Fall 12-11-2020

Safeguarding Surgical Technologists and Reducing Costs Related to Upper Extremity Strain Injuries in the OR

Wilhelmina Hofilena
wlhofilena@dons.usfca.edu

MSN Prospectus Clinical Nurse Leader - Final Paper

Safeguarding Surgical Technologists and Reducing Costs Related to Upper Extremity Strain Injuries in the OR

Wilhelmina Lu Hofilena

University of San Francisco

NURS 655-K5 Internship

November 02, 2020

TABLE OF CONTENTS

Section I: Abstract

Problem: In the operating room (OR), complex procedures and processes are performed under time pressures, which presents unique challenges regarding ergonomic-related injuries. Handling surgical instrumentation trays with awkward postures is one of the high-risk tasks performed in the OR that can result in upper extremity (UE) strain. A healthcare system-based hospital in Northern California had five reported upper extremity strain injuries by the surgical technologists (STs) in workplace safety (WPS) performance year (PY) 2018-2019. The project aims to decrease UE strain injuries among STs by improving the quality of surgical instrumentation trays and promoting the culture of safety through staff effective communication and engagement.

Context: Microsystem and culture assessments with gap analysis were performed to assess the need for quality care improvement. The team's current performance on safety was reviewed, and it revealed a quality gap that needed a key improvement effort to achieve the desired outcome. In the main operating room (MOR), UE strain injuries occurred in surgical technologists (STs) are associated with handling surgical trays and lifting instruments. Four of the five injuries resulted in prolonged leave and absence of skilled employees that significantly impacted patient care. The cost associated with backfilling injured employees and the claims related to employee recovery is causing significant financial constraints to the department and the organization. Also, there was an inconsistent reporting and data gathering process for identified safety risks and near misses.

Interventions: The quality project aimed to safeguard the STs for future UE strain injury was initiated to mitigate the microsystem’s identified problem. Initial data were collected through a questionnaire survey and from the sterile processing management (SPM) database. The team identified the most commonly used two-tiered laparoscopic instrument trays and performed tests

of change to improve the trays' condition and make them user-friendly. An adjunct rapid cycle test on ring stands was also performed to reduce the arm lift height when removing instruments from the container pans. A team satisfaction post-survey was collected to determine overall improvement feedback. A biweekly safety huddle was incorporated in the OR daily readiness review.

Measures: The outcome measure was defined as the number of reported upper extremity strain injuries related to STs instrument handling obtained from Supervisor's First Report of Injury (SFR). The target aim for injury reduction was 50% by October 2020, a goal based on two employees' 2019 injury incidence. The process measures were conducting pre and post Survey Monkeys to determine STs concerns on surgical trays and their overall feedback, creating an ergonomically and user-friendly surgical tray and establishing a safety biweekly huddle. The balancing measure is identified as the project's impact on the workflow, efficiency, and safety of the sterile processing department (SPD).

Results: The implemented intervention positively impacted the outcome. In over a year from the last reported injury in July of 2019, the improvement project maintained the zero UE strain injury in STs in the MOR. The process goals were also achieved, and the team improved the quality of all laparoscopic surgical trays in the MOR. The engagement of the OR staff on huddles reflects an increased awareness and robust feedback on safety.

Conclusion: Risk mitigation and effective communication are significant measures to improve safety and prevent the costly impacts of work-related injuries. The quality project was a success, and it resulted in notable changes and improvements in safeguarding STs from UE strain injuries. The reduction in an injury rate of 46.26% in PY 2020 opens more opportunities for the OR team to perform 6S lean processes and harm-reducing initiatives.

Section II: Introduction

A work-related injury is an exposure or an event in the work environment either caused by or contributing to a resulting condition or significantly aggravating a pre-existing illness or injury. Over-exertion, slip, trip and falls, and contact with objects and equipment account for more than 84% of all nonfatal injuries involving days away from work (National Safety Council [NSC], 2018). The NSC (2018) indicated that the cost in 2018 of these work injuries was $170.8 billion and included losses in wage and productivity, medical expenses, administrative expenses, and employer's uninsured costs.

Occupational Safety and Health Administration ([OSHA] 2013) identified that in 2011 hospitals represented one of the most hazardous working environments in the United States with a recorded 253,700 work-related injuries and illnesses rate of 6.8 per 100 full-time employees. OSHA added that this value was almost double the rate for private industries. The hospital environment's dynamic nature, combined with severe hazards, makes it a dangerous workplace setting. The Bureau of Labor and Statistics (2019) reported that the rate of nonfatal occupational injuries among private industry employees was unchanged for the first time since 2012 at 2.8 cases per full-time equivalent (FTE) workers in 2018, of which 308,630 cases involved sprains, strains, and tears. In 2004, 54% of workplace injuries in healthcare were musculoskeletal disorders (MSDs), disorders involving muscles, nerves, joints, or spinal disc injuries (Beck, 2008). Work-related musculoskeletal disorders (WMSDs) inevitably lead to increased rates in job turnover and extended sick leave, long-term disability, and decreased work efficiency (Clari et al., 2019). Even though lower back pain is the most commonly reported health issue, WMSDs also frequently affect other body regions such as the upper limbs and shoulders (Davis & Kotowski, 2015).

Operating room (OR) personnel, particularly those in the scrubbing role, are more prone to WMSDs due to being actively involved in creating and maintaining the surgical field and passing surgical instruments. The peculiarity of surgical technologists' work tasks plays a crucial role in the development of WMSDs. These unhealthy ergonomic conditions include continuous repetitive movements, the adoption of static and awkward postures, and the lifting/holding up heavy surgical instruments (Vural & Sutsunbuloglu, 2016). STs who are continually anticipating the demand and need of the sterile scrub team and the back table are subject to a strain of their upper limbs. They overload their muscles and joints when they are bending their wrists and holding elbows higher when handling surgical instruments and trays. From pulling instruments off the sterile processing department (SPD) to the return of the used instrumentation cart to the SPD decontamination area, the STs intra-operative flow (see Appendix A) continuously reflects strenuous, repetitive, and unusual notions to efficiently and effectively perform roles and functions of their job description. Excessive workloads, team communication, accident-prone design and condition of the OR, and inadequacy of precautions could contribute to harm and injuries among surgical personnel (Ugurlu et al., 2015).

In the performance year 2020 (October 2019 to April 2020), the peri-operative department had 76% accepted claims attributed to ergonomic-related, patient handling, and striking or contact in nature. Thirty-three percent of accepted claims were associated with upper extremities, and 48% caused strain injury from lifting, pushing, and pulling (see Appendix B). As an acute care setting, 57% of all the reported injuries were due to patient handling affecting upper extremities with a rate of 45%. There were four injuries in the OR due to poor body mechanics and seven due to a lack of situational awareness. These data highlighted a need for ergonomic safety to reduce and prevent injuries in the OR.

Problem Description

The OR is the unit in a hospital where surgical procedures are performed in a sterile environment. Caring for a surgical patient includes interactions among multidiscipline care providers and the detailed preparations before the patient gets into an OR suite. Ensuring and improving patient safety in the surgical environment begins before the patient enters the operative suite. It includes attention to all suitable types of preventable medical and surgical errors such as wrong patient/site/side surgery, retained foreign object, and surgical site infection (see Appendix A). Multiple supporting microsystems have indicated roles and duties to keep the OR patient and team safe in care delivery. To ensure that all needed supplies, instrumentation, and equipment are readily available and operational, the teams do many strenuous activities and fast-paced movements to ensure patient care is not delayed. It was also emphasized by Nelson et al. (2007) that patient transfer and repositioning, handling of equipment and heavy instruments, and awkward postures are some high-risk tasks performed in the OR.

Upper extremity (UE) disease or injuries are associated with repetitive manual work and forceful movements. Some essential preventive measures are in the form of ergonomic design and changes in workplace practices (Muggleton et al., 2010). Among the heavy workloads performed by STs that increase their risks for UE strain injuries are lifting surgical trays on and off the surgical case cart, lifting instrument baskets out of the container pans to the sterile back table, assisting in the procedure, and pushing and pulling the case cart between the OR and sterile processing department (SPD). These activities involve body ergonomics of lifting, bending, twisting, and repetitious and prolonged reaching. The increasing complexity of procedures warrants increasing weight on surgical trays, but this also poses an ergonomic strain on both the OR and SPD personnel. Patient access and optimizing block utilization help meet the department's productivity goal, reduce surgical backlogs, and meet the increasing demand for patient

care needs. There are metrics such as turnover time and first case on-time start to promote efficiency and patient care experience; however, these all have a tremendous impact on the STs' workflow and injury risk.

At the project site, the workplace safety (WPS) performance year runs from October 1 to September 30 with a regional safety goal of 3.8 per 100 full-time employees. A reported injury may include first aid only, reporting only, or a sustained injury resulting in an employee's loss of workdays. In PY 2018, the OR had 18 reported injuries at the rate of 13.17. The OR incurred 19 injuries with an injury rate of 22.58 in PY 2019 (see Appendix B). For two consecutive years, fourteen injuries resulted in claims or workman's compensation. Five reported UE strain injuries were with surgical tray handling, of which four directly resulted from lifting tight/stuck inner baskets off container pans. The four claimed injuries led to long-term disabilities, including returning to work with restrictions or modifications.

Loss of skilled staff for a prolonged period significantly impact a department's operational need, including staff dissatisfaction and exhaustion, hiring of temp positions, overutilization of per diem personnel, and overtime. Limited staffing and personnel working for longer hours increase the risk of fatigue and reduced attention to details. These conditions significantly increase quality gaps, exposing the team to increased risk for errors, harms, and injuries. In addition to affecting patient care outcomes, it is an incredible financial burden to an organization.

Available Knowledge

The PICOT question used to guide the search for evidence in this project was: Among surgical technicians in the main operating room (P), how will improving the quality of surgical trays and communication in safety (I) compared to current standard processes (C) will reduce the incidence of upper extremity strain injuries by 50% (O) on October 2020 (T)?

For the literature review, an electronic search was conducted from July to August 2020 in the CINAHL Complete, PUBMED, and Cochrane Database. RefWorks reference list of retrieved studies was also browsed to identify additional relevant materials. The keywords used were *ergonomics, upper extremity strain, surgical trays, musculoskeletal disorder, repetitive disorder, surgery, surgical technologists, operating room, OR, ergonomics, lifting injury, occupational injuries, occupational safety, efficiency,* and *lean process.* Limitations were set to include English only and publication dates no earlier than 2010. The search yielded no article about the safety and injuries specific to STs. However, using the keywords, 45 articles were found on operating room ergonomics and lean processes. Five articles were appraised in this review for the strength and quality of evidence using the John Hopkins Evidence-Based Practice (JHEBP) tool (see Appendix C).

Review of Literature

Clari et al. (2019) conducted a multicenter cross-sectional study on 148 OR nurses (ORNs) who worked at eight Italian hospitals. Their study aimed to evaluate the association between personal and job characteristics and the risk of upper limb WMSDs using disabilities of arm, shoulder, and hand (DASH) questionnaire. They collected information on socio-demographic factors, job characteristics, and clinical data. Altogether, the study findings indicated that ORNs exposed to full-time scrubbing are three times more likely to present with upper limb WMSDs than those working less than 120h/month as a scrub nurse. The prevalence was 45.9%, and the multivariate analysis showed that female gender and monthly hours spent working as a scrub nurse are directly associated with a higher DASH score (Clari et al., 2019). The ORNs seniority did not appear to associate with the disorder, and there was no association found concerning the type of surgical specialty or hospital. The researchers recommended

implementing ergonomic interventions on surgical equipment alongside job rotation and medical surveillance programs (Clari et al., 2019).

According to Lin et al. (2020), musculoskeletal disorder (MSD) has been recognized as one of the most common occupational injuries of which nurses in the medical service industry have been identified as a high-risk group. A cross-sectional descriptive design with stratified cluster sampling was used to collect data from 1,803 nurses. The survey employed a demographic questionnaire and a Musculoskeletal Nordic questionnaire. The researchers explored the prevalence of MSD in various body parts and their risk factors among hospital nurses. All participants were recruited from a single Northern Taiwan medical center, and there was a response rate of 82.69%, compiled in three months (Lin et al., 2020). Logistic regression was used to analyze discomfort in the shoulder, neck, and back, which were the body locations with relatively high prevalence rates. The study discovered that nurses had a higher incidence of musculoskeletal discomfort and that differences in work practices and conditions corresponded to the different discomfort locations. Implementing ergonomic improvement measures in ensuring appropriate work postures and methods was recommended to prevent or reduce the incidence of MSDs in nurses.

Long et al. (2013) conducted a systematic review of 29 studies published between 1990 and 2012. Their research was focused on the prevalence of work-related neck, shoulder, and upper back MSDs among midwives, nurses, and physicians. Seven criteria guided their assessment, and a point system was used to measure the level of quality from high to low. Across the reviewed studies, the researchers found substantial variation in prevalence rates: median annual prevalence rates were 45% (neck), 40% (shoulder), and 35% (upper back). Midwives, who have not been studied well, demonstrated prevalence somewhat lower than physicians and

nurses (Long et al., 2013). Work-related neck, shoulder, and upper back MSDs are prevalent among nurses and physicians, and if midwives have similar exposures, their outcomes are likely to be equal (Long et al., 2013).

Koshy et al. (2020) performed a systematic review of literature that evaluated current interventions to minimize occupational musculoskeletal injury in surgeons and interventionalists. They focused on the human factor and administrative interventions, such as intra-operative microbreaks and ergonomics training. Study types included randomized controlled trials, crossover studies, and cohort studies. The review of six studies concluded that occupational injuries in healthcare are a long-neglected, multifactorial, and very prevalent issue, with a reported 68% of surgeons suffering from generalized pain (Koshy et al., 2020). The reviewers added that ergonomic training could be a very accessible and effective way of achieving that goal with up to 69.9% of surgeons noting improvement in their symptoms. There is a consistent body of evidence to suggest that microbreaks are an effective ergonomic intervention with proven benefits to surgeons and patients. Standardization, large-scale studies, and validated assessment methods are still lacking, suggesting that further work is required to validate these interventions and ensure effectiveness as introduced on a widespread basis (Koshy et al., 2020).

