical data from 2015 (Center for Disease Control, 2019). The SIR can be broken down by procedure. The orthopedic rooms have mostly total joint procedures Monday to Friday between 7:30 am to 5pm.

The overall SIR reported for the hospital for all procedures was 1.33 in the first three quarters of 2018. For the Total Hip procedure, the SIR was 1.11 and for Total Knees it was 1.28. The expected value is 1.0 or below and the hospital benchmark is set at 0.95. All SIRs above 1 indicate there was more SSI than expected and SIRs lower than 1 mean there were less SSI than expected.

This author, the project leader, also spent several hours doing observations of staff and physician/surgeon movement into and out of four different OR suites. The starting point was
once the OR was considered “open”. When a room is open, the sterile supplies have been opened and a sterile back table has been set up. The end point was the point the patient left the room at the end of surgery or 60 minutes. There was some variation depending on the type of case being performed. Orthopedics had less traffic in and out than did general surgery. The observation during the gap analysis revealed there was an average of one entry or exit of the surgical suite every minute. This included other services as well as orthopedics. The maximum was 52 in a one-hour span and the minimum was 23. Some of the movement was inevitable: staff relief and the entry of the surgeon and scrub tech after scrubbing. Vendors were also responsible for much of the movement in and out of the rooms. Clearly, limiting movement in and out of the OR was warranted.

Practice Change

A Frasier Health group (2016) looked at possible interventions to minimize traffic in the OR. They proposed several suggestions (Garneski, 2016). Traffic in the OR should be limited to specific times and for specific reasons. Whenever possible, supplies and equipment are best obtained by a runner so the staff in the OR do not have to leave and re-enter the room. Also, movement should be batched as much as possible, so the number of entries and exits are minimized. There should be no entry or exit during critical points in the surgery. For orthopedic surgery, this period would include the time the joint capsule is open. Other types of surgery would have different definitions of critical times. For example, general surgery could define critical time as the time during which the abdominal cavity is open.
Available Knowledge

A literature search was performed using the SUMMON function of the Capella University library website. This function searched PubMed and CINAHL. The search was limited to peer reviewed journal articles and studies within the years 2014-2019. Key words used were “operating room traffic” and the combined terms “operating room traffic” and “surgical site infections”. A third search, using the previously mention terms but including a Boolean “or” with the additional term “door opening” returned some additional articles. The latter search parameters returned 893 articles. Articles that dealt with vehicular traffic and other types of traffic were excluded. Editorials and comment articles were also excluded. The 20 most recent and topical peer reviewed articles and studies were retained. The abstracts were reviewed and those who dealt with either only surgical site infections or where “operating room” was the only relevant term were also excluded. The CINAHL database was also queried using the same search terms but no new research studies were identified.

Definitions

Operating room (OR) traffic was not clearly defined. The Association of Perioperative Registered Nurses (AORN) spoke to OR traffic in its Guidelines for Perioperative Practice (2019) and noted that the traffic should be kept to a minimum. It did not, however, expand the definition of OR traffic. Wathen et al (2016) defined OR traffic as the total number of people that are present in the operating room and used staff in and out times as a measurement tool. Patel et al (2017) used a different approach to the measurement of OR traffic. They looked at the amount of times the OR doors opened and the length of time the doors remained open. Shepler (2016) defined foot traffic as a possible source of infection but did not elaborate on the when and where the traffic occurred during the procedure. The rationale for foot traffic as being a possible source
of infection was the disruption of air flow in the OR which allowed contaminants to come in from outside the OR.

Some defined the door openings but did not look directly at staff movement through the door. Bedard et al. (2015) defined a door opening as the door being in the open position, regardless of the time the door remained out or the amount of people that passed through the door. Esser et al. (2016) defined the door opening as a swing of the door away from the door frame of at least one inch. This was determined by the application of door sensors on the door itself and on the door frame. Sabrizedeh (2018) defined the time of a door opening, including the concomitant disruptions in the airflow during the different stages of the door opening cycle.

The definition retained for this project was the definition used by Bedard et al (2015). The door in the open position was counted as one. If multiple people passed through the door, one person was recorded. This was the simplest way for the observer to record the data. While the use of a door counter would have been helpful, it had been attempted in the Labor and Delivery area and the door counters broke, rendering them useless for data collection.

**Barriers**

Poor compliance to SSI elements, including reducing OR traffic contributed to SSI as described by Arifi et al (2016). Elliott et al (2015) reported a decrease in traffic after interventions (which included staff education, standardization of supplies and case cart accuracy), which were not maintained. However, they reported a shift in the type of staff who initiated the door opening. The amount of times nursing staff opened the door decreased but the number of times the anesthesia provider did increased. Several studies had instituted a bundled approach, which included a reduction in OR traffic. This made it difficult to determine which of the bundle elements had the most impact (Esser et al, 2015; De Oliviera & Gama, 2017).
Small sample sizes are a limitation of the above studies presented. Several were single site and had a small number of cases included in the study (Esser et al, 2015; Rovaldi & King, 2015). Poor statistical analysis and poorly defined variables were also identified in several studies (Mejia et al, 2015; de Oliviera & Gamma, 2017).

The literature reviewed demonstrated that it was possible to decrease OR traffic with various types of interventions. The literature also agrees that maintaining the reduction in OR traffic was difficult even with a sustainability plan. There was also some variation as to the operational definitions used.

**Interventions**

The interventions mentioned in the literature review were all very similar. They were designed to keep the OR door closed and limit movement. Lowe (2016) linked movement to an increase in turbulent airflow. Increased turbulent airflow increases the risk of SSI. Noguchi et al (2017) also suggested limited movement in the OR as they found that excessive movement could increase particulate count in the air. Airborne particles can act as transmission vectors for bacteria, thereby increasing the risk of SSI. Armellino (2017) and Spencer (2014) also concluded that turbulent airflow caused by OR traffic could be linked to an increase in SSI.

Other authors were more specific in their recommendations on how to limit OR traffic. All of the interventions revolved around limiting movement through the OR door (Elgafy et al 2018; Tsai & Caterson, 2014). Several literature reviews included several suggestions but mirrored the AORN Guidelines. Padgette & Wood (2018) recommended to keep OR traffic to a minimum however did not define what minimum should be. Elgafy et al (2018) developed a 10-step protocol to decrease SSI in spinal surgery. Part of the protocol was to decrease the OR
traffic by streamlining the circulating nurse’s duties and reducing the number of times he or she had to leave the room to get supplies or due to staffing changes.

**Summary**

The AORN Guidelines (2018 & 2019) versions stated that OR traffic should be kept to a minimum. Neither version defined what minimum should be. The Guidelines are evidence-based and reference recent studies to support its recommendations. The Guidelines for Environment of Care were reviewed and modified for the 2019 edition of the Guidelines.

The interventions that were most feasible for the project site included streamlining the nurses’ duties as described by Elgafy et al (2018). This included a barrier placed at the door during the critical period of the surgery, in this case, from capsule opening to wound closure was considered. Finally, a review of the preference cards for accuracy as part of the streamlining of the nurse’s duties could help decrease OR movement.

**Rationale**

The interventions required a change in staff behavior and workflow. To facilitate this change, Lewin’s theory of change was the framework used in the project. Lewin’s theory uses a 3-step approach to change. The simplest version has the Unfreezing Stage, the Change Stage and the Refreezing Stage (Wojciechowski, Pearsall, Murphy & French, 2016). Each stage addresses a point in the change process.

The first portion, termed “unfreeze” is usually the most difficult. Unfreezing means the organization, in this case the OR, is ready to change. The reasons for the change must be important and the status quo unacceptable (Mindtools, 2019). The SIR in the orthopedic rooms
should be zero or as close to zero as possible to avoid complications. The high SIR also impacts the payments the hospital receives from Medicare and other insurance payers.

The change stage involves new ways of doing things. The new way should improve performance and be accepted by those impacted. There are usually three ways of dealing with change. There are the early adopters, those that see the benefit of the new way early on and so adopt the change at the beginning of the process. There are those that follow along and will change with the majority and finally, there are the late adopters. These are the last people to change and sometimes will resist change completely. The interventions proposed are changes to the workflow. This can cause disruption as the staff get used to the new way of doing things.

Finally, once the change has been adopted, the “re-freezing” process occurs. This means there is stability, the new process is working and become enculturated into the workplace. The new workflows become the norm and OR traffic is reduced. With the reduction in OR traffic, there should also be a reduction in the SIR. Positive results help the cement the new workflows and the freezing process is successful.