Previous biomechanical studies indicated that transferring or lifting unstable loads affected workers' muscle activities and their range of motion (Pinto et al., 2013). To explore the change of muscular and biomechanical responses in different load stability and visual access conditions during asymmetric lifting tasks, 14 volunteers (eight males and six females) participated in an experimental study by Wang et al. (2019). In half of the lifting conditions, the box was covered to restrict visual access when lifting. The effect on back and upper extremities were measured using spine kinematic and kinetic, and the surface electromyography signals.

Data collected from each trial were divided into stages of lifting and placing. The overall study outcomes showed that lifting and moving a potentially unstable load could lead to perturbation during lifting tasks, slower lifting, and reduced peak muscle activity (Wang et al., 2019). The researchers noted there was higher activation of the upper extremity muscles when there was a need to enhance load control, and load stability and visual access affect lifting behavior and strategy (Wang et al., 2019). Lifting and pulling out instrument trays from a container can potentially be an unstable load, most notably when it's stuck, heavy, and shifting contents. Load stability and visual access during a lift affect people's behavior and biomechanical responses, which may help mitigate injury risk.

Rationale

John Kotter's eight-step change model and lean methodology aim to fundamentally change organization thinking and values, ultimately leading to a transformation of behavior and culture over time (Smith et al., 2012). Both methods help create maximum value for patients by reducing waste, increasing efficiency, and involving an engaged team for continuous process improvement and practice change. Kotter's change model and 6S lean methodologies (see Appendix D) blend appropriately to help understand and manage the current process and support implementing the needed change utilizing a step-by-step approach towards success and sustainment.

Built on the work of Kurt Lewin, John Kotter's change model sets out the eight critical steps of the change process with each stage relating to people's response and approach to change. This is a holistic approach providing a clear description and guidance on the entire change process, which is relatively easy to implement (Kotter International, 2014). The change model consists of the following eight-step process: (a) creating urgency, (b) forming a guiding

coalition, (c) creating strategic vision and initiatives, (d) enlisting a volunteer team, (e) removing barriers, (f) generating short-term wins, (g) sustaining acceleration and build on the change, and (h) instituting change. According to Kotter (1996), the steps are outlined to emphasize that change is not a quick and straightforward process. Each step needs to be fully completed to have a satisfying result and minimize the risk of failure.

Lean methodology is based on the 1960's Toyota Production System in Japan and the partnership of W.E. Deming and Henry Ford. It is a strategy that reviews organization processes to determine what are add values and eliminate waste. In healthcare, the lean approach has resulted in systems that are efficient, effective, and genuinely respond to a patient's needs (Sukdeo, 2017). Standard work is created and focused on improving quality and safety. In the lean approach, there is the 6S process: sort, straighten sweep, standardize, sustain, and safety. It is a systematic method aimed at optimizing a workplace environment and work performance efficiency to improve morale, productivity, and quality (Gautam et al., 2014).

In this project, the combined frameworks created a highly engaged team motivated by a sense of commitment, cooperation, partnership, and ownership. The 6S helped improve working conditions and developed a more pleasant work environment for employees and increasing production time. The eight-step change model was critical for preparing participants to see the change through to ensure the implemented initiative of standardizing surgical instrument trays with its safest configuration will be a long-term success.

The project leader functioning in a CNL role guided the team by implementing identified surgical trays changes. The first phase (steps 1-3) was creating a climate for change and included the CNL as the team leader and change agent, setting the sense of urgency, inspiring the team, and enabling the staff to visualize the goal and steps to achieve it. The second phase (steps 4-6)

was enhancing and enabling the team during which the STs change agents drove the project through engagement with their peers. The third phase (steps 7-8) included implementing and sustaining change during which the change agents performed small tests of change on two sets of surgical trays, gathered feedback from colleagues, and implemented a capable tray that has been worked on to reduce the risk for UE strain injury. Spreading the implementation to complete the remaining trays and working on other surgical trays using the same processes will ensure the sustainability of the process.

Specific Project Aim

This project aimed to safeguard the surgical technicians and reduce costs related to upper extremity strain injuries in the OR related to handling surgical instrumentation trays by 50% by October 2020. An occurrence of one claimed injury would meet the 50% goal. A safe and healthy workplace not only protects workers from injury and illness, but it can also lower injury/illness costs, reduce absenteeism and turnover, increase productivity and quality, and raise employee morale. The project outcomes were obtained by correcting the injury source attributed to STs' UE strains resulting from handling surgical trays. Additional outcomes were cultivating culture safety within the OR microsystem through staff engagement and effective communication on unsafe conditions and injury near-misses during daily shift huddles.

Section III: Context

A thorough assessment of the OR microsystem was completed using the Dartmouth Microsystem Assessment Tool and Institute of Healthcare Improvement (IHI) Clinical Microsystem Tool to guide the improvement themes and aims (see Appendix E). An OR is a sophisticated acute care setting that operates 24/7, including off-hours and weekends. The OR in this community hospital is a microsystem that focuses on providing safe and high-quality care on a wide variety of surgical specialty services. It consists of 11 state of the art OR suites. The MOR

has six suites where general surgery urology, gynecology, robotic, head and neck, and podiatry procedures are performed. The second operating room (SOR) has five suites where all total joints, sports medicine, and other podiatry and hand procedures are completed. Both OR pods have their own separate supporting SPDs. There are ten pre-operative bays where patients are prepared for surgery and 32 post-operative bays to recover after their procedures. An average day has about 30 to 35 cases, and the average month would have about 650 to 750 procedures. The OR has a total of 65 staff members, including 30 RNs and 22 STs. The department leadership team includes a service director, nurse manager, and two assistant nurse managers.

The OR microsystem's center is surgical patients who require many linking microsystems support to efficiently and safely deliver care. According to the authors' Nelson et al. (2007), characteristics of a successful microsystem consist of leadership support, staff engagement, the interdependence of care team, information and information technology, process improvements, performance outcomes, and patient-centered care. The OR microsystem dynamic evolves, reacting to the needs of the surgical population. All of the professionals continue to focus on improving care and reducing risk and harm to patients. The CNL is in the unique and best position to influence care innovation and improvement to achieve the quality and safety of surgical care outcomes (King et al., 2019). A 5 P’s assessment of purpose, patient, professionals, patterns, and processes projected a better understanding of the microsystem gap and identified a useful quality improvement project to reduce UE strain injuries in the OR.

The project charter (see Appendix F) was developed with a driver diagram (see Appendix G), which is a visual display of the team’s theory of what contributes or drives to the achievement of a project aim (Institute of Healthcare Improvement [IHI], n.d.). The IHI Gantt chart (see Appendix H) is a project planning tool that illustrates the tasks and deliverables

involved in project initiation, execution, and sustainment, providing a timeline for completing each project phase. To identify the aspects that may affect this project negatively and positively, the need to accomplish an assessment of the strengths, weaknesses, opportunities, and threats (SWOT) (see Appendix I) was vital for successful planning and implementation (King & Gerald, 2016). A fishbone diagram (see Appendix J) was created as a crucial graphic tool to identify and clarify the causes and guide the process improvement (Nelson et al., 2007). Once the charter was finalized, a statement of the determination (see Appendix K) was completed and signed.

In PY 2019 (October 1, 2018, to September 30, 2019), the OR in this community hospital ranked third with nine claimed injury counts. This is an injury rate of 22.59 based on 79,682 productive hours. This was a significant spike from PY 2018, during which there was an injury rate of 13.19 and five accepted claims (see Appendix B).

The four injuries that STs incurred were UE strain injuries directly associated with lifting an inner basket from a tray container and led to an extended leave of absences ranging from seven months to a year. This was a significant time loss of a skilled worker that resulted in hiring a temporary position. During the injured STs' recovery phase, the employees returned to work on limited and modified restrictions supported by the temporary transitional work agreement (TTWA). The TTWA allowed the employee to accomplish productive work with temporary work restrictions by the treating physician. The focus was to return the employee to the regular, usual, and customary job. However, since the employees were not functioning at full capacity according to an STs job description, their presence in the department impacted the daily staffing capacity, influenced morale among peers, and led to overtime accruals to backfill regular work shifts. These monetary compensations are significant financial losses and obligations in an organization.

A cost analysis of two STs' injuries in PY 2019 was completed to reflect the financial implication of hiring an ST temporary employee at a base rate of $66.00/hour and the insurance expenses paid to the employee while away from work seeking treatment. The return on investment (ROI) analytical tool evaluated the efficiency and benefit of the project in relation to the investment cost (Corporate Finance Institute [CFI], 2017). The calculation of the two injuries' average expense compared to the investment's overall cost reflected a ROI result of 530% (see Appendix L). It is a positive net return more remarkable than the project's associated value and tremendous cost savings for the organization.

Interventions

The quality improvement project was introduced in combined OR and SPD Unit-Based Teams (UBT). The UBT co-leads meet each month to discuss and resolve barriers in the OR's instrumentation needs. UBT's transform roles by creating an environment in which employees are encouraged to think critically about problem-solving and work innovations. The OR UBT meets every third Thursday of the month and has a safety champion, staff co-leads, and an OR manager co-lead. The change agents brainstormed the project's logistics during the initial kick-off meeting, as an interdepartmental collaboration was essential to monitor progress and updates. A baseline assessment on surgical trays was obtained via Survey Monkey and received an 80% response rate. The SPM database was utilized to retrieve initial data on surgical trays (see Appendix M) to be assessed based on the outcome of the survey questionnaire.

The education of the OR staff on safety was conducted at a monthly staff meeting. It introduced the previous and current state of the injuries in the OR and future opportunities to mitigate risks and improve processes. An ergonomic training on proper body mechanics was scheduled to follow up on encouraging and nurturing safety awareness among OR staff. This was

the first training conducted by the facility safety leaders and will be part of the department's annual safety initiative. To reinforce ergonomic safety in the department, safety leaders outsourced a comprehensive service with an ergonomist to further assess risk and provide insights to optimize team performance. More than just minimizing MSDs and pain, this was an opportunity to improve safety and promote quality work among OR frontline staff.

The OR staff gather daily at the start of every shift for a readiness huddle board. A biweekly huddle on Mondays and Wednesdays was incorporated into the huddle to obtain effective communication and improve staff engagement. Timely feedback and escalations on safety concerns and near misses were collected using a reporting form (see Appendix N), and a visual indicator determined the status of the action items. As staff resources, the assistant nurse manager's roles are critical in reinforcing accountability and identifying communication and education gaps during huddles. The team’s education and consistent engagement are intended to effectively cultivate an ongoing recognition, cooperation, and reporting of hazardous conditions.

Some engineering controls were implemented on the laparoscopic trays based on the surgical tray handling injury it caused in August 2019. This included modifying the inner basket and improvising the endo-rack that holds the endoscopic graspers. The interventions did not seem adequate as STs consistently escalated concerns with the laparoscopic surgical trays' set-up and condition. This project identified adequate quality gaps on the laparoscopic trays and implemented a process to sustain the quality improvements.

Using the PDSA model can lead to early, measured, and increased staff enthusiasm that will diminish anxiety and resistance to change (Nelson et al., 2007). PDSA is a method advocated by the IHI as a “trial-and-learning” method to test changes quickly to see how they work (Nelson et al., 2007). Teams repeat these test cycles until the difference is ready for

broader implementation. Interventions are determined to be successful based on the PDSA analyses. Teamwork needs to be developed to support process improvement and foster long-term success. If positive outcomes are achieved, then the team's success should be celebrated; if not, then the data should be examined to identify opportunities for improvement (Vassell, 2016).

Study of Interventions

The PDSA cycles were formulated, which helped guide the team on the series of change tests (see Appendix O). The three potential risk areas were the outer container's defect and design, the configuration of the inner baskets/trays, and the laparoscopic tray's overall weight. Based on the pre-survey, the team decided to assess and improve the two sets of commonly used two-tier laparoscopic trays. The objective was to strengthen the two laparoscopic surgical trays' quality and condition. Once the intervention's appropriateness was accepted, the team adopted the interventions to all remaining sets of trays. The demand for operation and the change agents and team leaders' unavailability were a known threat to completing the project.

The PDSA implemented to achieve effective communication and improve the team's engagement during huddles was initiated first to create a climate for change and help establish the need to focus on safety. The daily huddle has a minimal time of five to ten minutes to disseminate operational updates, reminders, and the day's schedule. Incorporating a segment that could extend staff interaction and discussion may prolong huddle time, and the safety data collection could be deferred to another day.

The supervisor's first report (SFR) was utilized to collect recent and current UE strain injury information among the STs. The electronic reporting form also provided additional reporting data. Accessing and reviewing SPM data was beneficial in analyzing trends in surgical processing and assets. Improving communication through huddle and monthly safety team

meetings effectively supplemented interventions on safety risk mitigations. The collaboration of CNL roles encompassed in this project were the three leading roles of educator, risk anticipator/system analyst, and outcome manager.

Measures

The family of measures on this project utilized a set of metrics to address outcome, process, and balancing measures (see Appendix F). Reducing the incidence to 50% of UE strain injuries induced by instrument handling was the specific outcome measure. One injury that will result in lost hours or workman's compensation was defined as the measure to meet the 50% goal.

There were four process measures included in improving safety culture and the 16 two-tier laparoscopic surgical trays. First, data were obtained on usage trends and the weight of the trays using the SPM system. To achieve 90% of this goal meant getting information on 14 out of 16 trays. Second, a baseline assessment on surgical trays and feedback on implemented changes were obtained via a Survey Monkey questionnaire. The team members received an 80% response rate on the survey. Third, a test of change on surgical trays was implemented, and prompt feedback gathered from end-users. The goal was to get feedback from 90% of the team of 16 STs. Lastly, biweekly safety huddles were implemented to collect staff feedback or escalations on risk hazards and near-misses. The goal was eight safety huddles per month.

A balancing measure was included to assess other parts of a system that might be affected during improvement activities. The action would be on the impact of the project on SPD staff due to changes made to the number of surgical trays: Will it cause a delay in processing time? Are they satisfied with the changes made? Does the new configuration promote ergonomic safety? There are 30 frontline staff in SPD who process these 16 laparoscopic trays, among many

other intricate trays every day. Their role is critical in ensuring that the assembly of the tray is consistent and sustained. It is a goal to be able to get a 75% response rate from the SPD team via Survey Monkey at the end of the year.