The protocol that was implemented required a change in the process and practice. The staff workflow in the OR changed as the movement in and out of the OR was restricted during certain periods of each case. Lewin’s Theory guided the project change through staff education on the risks of excessive movement in and out of the room during each case. The protocol was implemented and then the compliance to the new protocol was monitored and measured. The results shared with the staff can demonstrate the success and ensure that the new protocol is adopted. Thus, the successful completion of the PICOT requires staff to change their workflow. Lewin’s theory provides the framework for the preparation, implementation and enculturation of the change. Each step in the theory is critical since each step prepares the way for the next.
The Plan-Do-Study-Act cycle was also utilized to help adjust the interventions as data and feedback were collected. The PDSA cycle stands for Plan-Do-Study-Act. This cycle is used when testing small changes. The cycle has no definite time frame; however, shorter periods work best (Institute for Healthcare Improvement, 2020). In this case, the physical barrier was run through the PDSA cycle and changed based on feedback received from the staff. The case cards were already accurate, and the batching of staff breaks proved to be impossible to operationalize.

The independent variable was the OR traffic protocol that included a new physical barrier. The dependent or outcome variables included the SIR rate and the amount of traffic in and out of the operating room. Compliance to the protocol was also a dependant variable.

The assumptions for this project were that there would be adequate staff buy-in, by both the nursing staff and the physicians. The orthopedic surgeons were quite aware of the risk of an infection in the joint space after a joint replacement surgery. The nursing staff may have been more resistant because their workflow was the most impacted by the changes. The other assumption is that there was a relationship between movement in and out of the OR and SSI. There is a link, however a direct causal relationship has not yet been established and is beyond this project’s aims.

**Specific Aims**

The aim of the project was twofold: to reduce the amount of traffic in the operating room and have a positive change on the SSI rate. Reducing OR traffic has been shown to reduce the risk of SSI (Garneski, 2016). Some traffic, such as social visits, communication and supplies is easily avoidable. Other traffic, such as relief, going out to scrub and getting unusual supplies is often unavoidable. Minimizing the avoidable traffic can have a positive impact on the SSI rate.
Raising the awareness of OR traffic can also influence the rest of the operating room as people consider the impact of OR traffic and if their reason for crossing the threshold is a valid enough reason. Thus, compliance by all the OR staff and personnel is essential.

**Methods**

**Context**

The project took place in a large suburban hospital in Northern California. This hospital was part of a large multi-state hospital system. The hospital system was divided into service regions, with the Northern California Region being the largest. This hospital went from being the leader in the region with the least amount of surgical site infections to having the most. The surgical suite consisted of 10 rooms, two of which were dedicated to orthopedics. The OR was busy, doing at least 40 cases per day. Perioperative services were its own service line, reporting to the Chief Nursing Executive (CNE). The OR is a combination of the hospital and one medical group, two separate groups functioning under one umbrella. This made this service line unique to this hospital.

The hospital was an early adopter for all projects that came from the regional office; often being the alpha or beta site for implementation of projects. The SSI bundle was adopted in the first wave of rollouts. Despite this early adoption, the hospital continued to struggle with a high SSI rate. Further, an SSI bundle had been instituted approximately 18 months before with little success in decreasing SSI. The SIR varied greatly, and the average SIR remained above 1 for the entire period. The lack of success with the bundle meant the OR management team was open to other options and interventions. There was no financial cost to this project.
There were two distinct cultures at the site: leadership and staff. The leadership was innovative and open to new ideas. As noted about, the hospital is often the early adopter of change. The frontline staff, however, was more resistant to change, seeing the innovation as the required task of the week instead of meaningful long term change designed to make the patient experience better and ultimately, their work easier. This was a potential barrier that the doctoral leader recognized and began early inclusion of staff to obtain buy in.

The writer was the project lead and the observer for the data collection. Other members of the team included the orthopedic service lead, the Operating Room Medical Director, the OR Manager, Quality Nurse Consultant and the Infection Control Manager. The project was addressed as part of the SSI work group meeting. The providers, both surgeon and anesthesia, were somewhat resistant to the project. The anesthesia providers were concerned about the batching of the breaks and the timing, since it was originally suggested that breaks should occur before to after the capsule being open. The anesthesia providers were clear that pre and post capsular incision would put the patient at risk since those periods would be during induction and emergence. These were both critical periods during the anesthetic course. The surgeons accepted the project once they realized that it would not affect the length of surgery. Direct stakeholders for the project included the patient, staff, surgeons, and anesthesia providers. Indirect stakeholders included the OR leadership and hospital leadership.