Ethical Considerations

The faculty reviewed the project and determined to qualify as an evidence-based change in practice project rather than a research project. An institutional review board (IRB) approval was not required, and the project met the exemption criteria (see Appendix K). This was not research but a quality project to improve safety in the OR.

Ethics is an essential and integral part of healthcare. The concepts of autonomy, benevolence, nonmaleficence, fidelity, and justice are applied to this project to guide evidence-based practices. Autonomy was upheld when it was accepted that a ST is a unique person who has the innate right to have his or her own opinion, perspective, value, and belief and should be able to give feedback without any judgments or coercion (Burke, 2020). The beneficence was encouraging the STs to have the foundational moral of doing what is right and supporting the process improvement. The overall desired outcome of reducing injury and proactively participating in risk mitigation helped the nonmaleficence of not harming colleagues. Fidelity, being loyal and faithful to commitments and accountable for responsibilities, may have posed an ethical concern for a project (Beauchamp & Childress, 2001).

The STs have multiple competing priorities to expedite cases and prevent delays in care. Committing to a timely response with the use of improved trays might be an additional task. The project may not seem significant to STs who have never found an issue managing tricky trays due to their physical build and height. The trays' improvement may not be critical to those who observe situational awareness and constant mindfulness on safety and proper body mechanics.

This project's quality improvements are only a small fragment of more significant safety concerns on other trays and the department in its entirety. Improvements might not be perceived as impactful and meaningful. Fidelity was founded on building trust relationships between OR and SPD staff. Each role should function as a risk anticipator, providing substantial resources to support both units' safety culture.

Section IV: Results

The change agents actively participated and engaged the team members to provide feedback and identify gaps. The project team members brainstormed and established the project's goals and benefits, then initiated gathering baseline data by collecting information from the SPM and opening all ten laparoscopic cholecystectomy trays and six gynecology advance trays. The 6S method was adopted, and the process was completed in batches based on the following: What is needed for the current operation? Are sets currently being processed? What can be pulled from the storage racks? This initial assessment tremendously helped identify ergonomic risks and quality gaps in pulling instruments out of the containers. All the 16 trays were analyzed and did not have a uniform configuration on containers and inner baskets. It was noted that there was a two-container system currently in use. It was validated that both the laparoscopic cholecystectomy and gynecology advance trays were less than the weight limit of 25 pounds. As all instrument pieces were deemed critical, there was no indication to reduce or streamline any instrument out of the sets.

Based on the simulations, peer recommendations, and adoption of tray components from borrowed instrument sets, the team members designed a trial tray used on the PDSA cycle. STs found the improved trays ergonomic and user-friendly. Based on positive and amenable feedback, applied changes were adopted and spread to all laparoscopic two-tier surgical trays.

The STs also recommended a modification of the ring stand where the surgical trays were staged for an opening to help reduce their lift height. Series of the modified ring stands cycled through among STs to gather the feedback of their effectiveness and usefulness in risk reduction.

The Monday and Wednesday huddle days on safety were not consistent. There was an absence of safety escalation on some days and multiple items to follow-up on other days. The success of the safety huddle in engaging the team and improving communication was solely dependent on the nurse managers' consistency and diligence running the huddle. It became a value-added to the huddle when the staff was informed of their escalations' progress and completion. The use of the escalation form was useful and beneficial in tracking escalations, and the use of colored dots for action item completion was practical.

Section V: Discussion

Summary

The laparoscopic trays are the tallest containers and the most commonly used surgical sets in the MOR. Retrieving instruments from a certain angle or depth poses a constraint on UE and backs, especially for STs of smaller stature. Reducing the UE lift by lowering the ring stand and increasing the inner basket height made a difference in STs posture and body mechanics. Correcting the container system and improving the instrument layout inside the tray reduced the length of lift and potential for inner baskets to get stuck. The project's completion included spreading the improvement requirements to six remaining 2-tier laparoscopic and 12 non-laparoscopic instrument sets of the same container size. This action will guarantee that the project's laparoscopic sets will always have a consistent container available during instrument assembly.

The interventions were significant and showed successful results on both outcome, process, and balancing measures. The outcome measure was aimed at a 50% reduction or having only one staff injury by the end of September 2020. By October 2020, the STs did not incur a UE strain claimed injury associated with lifting challenging surgical trays. The outcome measure was successfully achieved at 100% (see Appendix P). The surgical tray containers were attained at 100% completion, including other instrument sets of the same size container. If this outcome can be sustained over time, the project effectively reduces UE strain injuries by STs.

There was 100% participation in the post-survey from 16 STs who were regularly assigned in the MOR. The goal rated at 75% for both surveys was met, having the combined 90% result. Overall, the STs were satisfied with the improvement project and concurred that it's tremendously helping them prevent UE strain injuries (see appendix Q).

The biweekly huddle has been maintained since it was initiated in June, and integrating it on Mondays and Wednesdays will continue to be the nurse managers' aim. Since implementation in June, the goal of having eight huddles in a month is met, and there is an upstream trend of safety events and near misses collected (see Appendix P). Using a colored button indicator as a visual tool was found to be beneficial in tracking the action items' progress. Frequent follow-up was a standing reminder with the assistant nurse managers due to constant and evolving daily operation changes.

The four process measures were achieved successfully, exceeding their goal rates. The SPD was not affected by having any recipe/count sheet changed. Still, a simple supplement to SPM reflected an instruction on the tray assembly and the use of paper wrapper and shorter stringer on each lower wire basket. The balance measure included a plan to survey the SPD team by the end of 2020 to capture the project's impact on their safety and efficiency.

The intervention's effectiveness will be thoroughly measured in the upcoming PY 2021 if the 0% to 50% incidence rate is maintained. For future projects, one could benefit from continuing to reinforce the team's effective communication process in capturing unsafe conditions and near misses in the workplace. Team engagement, performing tests of change, and getting timely feedback significantly impacted the outcome of this project.

Key Findings and Success Factors

The 16 trays laparoscopic trays have a two-tiered inner component: a wire bottom basket to hold loose and string instruments and a top endo rack to contain the graspers. The team noted that some containers are still in excellent working condition; however, only three trays had solid bottoms, and 13 had filtered bottoms. Having a filtered base increased the risk for strain injury by carrying the baskets of instruments while waiting for a colleague to check the filters and cartridges for any sterility break, i.e., cuts and holes. It was observed that there are two kinds of container system used, and one has a significant weight difference of two pounds. The team realized that SPD assembles the sets utilizing any readily available pan, and they do not keep a dedicated outer container for grouping the instruments. The team discussed that all other additional containers of the same size must be standardized to support and sustain the implementation process. Fourteen trays have a standard two-inch wire basket and endo-rack. However, four other endo-racks had the older configuration. The sets also have a paper liner that causes the loose and stringed instruments to shift and become disorganized while in motion.

During the simulation, staff rounding, and random observation, it was identified that STs vary in their retrieval method using straight down or reverse wrist motion, simultaneous or one rack at a time (see Appendix R). The variation in practice and body mechanics contributes immensely to risks for a UE strain injury. Additional contributing factors were bottom filters,

compromised or absent sterility indicators, and improperly secured, disengaged or dislodged retention plates. Compromised indicators and breakdown in sterility are errors that may result in patient delay and cost if not mitigated promptly. As with any instrument container or sterile delivery system, inspection for integrity is part of a good quality assurance program.

Borrowing laparoscopic trays from other healthcare system medical centers provided insight to the team of an ideal tray set-up and a significant step to the project's success. The partnership, close relationship, and collaboration of OR and SPD managers played a crucial part in seeing the project through completion. Knowing the vendors played a critical component in ensuring that the materials were expedited throughout the stages of rapid cycle tests, completion of intended trays, and other containers' necessary spread.

It was suggested by STs to have the ring stands height to be modified and lowered. A ring stand holds sterile basins and also serves as a staging area for instrument trays during case set-up. A maintenance vendor was contacted to find out the possibility of lowering the height of a ring stand. During the rapid cycle test, the STs identified that reducing the ring stand's height not only helps reduce the strain on their UE and back but is also applicable to all trays of variable heights. The brilliant idea of having a lowered ring stand complemented the improved surgical trays in reducing UE strain.

The ramping up in elective cases during the project time frame provided a high volume of procedures to test the sample trays. However, tracking the trays and getting real-time feedback during sterile set-up was challenging. For cycle time, it may take two or more days before it gets used again. During PDSA cycles, time and dedicating a change agent to perform the observation was a considerable barrier. Operational demand impacted by a hectic OR schedule and staffing deficit took away the allocated time planned to observe and track the cycle. To complete the set-

up in all the trays, team members worked on a weekend because it was less impactful on operations. The competing priorities brought forward by the COVID-19 pandemic shifted the focus and delayed the start of the project. When elective cases were postponed, it could have been an excellent opportunity for kick-off. However, the time was directed towards staff education and simulation training, evolving PPE guidelines and protocol, and surge planning. The mini-meetings and brief interactions with team members and staff were valuable and helpful in maintaining focus on the project.

Lessons Learned

Microsystem assessment utilizing the 5P's was essential and valuable in understanding unit culture, trends, and gaps. Engaging both UBTs influenced the team's collaboration and cohesiveness to this project's outcome. Introducing the importance and the concept of the project through a survey supported the proactive responses and engagement from STs. Collaborating with other healthcare systems' ORs and borrowing surgical trays allowed the team to see the difference in instrument tray set-up and adopted best practices.

The questionnaire survey was constructive in narrowing down the set of surgical trays to be included in the project. It also validated the trays that caused all previous injuries. Learning and accessing SPM made a difference in understanding and capturing accurate data on usage, trends, and surgical assets processing. Another critical lesson learned was understanding the process in place on container pairing. The need to spread the adopted changes was absolute for the project to work. When all the trays were completed, a weekly assessment on the SPD storage rack became necessary to determine if there were still filtered pans revolving throughout MOR.

The possibility of ring stand modification was a great suggestion by STs during the meetings, which became a simultaneous intervention to the surgical tray PDSA. When the trial

double-ring stand was introduced, the STs who regularly worked in the SOR didn't see the value of lowering the ring stand due to their unique process of opening trays in a back table. Hence, ring stand modification will not be an adjunct improvement in the potential spread of the project in SOR.

The project change agents and team leaders realized that having a minimum number of trays in rapid cycle testing is hard to track and monitor. Increasing the number of trays was necessary to obtain more feedback from ST end-users. Based on the STs' positive responses through a month-long data collection, the remaining trays progressed to completion without additional revision on the trial trays.

Conclusions

The OR is a high-risk environment influenced by culture, teamwork, and task complexity with few critical approaches for improvement, such as system engineering and collaboration (Wahr, 2020). The changes implemented to the surgical trays and ring stands (see Appendix R) were engineering controls to mitigate UE strain injury risks to STs. Administrative control was depicted by leadership guiding change with support, partnership, and engagement from the team. Ergonomics has been a common injury category in the OR, and these resulted from three main factors: force, frequency, and/or posture (A. Waland, personal communication, June 26, 2020). A standard surgical instrument tray reduces processing error, which is a barrier to the surgical tray's highest quality and safety. A poorly designed surgical tray was substantially improved using lean techniques. Safety conversations and increased mindfulness also declined the injury rate from PY 2019 of 22.59 to PY 2020 of 12.15. A translation of 46.26% improvement over last year's performance.

The OR microsystem's goal and collective efforts are to lower the injury rate trend and hope to meet the regional goal of 3.8. The work on these surgical trays will yield a significant financial benefit to the organization by reducing processing time on the instruments and reducing the cost associated with the backfilling and treatment of an injured employee. In addition to substantial cost savings, optimizing surgical trays decreases weights of the tray and instruments cleaning times without a negative impact on turnover time (Chicos et al., 2019). The lean methodology of surgical instrumentation will also encourage the surgical teams' participation through continuous process improvement. Ongoing monitoring, random audits, and consistent huddles are critical plans for sustainability.

Implication for Practice

Patient and staff safety are always paramount. Checking that instruments have been appropriately reprocessed helps to ensure the safety of our patients. It is vitally essential for all staff (OR and SPD) to use safe instrument container systems and understand why proper reprocessing, container system functionality and ergonomics are steps in safeguarding patients and staff against harm injury. Mitigating hazardous risks promotes satisfaction and joy at work and a healthier workforce. A breakdown of sterility caused by ineffective container set-up may also lead to increased operative times and costs.

Knowing vendors and building a productive relationship with them was another critical element to successfully completing this project. Vendors have to be flexible to meet timelines and are great resources. Having supportive SPD leadership and involving their team in the process was imperative. SPD staff are instrumental in executing and maintaining the implemented changes on the surgical trays.

The ergonomic refresher training offered by the safety leader and the ergonomic assessment involving a consultant increased the frontline staff's interest and engagement in the process. Observing workflows from another perspective or understanding processes having fresh eyes seemed to have reinforced and highlighted the staff's safety culture. The attention includes the potential solutions to barriers and the advocated use of the existing ergonomic equipment (see Appendix R).

The CNL roles of team manager, risk anticipator, and outcome manager can significantly influence this project's continued success by providing the support and leadership partnership with all key stakeholders. To safeguard the STs against incurring another injury associated with surgical tray handling is very dependent on safe tray assembly from SPD. An optimized surgical tray can also reduce cost, physical strain, preparation times, and processing times from an SPD standpoint. Streamlining trays is also an effective strategy for hospitals to reduce costs and increase operating room efficiency (Dyas et al., 2018).

Sustainability

The project's usefulness and the continuous engagement from frontline staff will be instrumental in potentially spreading the 6S lean process and quality improvement projects to other areas such as the OR cores, SPD storage racks, and other service specialty trays. The change agents also adopted the 6S lean process and worked on the robotic and major ortho sets based on survey results. There are now three service specialty trays and a robotic general set weighing less than 18 pounds each from a massive tray of 36 pounds. The major ortho tray weighing 34 pounds has been streamlined to two sets of 14 and 20 pounds. The constant feedback from frontline staff, designing a repeatable inspection process, and adopting new and improved best practices are crucial elements to maintain the improvement achieved on this

project. There is a high likelihood that container pans with filtered bases will be used again in the two-tier laparoscopic sets if these instruments are processed in the MOR SPD. Hence, there’s a need to work on similar containers in the SCOR to prevent fallout. Providing instruction on the SPM database of the tray standard set-up will continually remind SPD staff to assemble trays correctly and, hopefully, maintain the quality outcome. The team will perform a weekly random audit of the improved trays to ensure the project's improvements are sustained

Section VI: References

Beauchamp, T. L., & Childress, J. F. (2001). *Principles of biomedical ethics* (5th ed.). Oxford University Press.

Beck, D. M. (2008). Ease that aching back: Ergonomic issues in the OR. *OR Nurse, 2*(5), 47–49. https://www.nursingcenter.com/journalarticle?Article_ID=790394&Journal_ID=682710&Issue_ID=790370

Bureau of Labor Statistics. (2019). *Injuries, illnesses, and fatalities*. https://www.bls.gov/iif/

Burke, A. (2020). *Ethical practice: NCLEX-RN*. Registered Nursing.Org. https://www.registerednursing.org/nclex/ethical-practice/

Cichos, K. H., Hyde, Z. B., Mabry, S. E., Ghanem, E. S., Brabston, E. W., Hayes, L. W., McGwin, G., Jr., & Ponce, B. A. (2019). Optimization of orthopedic surgical instrument trays: Lean principles to reduced fixed operating room expenses. *The Journal of Arthroplasty, 34*, 2834–2840. https://doi.org/10.1016/j.arth.2019.07.040

Clari, M., Garzaro, G., Di Maso, M., Doanto, F., Godono, A., Paleologo, M., Dimonte, V., & Pira, E. (2019). Upper limb work-related musculoskeletal disorders in operating room nurses: A multicenter cross-sectional study. *International Journal of Environmental Research and Public Health, 16*(16), 2844. https://doi.org/10.3390/ijerph162162844

Corporate Finance Institute. (2017). *What is return on investment*? https://corporatefinanceinstitute.com/resources/knowledge/finance/return-on-investment-roi-formula/

Davis, K. G., & Kotowski, S. E. (2015). Prevalence of musculoskeletal disorders for nurses in hospitals, long-term care facilities, and home health care: A comprehensive review. *Hum Factors, 57*(5), 754–92. https://doi.org/10.1177/0018720815581933

Dyas, A. R., Lovell, K. M., Balentine, C. J., Wang, T. N., Porterfield, J. R., Jr., Chen, H., & Lindeman, B. M. (2018). Reducing cost and improving operating room efficiency: Examination of surgical instrument processing. *Journal of Surgical Research*, *229*, 15–19. https://doi.org/10.1016/j.jss.2018.03.038

Gautam, V. S., Shah, A. R., Parmar, A. N., & Kedarita, V. D. (2014). Study of 6S concept and it's effect on industry. *International Journal of Emerging Technology and Advanced Engineering*, *4*(10), 272–277. https://www.semanticscholar.org/paper/Study-of-6s-Concept-and-its-Effect-on-Industry-Gautam-Shah/0ce136cea666cef096b7b4cc2a50b50f63a03ecb

Institute of Healthcare Improvement. (n.d.). *Quality improvement essential toolkit*. www.ihi.org

Institute of Healthcare Improvement. (n.d.). *Science of improvement: testing changes*. http://www.ihi.org/resources/Pages/HowtoImprove/ScienceofImprovementTestingChanges.aspx

King, C. R., & Gerald, S. O. (2016). *Evidence-based practice: Clinical nurse leader certification review* (2nd ed.). Springer Publishing Company.

King, C. R., Gerald, S. O., & Rapp, C. (2019). *Essential knowledge for CNL and APRN nurse leaders*. Springer Publishing Company.

Koshy, K., Syed, H., Luckiewicz, A., Alsoof, D., Koshy, G., & Harry, L. (2020). Interventions to improve ergonomics in the operating theatre: A systematic review of ergonomics training and intra-operative microbreaks. *Annals of Medicine and Surgery*, *55*, 135–142. https://doi.org/10.1016/j.amsu.2020.02.008

Kotter International. (2014). *The 8-step process for leading change*. http://www.kotterinc.com/8-steps-process-for-leading-change/

Kotter, J. P. (1996). *Leading change*. Boston Harvard Business Review Press.

Lin, S. C., Lin, L. L., Liu, C. J., Fang, C. K., & Lin, M. H. (2020). Exploring the factors affecting musculoskeletal disorders risks among hospital nurses. *PloS One*, *15*(4), e0231319. https://doi.org/10.1371/journal.pone.0231319

Long, M. H., Bogossian, F. E., & Johnston, V. (2013). The prevalence of work-related neck, shoulder, and upper back musculoskeletal disorders among midwives, nurses, and physicians. *Workplace Health and Safety*, *61*(5), 223–9. https://doi.org/10.1177/216507991306100506

Microsystem assessment tool. (2015). The Dartmouth Institute. http://www.clinicalmicrosystem.org

Muggleton, J. M., Allen, R., & Chappell, P. H. (2010). Hand and arm Injuries associated with repetitive manual work in industry: A review of disorders, risk factors and preventive measures. *Ergonomics*, *42*(5), 714–739. https://doi.org/10.1080/001401399185405

National Safety Council. (2018). *Top work-related injury causes*. Injury Facts. https://injuryfacts.nsc.org/work/work-overview/top-work-related-injury-causes/

Nelson, A., Thomas, W. R., Spratt, D. G., Petersen, C., & Hughes, N. (2007). AORN guidance statement: Safe patient handling and movement in the peri-operative setting. *Association of Peri-operative Registered Nurses*.

Nelson, E. C., Batalden, P. B., & Godfrey, M. M. (2007). *Quality by design: A clinical microsystem approach*. Jossey-Bass.

Occupational Safety and Health Administration. (2013). Worker's safety in the hospital: Know the facts. *United States Department of Labor*. https://www.osha.gov/dsg/hospitals/documents/1.1_Data_highlights_508.pdf

Occupational Safety and Health Administration. (2018). *Worker safety in the hospitals: Caring for our caregivers*. The United States of Labor. https://www.osha.gov/dsg/hospitals/understanding_problem.html

Pinto, V. J., Sheikhzadeh, A., Halpern, M., & Nordin, M. (2013). Assessment of engineering controls designed for handling unstable loads: An electromyography assessment. *International Journal of Industrial Ergonomics*, *43*(2), 181-186. https://doi.org/10.1016/j.ergon.2013.01.004

Smith, G., Poteat-Godwin, A., Harrison, L. M., & Randolph, G. D. (2012). Applying lean principles and kaizen rapid improvement events in public health practice. *Journal of Public Health Management and Practice*, *8*(1), 52–54. https://doi.org/10.1097/PHH.0b013e31823f57c0

Sukdeo, N. (2017). *The application of 6S methodology as a lean improvement tool in an ink manufacturing company*. International Conference on Industrial Engineering and Engineering Management. https://doi.org/10.1109/IEEM.2017.8290176

Ugurlu, Z., Karahan, A., Unlu, H., Abbasoglu, A., Elbas, N. O., Isik, S. A., & Tepe, A. (2015). The effects of workload and working conditions on operating room nurses and technicians. *Workplace Health and Safety*, *63*(9), 399–407. https://doi.org/10.1177/2165079915592281

Vassell, P. (2016). Improving OR efficiency. *AORN Journal*, *104*(2), 121–129. https://doi.org/http://dx.doi.org/10.1016/j.aorn.2016.06.006

Vural, F., & Sutsunbuloglu, E. (2016). Ergonomics: an important factor in the operating room. *Journal of Perioperative Practice*, *26*(7-8), 174–78. https://doi.org/10.1177/1750458916026007-804

Wahr, J. A. (2020). Operating room hazards and approaches to improve patient safety. *Patient Safety Network. Agency for Healthcare Research and Quality*. https://psnet.ahrq.gov/issue/operating-room-hazards-and-approaches-improve-patient-safety#

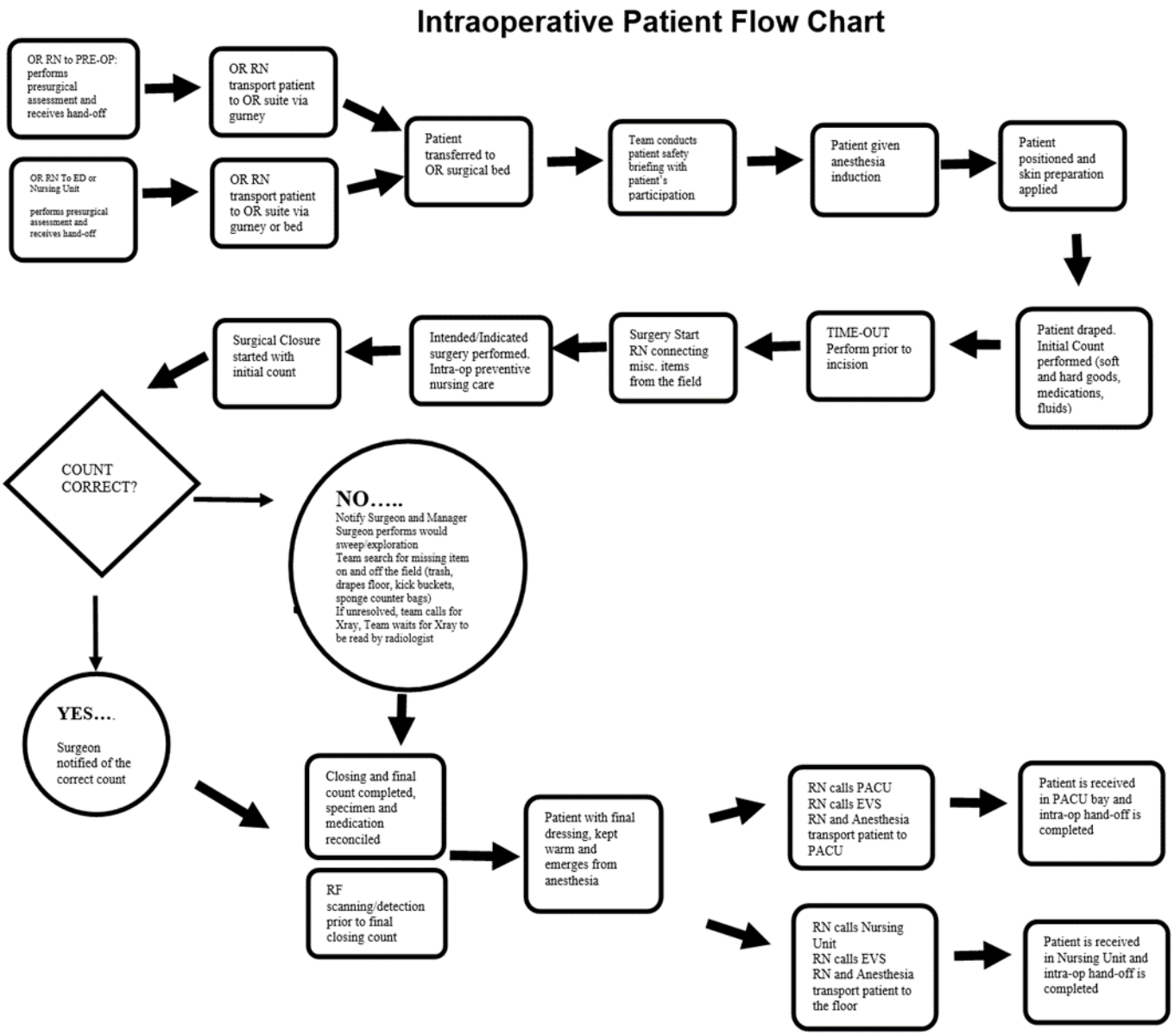
Wang, X., Lavender, S., & Sommerich, C. (2019). The effects of load stability and visual access during asymmetric lifting tasks on back and upper extremity biomechanical responses. *Human Factors*, *61*(5), 712-721. https://doi.org/10.1177/0018720818814107

Waland, A (2020, June 26). Personal communication.