Benefits to the project included better utilization of time and workflow. The long term benefits are to the patients in reducing the potential for SSIs. There was no additional direct costs for this project. The additional time for direct observation of the OR traffic was soley coniced by the doctoral learner.
**Intervention(s)**

**Project design.** This was a Quality Improvement project that utilized both direct observation and a quantitative data collection tool to measure the outcomes.

**Setting.** The setting was the orthopedic operating rooms. The project was limited to primary total knee and hip arthroplasty cases only (inclusion criteria). Arthroplasty revision cases were also excluded because of the variable nature of these cases. Other types of orthopedic cases were also excluded. The inclusion cases were selected because of the stable nature primary total knee and hip arthroplasty. There is very little variability between one case and the next.

Once IRB approval was obtained, the staff was educated on the interventions and the PDSA cycle. Prior to the first case of the day, the circulating nurses were reminded of the interventions (which were) to do during the case. Emails were also sent to the providers with the interventions and timeline. A physician champion also volunteered to help with the project.

The initial intervention, after the measurement of the baseline data, was to use a safety strap across the doorway as a physical reminder not to enter or leave the room once the incision was made. The second intervention was an attempt to batch staff relief, both nursing staff and anesthesia staff. The third intervention was the review of the preference cards.

Direct observation and the same data collection tool were used to collect date after the interventions had been implemented. The original interventions were followed for a period of four weeks and if staff offered feedback, it was collected. During week five, in conjunction with staff, the interventions were adjusted. The newly adjusted interventions were then applied for a 4-week period and data was collected. In the tenth week, the data was presented to the staff and sustainability ideas were collected from the staff.
After two weeks, the interventions were modified. The use of the strap was discontinued because the staff were forgetting to use it and when it was used, it became a safety hazard. The strap was replaced with a red and green sign. Green for when the case was open, but no incision was made and red from the point the incision was made to dressing applied. The circulating nurse was to flip the sign at incision. The other intervention, not originally proposed in the project was that the waterless alcohol scrub for surgical hand scrub was moved from the scrub sink to inside the OR, thus reducing OR traffic further. The staff was given the option to use the waterless scrub or to do a traditional scrub with soap and water. The soap and water scrub required the staff to step out of the room. The waterless scrub could be easily used in the OR and still complied with guidelines.

The team was involved in an advisory nature. The data was reported to the team and the decision to continue or stop and some minor changes (like observing traffic from within the room versus from outside the room) were discussed. The changes recommended by the team were then implemented. The staff were also advised of the changes to the interventions.

**Study of the Intervention(s)**

The interventions, especially the signage on the core doors was successful in reducing traffic and modifying the reasons for the traffic. The change in reasons for the OR traffic was consistent with the literature (Rovaldi & King, 2015). The preference cards were precise which reduced the amount of times the circulator had to leave the room and get supplies. The unsuccessful intervention was the batching of staff breaks. This was difficult to accomplish because of the union environment for regular staff and anesthetic milestones for the anesthesia providers.
The implementation plan included a PDSA cycle at two different weeks, weeks one and two. The initial barrier intervention was a strap across the door. After the second PDSA cycle, this was deemed to be dangerous because the strap was below eye-level. This could cause injury if there was an emergency and a provider had to quickly exit the room to get some supplies, a crash cart or other help. This was changed to signage placed at eye-level. This was discussed with the staff and deemed adequate.

The efficacy of the interventions was measured through direct observation of the operating traffic and compared to the baseline traffic. The OR Foot Traffic Surveillance Tool (See Appendix A) was used to quantify the data related to door openings. The staff were educated on the interventions and apprised that the goal was to decrease traffic in and out of the room. The author was also observing that the interventions were actually being applied, i.e. the safety strap across the door was being used or after the change in the intervention that the sign was being utilized correctly. When the interventions weren’t used appropriate, spot education was provided to the staff. Although difficult to correlate, the SIR post-intervention was also compared to the baseline SIR. There were many factors, such as patient comorbidities, wound classification, and the amount of OR traffic that could ultimately influence the SIR.