Section VII: Appendices

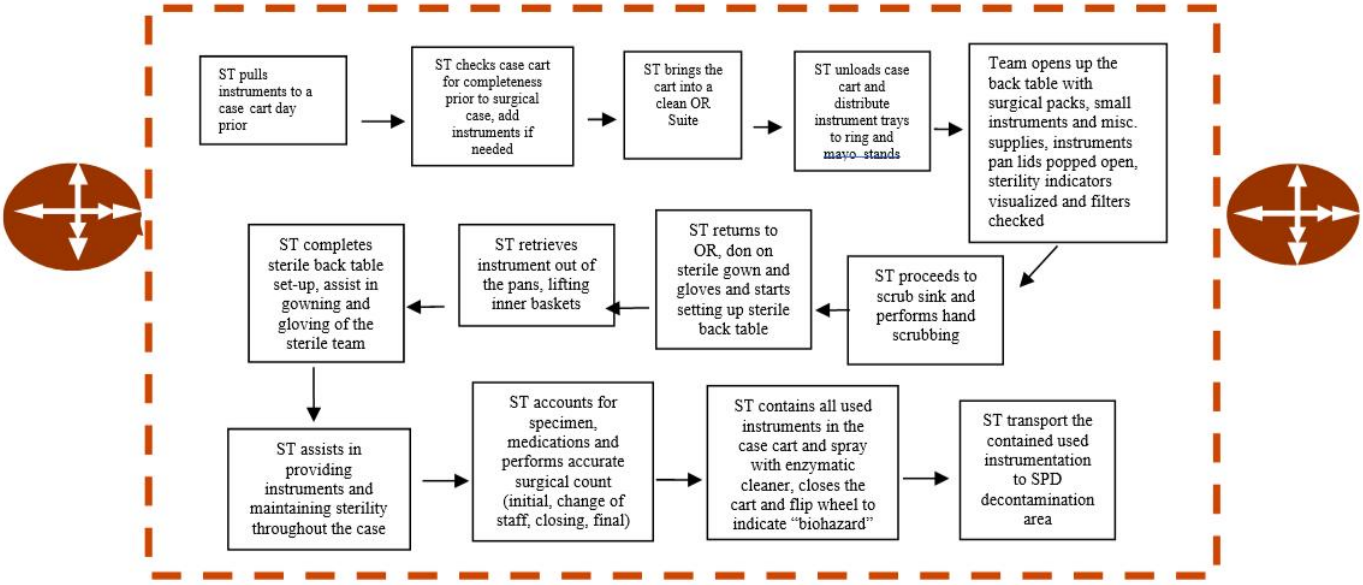
Appendix A

Process Flow/Map



SURGICAL TECH INTRAOPERATIVE PROCESS FLOW

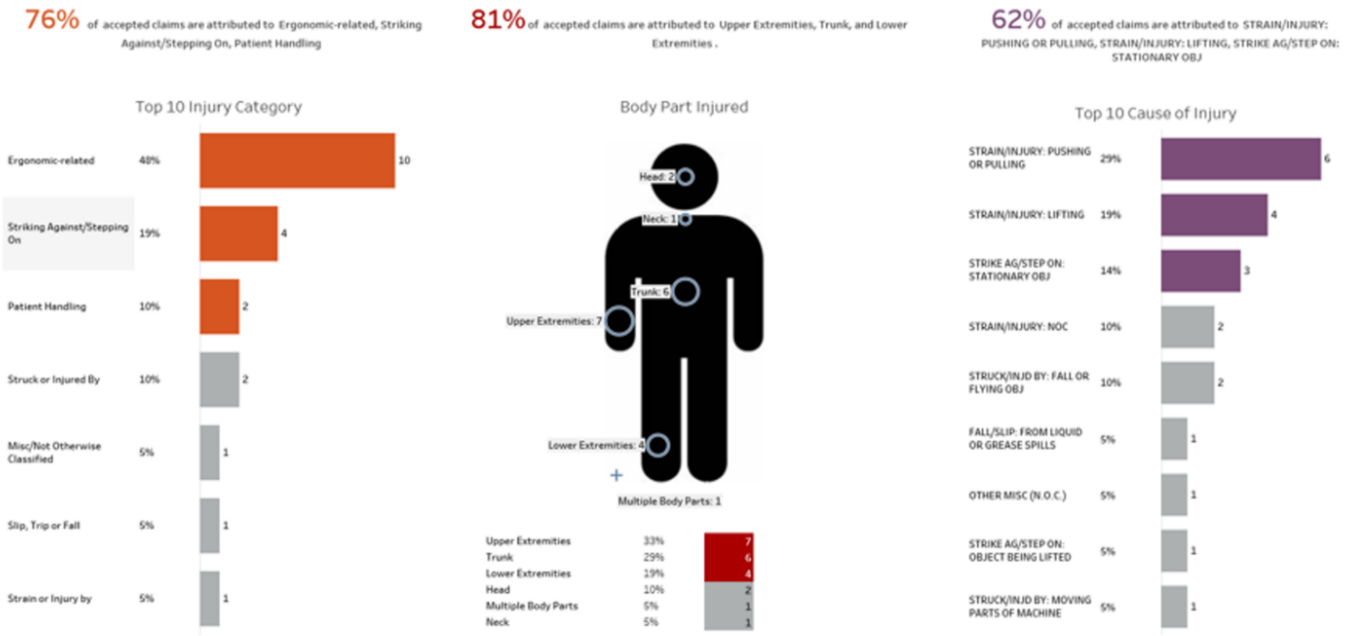
Purpose: To provide appropriate and accurate surgical instrumentation



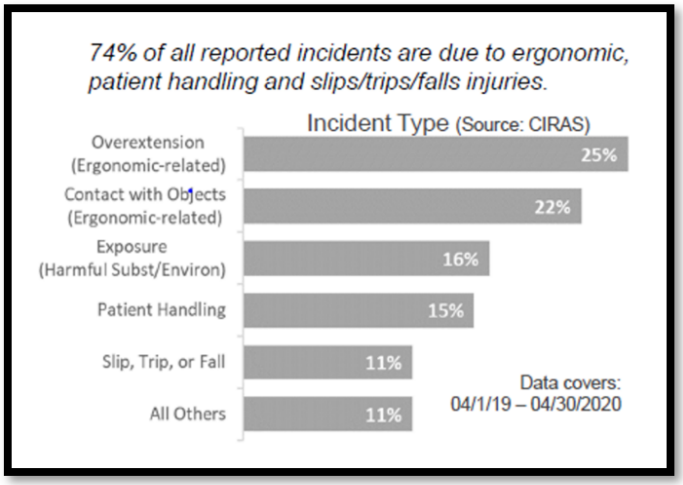
Professionals: OR Surgical Techs

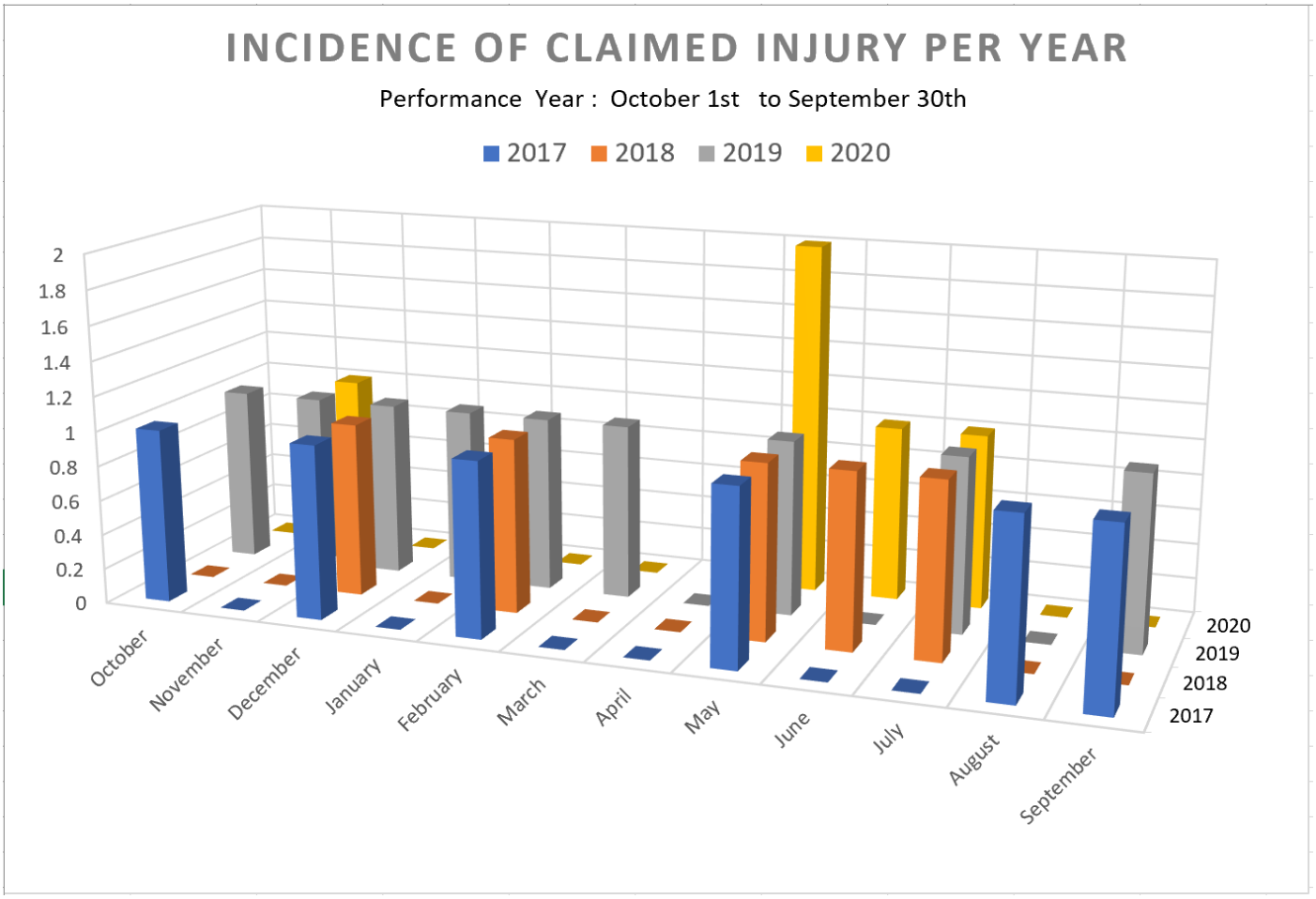
Appendix B

Injury Data Report



OR/Special Procedure Injury Impact Report





PY	Reported Injuries	Claimed Injuries	Injury Rate
2017	17	6	17.31
2018	18	5	13.17
2019	19	9	22.59
2020	11	5	12.14

Compared to PY 2019, a decline of 10.45 in injury rate translates to an improvement of 46.26% in PY 2020

Appendix C

Evaluation Table

Citation	Conceptual Framework	Design/ Method	Sample Setting	Variables Studied and Definitions	Measurement	Data Analysis	Findings	Appraisal
Clari, M., Garzaro, G., Di Maso, M., Doanto, F., Godono, A., Paleologo, M., Dimonte, V., & Pira, E. (2019). Upper limb work-related musculoskeletal disorders in operating room nurses: A multicenter cross-sectional study. *International Journal of Environmental Research and Public Health*, *16*(16), 2844. https://doi.org/10.3390/ijerph162162844	None	Multicenter Cross-Sectional Study between April and September, 2018	148 ORNs at 8 representative hospitals in Northwest, Italy Networks: hub, spoke and community hospitals Inclusions: Scrub Nurses, Circulating Nurses, 5 yrs. of seniority Exclusions: Part time ORNs, daily or weekly hire	Socio-demographic factor (age: <50, >50; gender) Job characteristics (yrs. as RN <20, >20; scrub nurse hours <120, >120, Clinical data on Upper Limb: previous pain episodes, localization of discomfort, familial predisposition Surgical specialty (frequency of surgical type, instruments used, surgery length and scrub nurse position) Soft specialty: plastic, vascular, neurosurgery, otorhinolaryngology Hard specialty: general surgery, ortho, urology, gynecology	Italian DASH (Disabilities of arm, shoulder and hand) 30-item questionnaire (response scale 1-5) measures degree of problems in performing activities activity related symptoms, impact on psychosocial domain Pearson correlation coefficient-strength of linear relationship b/n variables Logistic regression model- evaluate association b/n independent variables and binary response variable Multivariate model: age, gender, yrs. of work, no. hrs. scrubbing, surgical specialty	SAS software, ver 9.4 Dash Score mean value of 14.0 (+-17.0) Age mainly women (79%), men (21%) average age of 48 (+-6.1), Average yrs. as ORN (19.4), Average monthly scrub hrs. (108.1/49.4%); Hospital network (hub-101, spoke-13, community-34) Surgical specialty: Soft =34, hard=111 Episodes of previous UL pain No= 76 (51.7%) Yes = 71 (48.3%)	1-2 ORNs (48.3%) had experience 1 or more episodes of UL pain esp. arm/shoulder (36.1%) and hand (12.5%) Univariate analysis (OR=3.15, 95% CI:1.26-7.87, p=0.01 = female 3x risk) (OR=2.63, 95% CI:1.25-5.52, p=0.01=working >120 hrs. 2x risk) Age and specialty increased risk but not significant FT scrub nurses 3x risk than rotating b/n different job tasks Poor ergonomic design of surgical instruments appeared to be a contributing risk for WMSD, creating unease of handling by scrub RNs and develop/increase UL disabilities (arthritis, sprains, dislocations, fractures)	Strength: Based on findings, this study was able to identify/propose several strategies to overcome WMSD in OR: job rotation, microbreaks with exercise, specific ergo training, physical fitness and ergo intervention on surgical equipment's/instruments Limitations: Limitation: use of self-reported outcome subject to recall bias; a nonresponse analysis could not be performed due to lack of non-respondent data; Study design fails to estimate the causal relationship between factors and risks of WMSD JHEBP = Level IV, high quality

Citation	Conceptual Framework	Design/ Method	Sample Setting	Variables Studied and Definitions	Measurement	Data Analysis	Findings	Appraisal
Lin, S. C., Lin, L. L., Liu, C. J., Fang, C. K., & Lin, M. H. (2020). Exploring the factors affecting musculoskeletal disorders risks among hospital nurses. *PloS One*, *15*(4), e0231319. https://doi.org/10.1371/journal.pone.0231319	None	Cross-sectional descriptive design with stratified cluster sampling Data Collection: self-pace questionnaire placed into a box located outside worksite within 7 days. Voluntary. 10-20 min to complete	1, 803 Nurses Participants from a single northern Taiwan medical center (2,089 bed / 2, 161 RNs) Study timeframe: November 2011 to January 2012.	**Demographic:** *Gender *Job title (admin, mgt, FT, PT, etc.) *Department type (internal medicine, surgery, OB Gyne, pediatrics, ICU, others) * work mode (fixed, 3-shift rotation, 8 hrs./day, etc.) * daily work-rest time *Hx of MSD (yes or no) *Age *Exercise habits *Bodyweight *Work seniority *No. of hrs. worked /day *No. Of days worked/week *BMI **Nordic MSQ:** *9 body locations (shoulder, neck, lower back, upper back, elbow joint, hand or wrist, hip/ knee/ ankle joints) *Discomfort (past year, past week, affected life or ability to work w/yes=1 and no=0) Highest discomfort for each location=3 and lowest = 0	A self-administered survey including a demographic questionnaire and a Nordic Musculoskeletal Questionnaire	Data analyzed using IBM SPSS software statistical version 23.0 for Windows Descriptive statistics = analyzed the prevalence of MS discomfort Chi-square test= examine variations in MS discomfort prevalence b/n difference participants' demographics Logistic regression= determined risk factors related to MS discomfort Odds ratios (OR) = calculated to determine the contribution of each risk factor for shoulder and neck/back *p*-value = <.05 considered statistically significant Age= average 36.63+_11.24 Sex = 99.06% women ½ of RN's have a normal weight (54.1%) Overall: 76.59% rarely exercise, 87.52% no hx of MSD, 68.61% were Full-time RNs, most worked in Internal Medicine, 60.29% worked 3-shift rotation, average working yrs. was 11.61+-9.33, average hrs./day was 8.90+-1.51	The greatest prevalence of MSD symptoms by body regions: Right shoulder=85.8% Left shoulder = 80.9% Neck = 62.4% Right wrist = 62.2% Lower back = 60.4% Risk factors for discomfort: Shoulder = department type, exercise habits, and age (p=.05) Neck = seniority in the current unit, "job title" and history of MSD (p=<.05) Upper back = age and seniority in the current unit (p=.05) Lower back = seniority in the current unit, department type and no. of days worked per week (p<.05) Causal analysis of neck, shoulder and wrist pain associated with the use of computers and ergonomic factors (posture: table and chair and mouse suitability)	**Strength:** Used a standardized questionnaire that can be used to investigate symptoms of specific location further, enabling MSD problems to be more defined. The Nordic survey has known adequate internal consistency, reliability, & validity **Limitations:** *One site only. *Self-reported and no physiological testing to confirm the diagnosis; hence discomfort caused by non-work can't be eliminated, resulting in prevalence may be overestimated. *MS discomfort is for multiple reasons and not for the workload *Investigated only demo character. and work-related factors to MS discomfort neglecting other possible influence, i.e., burnout, resilience, satisfaction, work stress level and ergo training level **JHEBP**= Level IV High quality

Citation	Conceptual Framework	Design Method	Sample Setting	Variables Studied and Definitions	Measurement	Data Analysis	Findings	Appraisal
Long, M. H., Bogossian, F. E., & Johnston, V. (2013). The prevalence of work-related neck, shoulder, and upper back musculoskeletal disorders among midwives, nurses, and physicians. *Workplace Health and Safety*, *61*(5), 223–9. https://doi.org/10.1177/216507991306100506	None	Systematic review Initial search = 1383 of which 1309 were excluded based on title, duplication, and abstracts Reference lists of retrieved articles were hand search for additional articles	29 articles published b/n 1990-2012 using 4 electronic databases: PubMed, Medline, CINAHL, and Embase Inclusion criteria: *Primary research published in English in a peer-reviewed or professional journal *Study sample: midwives or nurse midwives, RN, physicians/surgeons *prevalence/incidence rate during the period, not more than 12 mos. * a validated tool was used to measure the outcome Exclusion: Studies of "nursing personnel" or "nursing staff."	*Study setting and population described *Sampling random or whole population *Response or follow-up rate >70% * Nonresponders described *Specific inclusion criteria applied *Demographic information is given *Confidence interval (CI) or standard errors of prevalence (SEP) given	Criteria used to assess quality suggested by Loney et al., 1998) 1 point for each positive assessment: 5-7 points = high quality 3-4 points = moderate quality 1-2 points = low quality	Substantial variation in the prevalence rate Several studies observe rates that were well above the calculated median Methodological issues were noted: the possibility of nonresponse bias, overestimation of prevalence and not providing confidence intervals Some study samples included a small portion of RN and some labeled nursing personnel including ancillary staff (i.e., EVS, dietician) limiting the generalizability of results to fully qualified medical professionals Prevalence and incidence were identified by self-report in all included studies Inconsistency of outcome variables limits meaningful comparisons	MSDs are one possible source of attrition or premature retirement from the midwives, RNs and physician's workforce that may merit investigation The median annual prevalence of NSU MSD ranged from 35% to 45%, 35%= Upper back 40% shoulder 45%= neck Most studies rated moderate in quality Methodological concerns encountered included sampling problem (small sample sizes, sample bias, heterogeneity) and inconsistency of outcome measures, the likelihood of nonresponse bias, and low response rates Additional confirmatory studies of NSU-MSD among midwives urgently needed	**Strength:** Authors able to assess quality and prevalence for variety of reviewed articles **Limitations:** *Extensive and repeated search of literature limited midwives to only 1 study *studies published in languages other than English weren't included, and eligible articles may have been inadvertently missed **JHEBP** = Level III, good quality

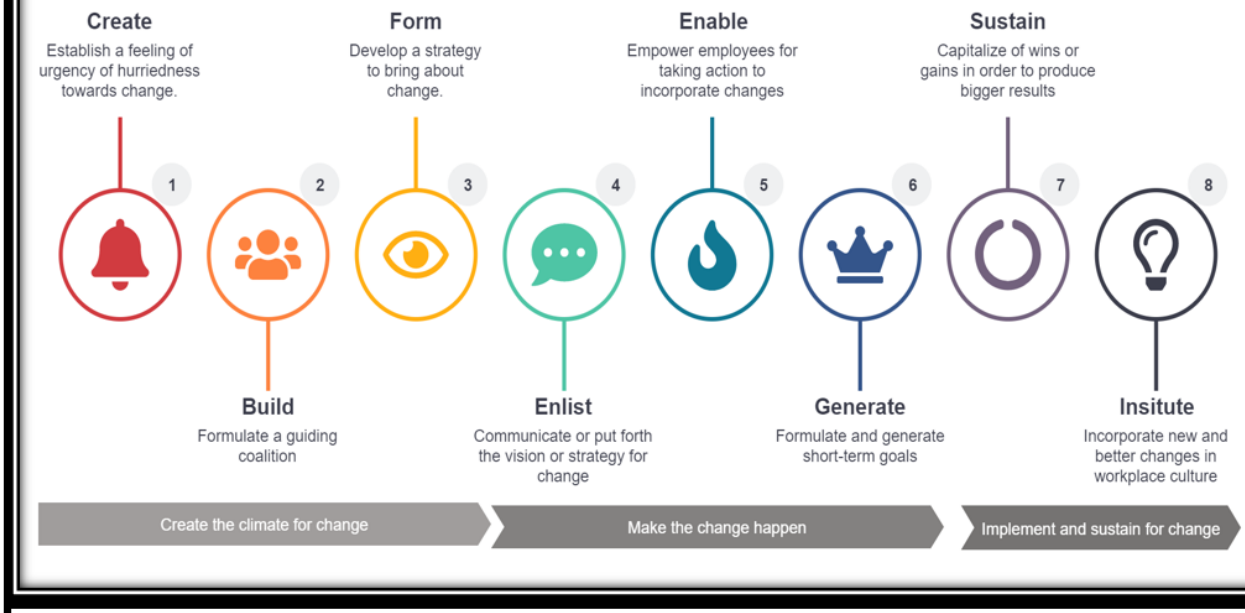
Citation	Conceptual Framework	Design/ Method	Sample Setting	Variables Studied and Definitions	Measurement	Data Analysis	Findings	Appraisal
Koshy, K., Syed, H., Luckiewicz, A., Alsoof, D., Koshy, G., & Harry, L. (2020). Interventions to improve ergonomics in the operating theatre: A systematic review of ergonomics training and intra-operative microbreaks. *Annals of Medicine and Surgery*, *55*, 135–142. https://doi.org/10.1016/j.amsu.2020.02.008	None	Systematic Review: RCTs, Cross-sectional studies and Cohort studies Articles screened by title and abstract	Literature search carried out from September 2017 to July 2019: N= from 125 to 6 full-text articles Inclusions criteria: Studies in the OR that: *investigate ergonomic intervention *utilizing administrative intervention to prevent MS injury *implemented an administrative intervention as part of study design Exclusions criteria: Studies reporting on: *outside OR * non-medical staff *use of bespoke or specialized equipment *not implemented ergo training or form of administrative intervention	Variables: *Intra-operative microbreak * surgical ergo training Review: Four articles investigated on use of intra-operative microbreaks; no of participants completed study ranged from two to 56 Two articles investigated on use of ergonomics training: no of participants ranged from 7 to 38 that completed follow-up Participants with a surgical specialty: Pediatric surgeons (37); urology trainees (36); and a mixture of general, ortho, neuro, ENT, gyne, plastic, thoracic, vascular cardiac and robotic surgeons	PRISMA	Administrative controls = workforce or human changes (taking breaks during operation and ergo training): *5 studies described the use of intra-op microbreaks as an ergo intervention *2 studies investigated the use of ergo training Ergonomic training can be a very accessible and effective way of reducing MS injuries in surgeons, with up to 69.9% noting improvement in their symptoms	All studies demonstrated microbreaks to be beneficial to surgeons through multiple domains: reduced reported muscle discomfort to improve mental health and overall well being All studies demonstrated microbreaks are an effective method of reducing muscular fatigue and mitigating the occupational risk of injury There is a consistent body of evidence suggesting that microbreaks are effective ergo intervention with proven benefits to patients and surgeons Microbreaks decrease primary task workload allowing more time for communication b/n members minimizing risks of fatal errors. The structure of the breaks varied b/n studies	**Strength:** The review was concise focusing only on administrative and human factor interventions such as micro-breaks and surgical ergonomic training (internationally available and require a relatively small amount of resources to incorporate into practice **Limitations:** *No systematic assessment of bias carried out * the no of participants was low in all six studies limiting external validity *meta-analysis wasn't carried out due to data heterogeneity * Standardization, large=scale studies and validated assessments are lacking to validate interventions further and ensure effectiveness. JHEBP = Level III, high quality

Citation	Conceptual Framework	Design/ Method	Sample Setting	Variables Studied and Definitions	Measurement	Data Analysis	Findings	Appraisal
Wang, X., Lavender, S. A., & Sommerich, C. (2019). The effects of load stability and visual access during asymmetric lifting tasks on back and upper extremity biomechanical responses. *Human Factors*, *61*(5), 712–721. https://doi.org/10.1177/0018720818814107	None	Experimental Study Participants refrained from intensive physical activity 24 hr. prior to study and all signed informed consent Participants lifted stable load 5x and potentially unstable load 10x with both uncovered and covered boxes = total 30 lifts each 1 lift/min Sequence of blocks of load stability conditions and load conditions were randomized	14 participants: males=8 Females= 6 Inclusion Criteria: Height (178+/-3.1cm) Weight (168+/-8.8 lbs.) Age (21.8+/-0.9 yrs.) Exclusion Criteria: *Age (>45, <18) *significant pain on back, leg, neck or shoulder in past 12 mos. *back surgery *limiting clinical condition *pregnancy Lifting method: Lift a wooden box from a floor location 20 cm in front of toes to a surface positioned 75 cm above the floor at person's left side: no movement of feet when lifting, free lifting technique (squat-lift recommended), lifting to approx. elbow height on left side (90 deg asymmetry)	IV 1=stability of the load in the box IV2=ability of the person lifting to see the content of the box (visual access) IV3= where the ball shifted (unstable) IV4= where the ball did not shift (potentially stable) DV1= stable load (books) DV2= unstable load (bowling ball) DV3- wooden box weighed 4.8 kg DV4=additional weight on content of the box depending on load 6.8 kg DV5=cover in the wooden box DV6= box packing material	*Kinematic (spine movement T1 relative to L5/S1: forward flexion, lateral bending, twisting) and kinetic measures *Electromyographic (EMG) measure signals obtained from surface wireless electrodes at sampling rate of 2000 Hz collected from R/L Anterior Deltoid (ADL/ADR), Biceps (BCL/BCR), Erector spinae (ERSL/ERSR) *lifting duration w/ 3-dimentional accelerometer on the box which is placed on an electronic scale when lift completed *Spinal movements in 3 dimensions collected using magnetic motion capture w/ sampling rate of 100 Hz.	Data collected from each trial stages: lifting (squat or semi-squat in vertical direction) and placing (standing position w/ box moving in transverse plane to destination). Digital smoothing algorithm applied to raw EMG data Linked-segment biomechanical model for kinetic and kinematic date Motion Monitor sensors for lower extremity and sacral kinematics SAS proc GLM procedures to assess normality and homogeneity of data SAS proc ANOVA procedure for 2-way w/in subjects' analysis of variance Individual t-test = significant load stability by visual access interaction effect Bonferroni correction adjusted alpha level	Overall: lifting tasks with stable load took .12 sec less than lifts w/ potentially unstable load (p <.01) Having visual access can lower muscle activation and significantly decreased frequency of load shifting when handling the potentially unstable load (p <.05) Lifting and moving potentially unstable load that could lead to perturbation and people tend to lift slower Differences in biomechanical responses indicated load handling strategy and lifting behavior could vary due to personal factors i.e. risk perception Lifting a potentially unstable load didn't increase all biomechanical responses: EMG responses lower during unstable conditions and participants relied more on upper limbs to control load	**Strength:** Experimental study concluded valuable key points applicable in work industry: *lifting a potentially unstable load lowers speed which in turn reducing peak muscle activities *load stability and visual access affected the lifting behavior and strategy *higher activation of UE muscles when there's a need to enhance control of the load **Limitations:** *No shoulder kinematic data was obtained * Lifting pace wasn't controlled *EMG data from LL muscles and other trunk muscles were not included *the effect sizes for several measures were small though the differences were statistically significant **JHEBP**= Level 1, high quality

Appendix D

Change Theories/ Models

JOHN KOTTER 8-STEP CHANGE MODEL



Staff meeting safety presentation	Engaged OR change agents	Completing subset trays
Combine OR/SPD UBT meeting	Baseline data collection	Complete MOR 2-tier lap tray
OR active safety Team	Collaboration with other OR's	Spread project to SOR
Biweekly safety team huddle	Vendors partnerships	Ergo cart education/utilization
Safety leaders annual ergo training	Trays/ring stand tests of change	SPD storage rack 6S lean
Conduct surveys	Feedback from end-users	MOR core cart 6S project
	Team ergonomic assessment	Safety huddle: action items ff-up

6S Lean Methodology

Appendix E

Microsystem Assessment

Supporting Microsystem Profile – Operating Room

A. ***Purpose:*** To provide safe and high-quality surgical services to patients in the following specialties:
General Surgery, Robotic Surgeries, Gynecological, Head & Neck, Podiatry and Hand, Urology, Vascular, Sports Medicine, and Total Joints

This community healthcare facility is offering a wide variety of primary and specialty services in the East County. The medical center was established in 2007, encompasses a 637,000 square foot, and 150 bed capacity- all in private rooms. Along with medical-surgical and intensive care units, the hospital has perinatal services and eight labor and delivery rooms, 36 emergency department treatment bays, 11 high tech surgical suites, two interventional radiology suites, 6 GI procedure rooms, full imaging services, infusion center, onsite occupational health center and more. Adjacent to the hospital is a medical office that houses Adult Medicine, Women's Health, Pediatrics, and other additional services such as laboratory, pharmacy, imaging services, health education, member services, and a business office. This healthcare-based medical center is one of the two medical centers in the service area and a center of excellence especially for total joint procedures and robotic procedures.