Measures

Baseline data was collected through director observation and data recorded on the data collection tool (see Appendix A, Fig. 1). The staff in the rooms were aware of the observations and verbally agreed to being observed as part of the project. The tool called OR Foot Traffic Surveillance Tool was developed by another hospital (University Health Care System, Inc.) struggling with OR traffic issues. Permission was obtained from the author, Debora S. Mulling, to use the tool. This was developed at University Health Care System and there was no
discussion on the poster of the validity of the tool. However, this tool is mainly a means to record reasons for and quantify door openings. The tool allowed the observer to identify who was going in and out of the OR and for what reason. If the reason was not immediately identifiable, or it was a reason not identified on the tool, that traffic was classified as other. Otherwise, each transit through the door was classified as inner door/outer door, who transited and for what reason. A different hash mark (tick, plus, check and dash) represented the different time periods during surgery. The data was collected through direct observation during weeks 1 through 6 of the project. Data collection was suspended during week 5 because of a potential work disruption.

The main measure for this QI project was direct observation of the operating room traffic. The traffic was divided into four periods during surgery. These periods represent periods where traffic and the turbulent airflow increased the risk of contamination and SSI. The first period was defined from the point the cases was “open”. This means sterile supplies were open and the surgical technicians was preparing the back table and mayo stand for surgery. The patient is not in the room at this point. The second period was defined as the point from which the patient was physically in the surgical suite to incision. The third period was the time from incision to beginning of closure. The fourth period was from closure to the application of the dressing. Traffic varies between all these periods.

The second measure was the SIR. This is a ratio of actual surgical site infections to expected cases. The expected number of infections is based on a calculation performed based on 2015 hospital acquired infections (HAI) data adjusted for each facility (CDC, 2019) The actual number of infections is based on chart reviews. The SIR was derived from a 30-90-day observation period. The National Healthcare Safety Network (NHSN) compiles the data and provides a report to member hospitals.
The site participates in NHSN and receives a monthly report. The sampling used by NHSN includes all inpatient cases. Since the site sends home approximately 85% of its primary hips and knee joint replacement surgeries, this represented an average of 12 cases per month for total knees and 25 cases per month for total hips. The infections reports are then reviewed to ensure the correctness of the data. This measure was chosen because it is a standard ratio and used to compare infection rates across the country.

Analysis

Descriptive statistics and graphs were used to analyze and display the data. The tool returned a count of times someone went through the door. This is interval data. Each time someone went through the door was counted as a single instance. Averages of each reason for opening the door were tabulated in a Pareto chart to determine which had the highest rate (See Appendix B, Fig 1, and 4). The reason compared to the time of surgery was also compared using bar charts as were the staff member causing the traffic versus time of surgery. The number of door openings was also calculated from the average of door openings per case over the length of the case. The formula used was the following: (sum of door openings/number of door openings) divided by (sum of length of case/number of cases).

Although very difficult to link any reduction in SSI directly to this project, the data did show an overall decrease in the amount of OR traffic. As the different interventions were applied, the type of traffic shifted although the two major sources of the traffic, the circulator and vendor, remained the leading causes of the traffic. All data was tabulated in an Excel spreadsheet. The data was grouped in role versus reason and surgical time versus reason as well as surgical time versus role. The data was then graphed in the same groupings.
Ethical Considerations

The proposed project was a quality improvement project with changes in workflow. There were no interventions performed directly on the participants. Both the project site and Capella University deemed this project exempt as non-human research. All data was de-identified following the Health Insurance Portability and Accountability Act (HIPAA) of 1996 (HHS, 2013). Participants were assigned a number or code, and only the principle investigator had access to the information. All data was stored in a secure fashion, either encrypted or password protected. The project lead was the only person to know the password and have access to the data.

Results

The project trialed three interventions: a review of case cards, batching of breaks and the physical barrier/reminder on the door. The cards were already in excellent condition, therefore little change was required to the case cards. These cards are used to provide each case with the requested supplies before each surgery. The batching of the breaks proved to be impossible and finally the barrier across the door which was modified through a early PDSA cycle.

The review of the preference cards was the simplest of the interventions and revealed that the cards for the primary joint procedures were up to date. This meant that the times the RN left the room for supplies it was only for un-anticipated supplies. It was noticed, even with the card correct, that the first cases of the day appeared to be less well prepared than subsequent cases. The first cases were prepared by the Sterile Processing staff. They are familiar with the supplies but not with the intricacies of each case and surgeon’s preferences.

The batching of staff breaks was impossible to accomplish. For the anesthesia staff, it was impossible for them to go on break during the induction or emergence of the patient. These
are critical times in the care of the patient, and it would have been unsafe to hand-off to another provider. The only time the anesthesia provider could safely go on break was after incision, when the patient was stable and in the maintenance phase. For the nursing staff, while batching was possible, it was not functionally feasible because the relief staff came in at different times. Also, from a patient safety standpoint, although not officially codified, it is considered safer if only one of the staff members in the case is on break at a given time.

There was a gap in the data collection due to a work disruption, an unforeseen organizational issue. It was decided in conjunction with OR leadership that it would be better if the data collection were suspended for the duration of the one-week disruption. The work disruption did not affect the OR directly but there was tension. This created a one-week gap in the data collection process. The staff did not receive any different instructions for that period so although there was no data collection, the expectation was that the staff was still following the project protocol of limiting OR traffic.

The most successful intervention was the modified physical barrier at the door. The original intervention was placing a safety strap at the door. The intervention was designed to place a visual reminder to staff that traffic should be limited after incision. The safety strap was placed at waist level. After two weeks of observation, it was noted that the nurses often forgot to pull the strap across the door and when they did, it could potentially be a safety concern as it was not immediately visible when exiting the room. During an emergency, this could create a hazard for the RN to trip and fall.

The intervention was modified so that the physical reminder was changed from the safety strap across the doorway to a sign that was placed in the door. The sign was green on one side,
stating that the room was open, and that entry should be only if necessary. The other side of the sign, to be used once incision was made, stated that incision had been made and that the person should call into the room before entering. The sign was more successful with nurses placing it in the door and changing it from green to red at incision.

An intervention suggested by the staff and adopted as part of the project was to move the waterless scrub from the scrub sink area to inside the room. This reduced the scrub traffic as staff could now perform the surgical hand scrub from within the room. This intervention was applied through the entire OR and not just in the orthopedic rooms. Although not an intervention, the observations and discussions about OR traffic created a mindfulness about OR traffic and behaviors changed. Even when the staff forgot to use the signs, there was still an awareness and traffic was reduced. Of course, it is impossible to determine if this was a byproduct of observation or a real increase in awareness.

An unintended consequence of increasing awareness of OR traffic was that any other SSI bundle intervention was met with resistance. For example, strict glucose control is part of the site’s SSI bundle and was rolled out after the project concluded. This required a nurse from the recovery room to come to the OR and enter the room to perform the finger stick blood glucose because the OR nurses weren’t trained. The first objection was that this would increase OR traffic.

At the start of the project, there was 1.96 door openings per minute. At week 6 of the project, the number of door openings had dropped to 1.04 per minute. This represents a decrease of 46.9%. The reasons for the OR traffic also changed over the course of the project (See Appendix B). The SIR during the planning stages of the project was 1.75. During the initial
implementation it had dropped to 0.44 and by the end the project, the number of infections was 0, which would translate to an SIR 0. The SIR has a lag time for primary joint procedures of 90 days.

Findings from the direct observation suggested that vendors remained the largest reason for OR traffic, especially after incision are made. Staff relief was also an important reason for OR traffic. Scrubbing was the third most common reason for OR traffic and this dropped off as the scrub product was moved into the OR. During week 1, vendors accounted for an average of 23 transits through the door. At the end of the project, this had decreased to an average of 15. The represented a decrease of 34%. There was no change in the amount of transits for the circulator. The circulator exited the room 13 times prior to the intervention and 13 times after the interventions were put into place.

The timing of breaks was a major obstacle to the project. There were two major reasons: anesthetic milestones and relief staff schedules. The anesthesia providers could not go on break during induction and emergence, this meant that the providers could only go on break after the incision was made. As for the nursing staff, the operating technicians typically did not go on break once the capsule was open. The nurses typically went when a break was offered. There was no way to batch breaks. The vendors also were an obstacle as they typically did not bring their carts with implants into the room until after the room was open, thus contributing to the OR traffic.