The Perioperative Department has 10 Pre-op bays and 32 Post-Op bays. There are two OR pods: the SOR where all the total joints, sports medicine, podiatry, and other ortho procedures are performed; the MOR has rest of the specialty procedures being performed. There are also two Sterile Central Processing departments providing services to two separate OR locations. Adjacent to the MOR is the two IR suites, which are also under the leadership of the OR Manager. The OR department has regular operating hours of 0700 to 2330, Monday to Friday. There is an average of scheduled 30-32 cases performed daily in addition to urgent add-on cases.

Name of Service Area: Operating Room	Site Contact: W.H OR/IR Manager	Date: 03/09/2020
Peri-Operative Service Director: R. M Chief Nurse Executive: J.J.	OR Service ANM's: R.V. (AM) and P.M. (PM)	Physician in Chief: J.G., M Chief of Anesthesia: J.P., MD

B. Know Your Patients/Customers: Take a close look into your microsystem; create a "high-level" picture of the Customers that you serve. Who are they? Wha resources do they use/request? How do customers view the services they receive?

Patient Demographics (Jan 2018 – Feb 2020) Race	**%**
White/Caucasian (American, US)	69.9%
Mexican	6%
Non-Hispanic/Non-Latino	5.4%
Native Hawaiian/Pacific Islander/Filipino	3.1%
Hispanic/Latino	1.9%
Other	13.7%
Patients Demographic (Jan 2018- Feb 2020) Age	**%**
Infant: 1-2	0.2%
Young Child: 2-6	1.0%
Child: 6-12	1.2%
Adolescent: 12-18	2.0%
Young Adult: 18-25	3.9%
Adult: 26-35	7.9%
Middle aged: 36-45	11.3%
Older Adult: 45-60	25.8%
Elderly: 60-74	31.3%
Old Age: >75	14.0%
Patients Demographic	**%**

List of Top 10 surgeries (Jan 2018- February 2020)	
1.TotalKnee Replacement	6.Laparoscopic Total Abdominal Hysterectomy
2. Cystoscopy (adjunct)	7.laparoscopic Appendectomy
3. Laparoscopic Cholecystectomy	8.Ureteral Stent Placement (adjunct)
4.Total Hip Replacement	9. Total Anterior Approach Hip Replacement
5. Laparoscopic Salpingectomy	10. Laparoscopic abdominal Intra-lysis of Adhesions
Service Specialty Blocks	**Days in Week (0800-1530)**
General Surgery	Mon, Tues, Wed, Thurs, Fri
H&N	Tues, Wed, Thu
Gynecology	Mon, Tues, Wed, Thurs, Fri
Urology	Wed
Robotic	Mon, Tue, Wed, Thurs, Fri
Total Joints	Mon, Tue, Wed, Thurs, Fri
Podiatry	Mon, Tue, Wed, Thurs, Fri
Ortho Hand	Mon, Tue, Wed, Thurs, Fri
Sports Medicine	Mon, Tue, Wed, Thurs, Fri
GI room	Mon once a month
Blue Room	2nd and 5th Monday of the month
Red Room	None, but can be assigned for the unfilled block

Staff Satisfaction Scores - People Pulse 2019: 93% Response Rate	**%**
Measures that are of relative strengths:	
Organizational Performance Index	68
Patient Safety Index	66
Team Effectiveness Index	66
Measures that are of relative opportunities:	
Workplace Safety Index Inclusion Index	64 62
Culture of Health Index	61
Patients Points of Entry: (January 2018 – February 2020)	**%**
Admitting Department	83.8%
Emergency Department	7.4%
Nursing Units	8.8%
Patients Discharge Disposition: (January 2018- February 2020)	**%**
Outpatient - Home	74.2%
23 hours admit - inpatient	1.57%
Inpatient	24.93%

Demographic (Jan 2018-Feb 2020) Sex	
Male	58.9%
Female	41.1%

Capacity:11 OR Suites	MOR: 6 Rooms Sand Creek OR:5 Rooms

Top Payors	**Customers who are frequent users of your service and their reasons for interacting with your microsystem**	**Other services you interact with regularly as part of your normal work processes.**
Kaiser Health Plan	Patients having multispecialty procedures	Pre-op and Post Anesthesia Care Departments
Kaiser Foundation Hospital	Surgeon and Anesthesia Providers	Clinic Schedulers, OR schedulers and System Administrator
The Permanente Medical Group	Company Reps and Vendors for tech and operating support	Admitting Department
Medicare	Sterile Processing Department supplying processed surgical instrumentation	Supply Chain / Material Department for disposable supplies: replenishing and ordering process, case cart picking
Medical	Environmental Services to provide and maintain cleanliness and terminal decontamination	Facility Engineering and Clinical Biomed for equipment repair /maintenance and environment of care regulations
		Laboratory and Pathology Departments for patient's specimen processing
		Pharmacy for medications
		Imaging/Radiology for fluoro required procedures
		Nursing Units (med-Surg, ICU, ED, step down) endorsing and receiving surgical patients
		Quality, Risk, Infection Control and Safety Specialist for referral, consults and team support

Workload distribution: Do these numbers change by season? (Y/N)	**#**	**Y/N**
The surgical workload in last month (February 2020)	729	Y
The surgical workload in last year's quarter (October 2019-December 2019)	2256	Y
The surgical workload in the last six months (September 2019 to February 2020)	4458	N
The surgical workload in a year (January 2019- December 2020)	8626	N

***Complete "Through the Eyes of Your Staff."**

C. Know Your Professionals: This is a comprehensive picture of the microsystem: who does what and when? Is the right person doing the right activity? Are roles being optimized? Are all roles that contribute to the patient experience listed? What hours are open for business? What is the morale of the staff?

Current Staff	FTE Day	FTE Eve	FTE Total	Role/Function		Days of Operation	Hours of Operation
Registered Nurses	18	4	22	Circulating Role and Scrubbing role, core support; service leads (7)	Day 1	Sunday	24 hours On-Call STB for urgent/emergent procedures
RN Per Diem	7			Backfill staffing hole (sick calls/vacation/training/LOA)	Day 2	Monday	0700-2330 regular shifts On-Call STB 2330 to 0700
Traveler RN	3			Temporary positions for the 11th room surgical backlog reduction and staff on LOA	Day 3	Tuesday	0700-2330 regular shifts On-Call STB 2330 to 0700
Surgical Techs	20 (2 actively on MLOA)	3	23	Assisting surgery by providing instrumentations to the surgical field in scrub and non-scrub role; core support; service leads (7)	Day 4	Wednesday	0700-2330 regular shifts On-Call STB 2330 to 0700
ST Per Diem	4 (additional 3 to fill)			Backfill staffing hole (sick calls/vacation/training/LOA)	Day 5	Thursday	0700-2330 regular shifts On Call STB 2330 to 0700
Traveler ST	2			Temporary staff for the 11th room surgical backlog and staff on LOA	Day 6	Friday	0700-2330 regular shifts On-Call STB 2330 to 0700
Equipment Techs	2	1	3	Stages the OR with equipment, helping with turnover case needs, nursing	Day 7	Saturday	24 hours On-Call STB for urgent/emergent procedures

		assistant to the pharmacy, lab, pathology, x-ray)			
Department Secretary	1	Assist in staffing and payroll entries, clerical and admin support			
OR Schedulers	2	Maintains OR schedule by scheduling and calling patients three days ahead, coordinates with clinics and vendors			
OR Scheduler Per Diem	1 (1 position to fill)	Backfill OR Scheduler absence or additional support for busy days			
System Administrator	1	Data collection and management			
Assistant Managers	1 1 2	Daily operation and OR access management; performs other management roles such as payroll, issue resolution, team performance	**Which activities are you involved in? All listed items are applicable:**		
			❑ EHR		Communication:
Surgeons	Variable	Performs Specialty surgical procedures	❑ Data Management for Daily Readiness Board		❑ Phone Text
Surgical Residents	Variable	Assist surgeons in completing surgical procedures	❑ KP Schedule/ Staffing		❑ Emails
Physician Assistants	Variable	Assist surgeons in completing surgical procedures	❑ Biweekly Payroll processing/approval		❑ Spectra link phone
RNFA's	3 1 4	Assisting role	❑ Taleo: Position Hiring/Termination		
RNFA Per Diem	2				
Surgical Assistants	3	Assisting role	❑ Capital Budget and Position Control		
			❑ Capital and operating cost equipment procurement		
Anesthesiologist	T=38	Provides anesthesia induction	❑ Compliance: Staff Licenses/ Certification		
CRNA's	T=42	Provides anesthesia induction and supervised by Anesthesiologist	❑ OR Daily Readiness		
Anesthesia Techs	3	Supports anesthesia care, OR suites anesthesia set/up and staging	❑ Safety Rounding and Risk Mitigation		
			❑ Multidiscipline Collaboration and Coordination of care		
Storekeepers	2	Orders and replenishes OR disposable supplies and other misc. items	❑ Staff Development: in-service/ clinical ladder/ trainings		
Supply Chain	1 1 2	Surgical cart picking and OR suites supplies restocking	❑Staff Competencies: KP Learn, HealthStream, SPH, other training		
Cost Specialists	1	Manages and supports Supply Chain and Storekeeper. Assists OR staff and management	❑ Team Resource, Daily issue resolution, and escalation		
Managers and Assist Mgr.	2	Oversights of Supply Chains Techs and Storekeeper in the OR	❑ Performance Improvements Projects (RIE)		
			❑ Efficiency and productivity metrics		
SPD Mgr. / Assist Mgr.	2	Manages all SPD staff, partners with OR leadership/mgt for instrumentation improvements and maintenance. Ensures safe handling and processing of	❑ Team Performance and Attendance Management		
SPD Techs	12 9 21	Safe handling, decontamination, processing and storage of equipment in the OR			
SPD Per Diems	10	Backfill SPF staff on LOSA/Sick calls, Vacation, etc.).			
Imaging Techs	2-3	Tech support for fluoro/imaging needs of specific procedures.			
Total Joint Co. Reps	3-4	Daily tech support for implants			
Other Co. vendors/reps	variable	Tech supports as required by a surgical procedure			
AM EVS Personnel	4	Cleans the OR between turnovers and maintains all other common areas			
PM EVS Personnel	3	Terminal cleaning OR suites and environmental care of the entire department for next day operation			
Pathology Tech	1	Picks up path specimen (9-5)			

				Do you use On-Call?	❑X Yes ❑ No
				Do you use floats?	❑X Yes ❑ No
Staff Satisfaction Scores			**%**	Do you use Travelers	❑X Yes ❑ No
How stressful is this microsystem?	% Not satisfied		10%		
Would you recommend it as a good place to work?	% Strongly Agree		90%		

D. Know Your Processes: How do things get done in the microsystem? Who does what? What are the step-by-step processes? How long does it take to complete the work here, are the delays? What are the "between" microsystems hand-offs? Have you discussed a shared purpose with clinical microsystems and other supporting microsystems?

1. Daily OR staff delegation of assigned roles and cases at the huddle board at 0700, 0900, and 1500 start of shifts. Changes in assignments and roles occur throughout the day to meet the need for daily operation and staffing requests.
2. Surgical case preparation involves the following roles: circulating nurse, surgical tech, anesthesia tech, anesthesia personnel, RNFA, or SA if assigned, and other additional core staff support.
3. Nursing Hand-off: patient from pre-op department or nursing unit, post-op hand-off to PACU or nursing unit, every change of staff during a surgical case
4. RN's patient transport into the OR suite using a gurney from pre-op, and bed /gurney from the nursing units. RN uses the same transport method to endorse patient to PACU or Nursing unit.
5. RN's to download patient information in Black Video Diamond System and uploads the images in the PACS gear system for all laparoscopic cases. RN to validate in KPHC presence of all images captured for a specific patient after each case.
6. ST Hand-off: change of staff during a surgical case, relief hand-off on core support assignment change, dirty case cart delivery to SPD
7. Universal Protocol and Safety Briefing: conducted before patient anesthesia induction using safety briefing, time-out (before incision), and post-op debrief (during surgical closure). This is to reduce and prevent harm and errors in the OR with wrong site/side surgeries, retained foreign objects, fire risk, documenting correct ASA and complications coding, and ensuring that all the essential needs of the patient and the procedure are met and available. This is also a process to discuss the necessity of a subsequent case.
8. Surgical Tech sterile back table: pull clean case cart from the core; spread items to the OR table, ring stands, and mayo stand; open supplies in a sterile manner; perform surgical hand scrub; set-up the back table; receives wrapped sterile instruments from a colleague; lifts instruments trays out of pans and completes the sterile set-up. At the case conclusion, all items in the back table are disposed of in classified hampers, and all instruments are arranged and contained in the case cart.
9. Surgical Tech instrument handling and transport: Upon case completion, ST contains all used instruments and other positioning devices inside the cart and performs point of use enzymatic instrument spray to prep and remove debris before leaving the OR suite. There should be no fluid inside the cart to prevent leak and spill during transport. ST will close the case cart and flip the case cartwheel indicator to identify that the items inside the cart contain biohazard items. ST leaves the OR suite and transport case cart to the SPD decontamination area.
10. Surgical Count on every surgery performed before incision, change of staff, initial wound closure, and final skin closure to prevent retention of foreign objects in the patient. This includes physician visualization and confirmation of all countable
11. items before the patient leaving the OR suite. This also includes the use of sponge counter bags to display all used sponges for the team to validate.
12. RD Scanning Technology: RN will perform scanning of the operative site before final skin closure to ensure no sponges are retained in the patient. This includes documentation of the scan to HC. This could be done with a wand, mat, or extremity scanner.
13. Surgical clipping to be done outside of the OR suite and RN surgical chlorhexidine skin prepping dry time to be 3 min prior to draping.
14. Implant verification prior to delivery to surgical field per policy and documentation in KPHC and Easy Tracker system to account for all used ambient and frozen grafts and misc. implants.
15. Total Joint sequential room standard work in clearing the room after the procedure, opening supplies and instruments, patient in room time. There are defined roles by each team member to optimize turnover time and efficient patient in and out times.
16. Surgical Techs to stage instruments in every next day case cart and supply chain tech to gather all reposable items with the use of preference cards
17. 6S process in the OR: MOR using a Kanban system to indicate SCT to replenish supplies; SCOR has slide indicator for staff to manage low par items and SCT to restock needed items
18. Handling of sharps: Sharp safety zone must be available, visible, and identified in every surgical case. No recapping of needles and use of sharp boxes in the sterile back table reduces needle stick/sharp injuries.
19. Informed Consent Process: Consent are entered in HC, Pre-op RN verifies electronic consent with the patient on the day of surgery and witnesses it, OR RN pulls the e-consent in WOW station and shows to the OR team during a safety briefing
    Consent for patients coming from ED and Nursing units still uses paper consent and goes in transition with patients.
20. Handling of specimen: ST to verify from field if the specimen could be passed off, RN and ST to confirm correct patient label (name, MRN, specimen, disposition) on the specimen container looking at the white count board, RN to print out request form after completing E-path, RN to dispose of specimen for a requested method of processing.