The Pareto charts (Fig B4) show that Staff assist, and Staff breaks remained among the top three reasons for OR traffic. This contrasts with week one (Fig B1.) where patient related, supplies and supplies and scrubbing were the top three. At the beginning of week two, the
waterless scrub product was moved into the OR which explains why scrubbing dropped in frequency. The bar charts explain who was responsible for the traffic and at what point during the surgery this occurred (see figures B2, B5). There is no identifiable pattern to who caused the traffic, but it is clear that the circulator and the vendors were responsible for most of the traffic during the incision period.

The last set of bar charts (Fig B3 and B6) identify the reason for the traffic at different periods during surgery. Staff breaks were the largest reason for traffic during the incision period of surgery. Supplies were most often the reason during the case open period. Scrubbing dropped as a reason during the project and occurred most often during the patient in the room period of surgery. Although the project raised awareness of OR traffic to the staff, there was still a sense that the staff was not taking the project seriously, thus there was some like of buy-in. This lack of buy-in certainly was an obstacle.

**Sustainability**

This project has retained the interest of the staff and the awareness of OR traffic remains high. The site is rolling out another phase of the SSI bundle, which would have the PACU nurse come into the OR to perform a finger stick blood glucose. The first objection was related to OR traffic. With this type of enthusiasm, the project will be easily sustainable. The plan will include spot audits to ensure that the signs are still being used as they are the key to success.

**Future Practice**

There needs to be more study to develop future practice related to reducing OR traffic. It is clear that OR traffic must be reduced, however, it is not clear how to fully achieve this objective on a consistent basis. As described, the signs in the door appear to be effective
however, the staff may become accustomed to the signs and they would lose their effectiveness.
In addition, better measures to reduce door openings by vendors is warranted.

**Discussion**

**Summary**

The amount of OR traffic decreased by 46.9% and the SIR decreased to 0. The project was successful in achieving its goal: to decrease the traffic in the Orthopedic rooms. The aim was to have a positive impact on the SIR. The SIR decreased to 0 during the length of the project. A major strength of the project was the increased awareness of OR traffic by personnel. This was evident in discussions about a new phase in the site’s SSI bundle which would increase traffic in the OR which immediately brought objections, siting the increase in traffic this new phase would bring.

**Interpretation**

The project was successful in its aim to have a positive impact on the SIR while reducing OR traffic. The project was limited to the orthopedic rooms however it increased the awareness of OR traffic throughout the OR. The increase in awareness demonstrated that nurses no longer entered and exited rooms to communicate; but would call into the room instead. Also, during the observations, the nurses would tell the observer why they were leaving the room to justify the movement. The literature demonstrates that similar projects were successful in reducing OR traffic for a period of time (Elliot et al., 2015; Hamilton, Balkam, Purcell, Parks & Holdsworth, 2018). Most of the projects stated that it was challenging to maintain the reductions in OR traffic over time. Clearly ongoing education and observation of some degree is essential.

As discussed earlier, a direct correlation between SIRs and OR traffic was not justified. This is similar to the literature findings. Alizo, Onayemi, Sciarretta and Davis (2019) looked at
the relationship between foot traffic and surgical site infections in General surgery and could find no direct causal relationship. They do acknowledge that there appears to be a causal relationship however, between foot traffic and SSI in orthopedic surgery.

As noted, the vendors remained one of the most common reason for OR traffic. There could be limited control exerted over the vendors, as they are not hospital employees. They were made aware of the project and its reasons but chose not to comply. Also, there were last minute modifications to surgical plans, which required different implants. The implants are not stored in the room, which meant the vendor had to go out to get them.

Staff relief was also relatively unchanged throughout the project. The site was a union facility which meant that the timing of the breaks was somewhat mandated. Also, after incision, there is less work to be done by the circulator and the anesthesia provider. After incision was the preferred time for breaks. This varied based on the case time: first cases typically didn’t have breaks, but the second and third cases usually did.

Limitations

There were several limitations. First, this was a small project, with only two of 10 operating rooms (Orthopedic) observed. Secondly, there was a break in the continuity of the project due to an unforeseen problem, which arose at the project site. This break in continuity may have skewed the data in some fashion. A work disruption occurred during week two and during that week, no data collection occurred at the request of the department leadership. Lastly, the staff was made aware that they would be observed (a requirement of the site’s IRB). This may have influenced their behavior related to door openings.

Although the OR leadership had been apprised of the project, and had agreed to it, there was some pushback from the anesthesia group and from the vendors. Their lack of willingness to
fully participate in the project was limiting. The OR leadership did speak with the vendors but with limited to no success. Lastly, the fact that staff knew they would be observed could also have skewed the results as they would want to support the project aims.

The project was concurrent with several other changes occurred to Perioperative flow of care, also aimed at reducing SSI. Some changes were designed to reduce OR traffic but were not part of the initial interventions. It would be difficult to determine conclusively if the interventions had a direct effect on reducing the rate of SSI. This was not the main objective. However, will be interesting to see if over time the traffic remains limited and the SSI rates decline.

Conclusions

The project was able to demonstrate that there was an excessive amount of traffic during surgical cases. This traffic is linked to an increase in risk of SSI (Esser, Shrinsky, Cady & Belew, 2015). The demonstration that a reduction in traffic resulted in a positive impact on the SIR was powerful to the nurses and other staff. The question now is will it be sustainable? The short answer to this question is: maybe. While the data supports continuing to monitor and keep traffic to a minimum, the reality is that there needs to be a culture shift. There was resistance to batching staff breaks, especially from the anesthesia group and the charge nurse making the staff schedules. The project site is also a strong union site which contributes to the cultural resistance to the batching.

The interventions were spread to General surgery rooms after the conclusion of the project. An immediate difference was seen in the traffic patterns due to the preference cards not being as accurate as the orthopedic ones. There was more traffic by the nurses getting supplies at the beginning of the case. This highlighted the need for accurate preference cards. This was
demonstrated by Elliot et al (2015) in their project. The batching of staff breaks still was not successful based on the issues described above. The physical reminder was still successful at deterring people from entering the room without a valid reason. The general surgeons were less accepting of the project and there was significant push-back by one surgeon in particular.

Based on what the writer has observed, the guideline on the surgical environment should be expanded and strengthened. Currently, the guideline simply says that traffic should be kept to a minimum, without defining what minimum is. This should be changed, and minimum should be better defined. Acceptable and non-acceptable example of OR traffic should also be included in the guideline. At the site, a policy should be developed on OR traffic, which defines what are acceptable and non-acceptable reasons for movement in and out of the OR and during which surgical periods traffic should be minimal. The next steps are repeating the project with more observers in place and a longer period of time. Spot audits should also be completed in the orthopedic rooms to ensure that the signs are still being used and that the staff are still aware that OR traffic should be kept to a minimum.

The project was kept small because the writer was the only observer available. More observers would mean that the interventions could be instituted in the entire OR. Time could be afforded to the service leads to work on their preference cards to improve their accuracy. Batching of staff breaks will require more work and may never be achievable. The physical barrier was the easiest and most successful of all the interventions.

The results will be disseminated with the staff through in-service sessions. The writer will also present the results as an accepted poster presentation at the AORN Surgical Expo annual meeting as well as at the project site’s leadership convention scheduled for March 2020 in
Anaheim California. This will ensure that OR traffic best practices will be discussed and hopefully implemented in other sites.
References


Operating Room Traffic and Surgical Site Infections


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Fig. 1 OR Foot Traffic Surveillance Tool. A tool to categorize OR foot traffic by surgery time, reason and staff member

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<td>Incision Closure:</td>
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APPENDIX B- Graphs of Reasons, Staff and surgical times. The graphs represent staff versus reasons; staff versus surgical time and reasons versus surgical time.

Week 1

Fig 1. Week 1 Pareto chart. Chart displays the average number of times the door was opened for each reason.

Fig 2. Week 1 Staff vs Time of surgery. Chart shows the time spent by different staff members during the surgery.
Fig 2. Week 1 Staff v. time of surgery. Chart displays which staff member went through the door during which portion of surgery.

Fig 3. Week 1 Reason vs time of surgery. This chart displays the reason and the time of surgery
Week 6

Fig 4. Week 6 Pareto chart Door openings vs reasons. Chart displays the average number of door openings vs reasons.
Fig 5. Week 6 Bar chart Staff vs. Time of surgery. Chart displays count of door openings by which staff member during which surgical period.

Fig 6 Bar chart Reason vs. Time of surgery. Chart displays count of door openings by reason during which surgical period.
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