TURNOVER TIME GOAL: Facility set goal of 20 min

FINANCIAL Status: OR has lucrative revenues generated from services rendered to members, like the ER. The operating margin is based on the allocated budget from the health plan. An increase in budget is related to the flexing volume of cases. Performing outpatient and elective cases usually are favorable to cost margin. OR is tend to be on overbudget directly impacted by operating cost (equipment, instruments, the environment of care, staffing, new technology, rapid improvement events, best and new practices, new physician, new service, implants, and more). Case cancellations, surgical delays, overutilization of blocks also impact operating margins.

USE and INITIATE the FOLLOWING: Orders/ Critical Pathways, Critical Events (Code, Malignant Hyperthermia, Massive Blood Transfusion Protocol), Rapid The response, Safety Rounding, Preceptor/Charge Role, post-op patient disposition

E. Know Your Patterns: What patterns are present but not acknowledged in your microsystem? What are the leadership and social pattern? How often does the microsystem meet to discuss processes? Are customers involved? What are your results and outcomes?

DO THE MEMBERS OF THE UNIT REGULARLY REVIEW AND DISCUSS SAFETY AND RELIABILITY ISSUES?	DOES EVERY MEMBER OF THE UNIT MEET REGULARLY AS A TEAM? HOW FREQUENT?	WHAT ARE THE IMPROVEMENTS or SUCCESS?
The OR leadership team huddles every day at 09:00 to discuss three days ahead schedule to capture surgical cases special requests and to close the loop on follow-ups done. This will mitigate errors and conflict on the schedule. Represented teams are OR Mgt, Supply Chain, SPD Mgr., OR Scheduler, and any staff available.	The front-line staff meets every day at 0710, 0910, and 1510, Monday to Friday, for huddles to review the OR flow, case schedule, changes in staffing, quality and safety metrics, and any rapid improvement events ongoing audits during sustainability period. This is an opportunity to hear from staff in the microsystem on concerns, issues, escalation, learnings, and other updates.	The turnover times have tremendously improved in upstream direction last year in comparison to 2018. It is currently sustained with minimal variations, most esp. for the 20 min turnover from the previous 30 min. The OR continuous to achieve the regional goal Of the SSI bundle of skin clipping and skin prepping measures from January of 2019.

There is a daily leadership safety huddle that occurs at 08:30 to discuss safety concerns from multidiscipline. Peri-operative Value Stream meets every Thursday to discuss past, current, and future process improvement events, identify barriers, follow-up actions, and plan for sustainability. The team represented are the consultants, process owners and facilitators, peri-op leadership, steering committee, and physician leaders. Local Product Council meets once a month to discuss contracts, new products, and product trials/introduction. This is represented by Supply Chain, OR leadership, Physician champions, WPS, and other support services. OR Committee and Quality/Infection Control meetings occur once a to discuss metrics, goals, outcomes, best practices. 2nd Friday of the month meeting on Total Joint for continuous process improvement. Represented by peri-op, home health, coordination of care, PT, physicians, WPS, nursing units Monthly Peri-op Directors and Managers Regional meeting once a month for peer networking, new issues, updates, and team collaboration	Staff Meeting occurs on the first Wednesday of the month from 0710-0800 and 1400-1500. Opportunities for staff development training and in-services on equipment and instrumentation, review of processes, policies, compliance, and competencies. Combined OR and SPD UBT Meeting on 2nd Tuesday of the month to discuss workflow, barriers to care, and process improvement. Mgt Co-leads represent this and Staff UBT Co-leads. Unit-Based Team (UBT) meeting every third Thursday of the month from 0710-0800/ 1400-1500 for all Surgical Techs at 0710-0800. The teamwork on projects tests of change, and identify areas for improvement. RN staff meeting on the third Thursday of the month (0710-0800/1400-1500). This is an opportunity to review current practice and processes and catching up with newly implemented processes.	From the start of PY 2020 (October 2019), the claimable injuries have subsided compared to 2018. The team focused on the reduction and prevention of injuries, mitigating and eliminating the risks, real-time feedback, and timely escalation and resolution. Total Joint Same-day Discharge has been successful from 7% to 89% in a year trend. The focus was on early ambulation, PT planning, an order of scheduling.

WHAT IS MOST SIGNIFICANT PATTERN OF VARIATION?

A. Work Place Injuries:
Increased in occurrence of workplace injuries related to instrument handling and lack of situation awareness when performing specific tasks.

ST: 4 injuries resulted in significant LOA as a result of lifting heavy and stacked instrument trays/pans
RNs: 12 injuries related to repetitive movement with the use of upper and lower extremities, patient handling, lack of situational awareness
Structural injuries: 5 associated with OR doors, two on surgical light handles
PY 2018 (October 2017 to September 2018):11 reported injuries / 3 resulted to loss of hours/
PY 2019 (Oct 2018 to September 2019): 20 reported injuries / 7 led to loss or hours
PY 2020 (October 2019 to present): 6 reported injuries/ 2 resulted to loss of hours

Staff satisfaction/ dissatisfaction related to instruments and supplies availability and processing. The team's escalation process is through verbal, text, or email.

Staff morale related to the impact of absences related to MLOA/ loss of skilled staff.

Travelers are covering temp positions to backfill staffing.

Per diems are pulled from the pool to cover for LOAs.

MLOAs range from 3-9 months depending upon severity and classification of injury.

Temporary Transitional Work Assignment (TTWA) of staff returning to work but are not counted on the skilled staffing mix and on modified restrictions not performing their essential functions and duties

B. Overtime:
Variations directly related to limited staffing resources due to LOA.
Case length or surgical cases run over, and there's limited no of staff for shift relief resulting in overtime
Staff working longer hours increasing the risk for fatigue, reduce attention to detail, and high risk for injuries.
Reduce in no. of staff covering for STB. Increase in call back activations results in staff needing rest in lieu of scheduled shift, or staff working through their scheduled shift and lacking rest contributing to safety risks.

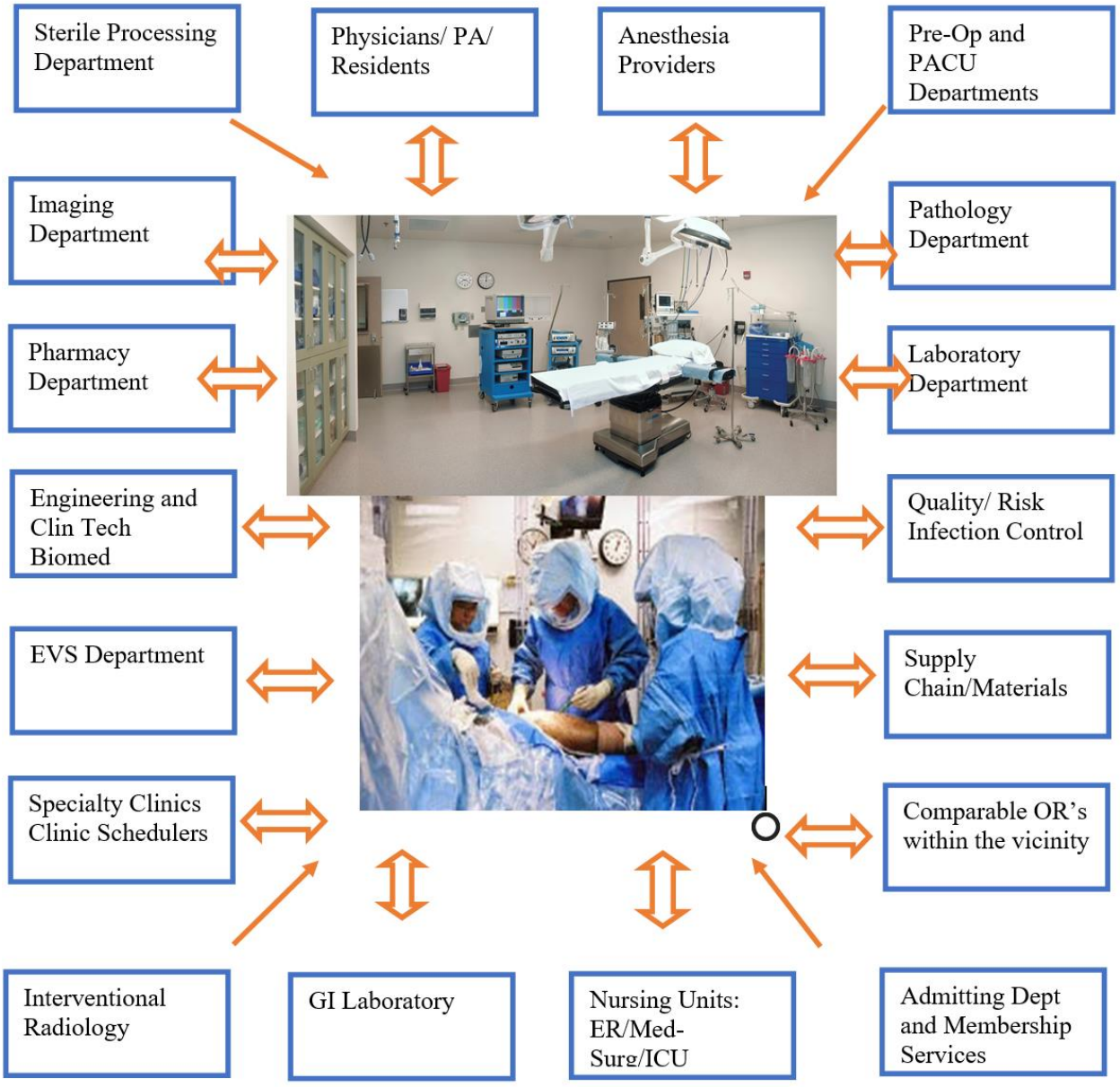
C. Allocations of specialty surgical blocks and care providers traveling in multisite. There are three medical facilities that the surgeon and anesthesia providers rotate to render services. There is also a specific site within the diablo service area where particular care is rendered, i.e., plastic and vascular cases in WC and Dublin, total joints in AMC. This variation, however, is consistent and expected.

D. Stewardship: Loaning and borrowing of supplies and instruments among medical centers to meet patient scheduling and physician block allocation. A variation in the process directly a result of resource allocation and financial allocations.

"Metrics that Matter"

- Productivity: no of staffing versus cases volume
- OR access and block utilization
- Turnover time 20 min versus 25 min
- First Case on Time Start at 0745 (robotic) and 0800 for all cases
- Missed meal and breaks penalties
- No of safe days
- Waste Management rounding
- KP Rounding (1:1 with direct report)
- SSI reduction with bundle protocol
- Prevention of index harms, i.e., RFO, fire/burn
- Prevention of surgical complications, i.e., DVT, MTP
- Hand Hygiene

OPERATING ROOM SUPPORTING/LINKING MICROSYSTEMS



Appendix F

Project Charter

Project Title: Quality improvement project to reduce upper extremity strain injuries in the OR associated with surgical instrumentation handling.

Global Aim: Develop a microsystem plan to reduce "claimed" workplace injuries in the Main Operating Room by 25% between 10/2020 to 10/2022, resulting in lower organizational costs compared to baseline 10/2017 to 10/2019.

Specific Aim: By October 2020, to reduce work-related injuries by 50% in the Main Operating Room that are caused by upper extremity strain concerning instrument handling by surgical technicians.

Background Statement:

A work-related injury is an illness or injury contributed, caused, or aggravated significantly by exposures and events in the work environment as a direct result of the allotted task to the specific job. The top leading causes that account for more than 84% of all non-fatal injuries involving loss of work are overexertion and bodily reaction, slips trip and falls, and contact with objects and equipment (National Safety Council [NSC], 2018). NSC reports that the cost in 2018 of these work injuries was 170.8 billion caused by losses in wage and productivity, medical expenses, administrative expenses, and employers uninsured cost.

In 2011 the Occupational Safety and Health Administration (OSHA) identified that hospitals represent one of the most hazardous working environments in the United States with recorded 253, 700 work-related injuries recorded and an illness rate of 6.8 per 100 full-time employees, almost doubling the rate for private industries as a whole (OSHA, 2013). In 2004,

54% of workplace injuries in healthcare were musculoskeletal disorders that involve muscles, nerves, joints, or spinal disc (Beck, May 2008). The US Bureau of Labor Statistics (2018) reported that back-involved injuries in 2016 accounted for 38.5% (134, 550 of 349, 050 cases) of all workplace-related musculoskeletal disorders.

The operating room (OR) presents unique challenges regarding ergonomic-related injuries (Moss, 2015). In the performance year 2019-2020, The community medical center perioperative department collectively reported 74% accepted claims attributed to ergonomics, patient handling, and striking or contact injuries. The 33% accepted claims were associated with upper extremities, and 42% were caused by strain injury from lifting, pushing, and pulling. In the performance year 2018-2019, The OR had 32 reported injuries in 28 staff members. These workplace-related injuries include upper extremity strain, struck by an object and repetitive motion. Four "claimed" injuries occurred with surgical technicians that resulted in long term disability directly as a result of lifting and handling heavy instrument trays.

These injuries led to the loss of skilled staff for a prolonged period and significantly impacted operational needs and teamwork in the department. Lower staffing levels led to staff dissatisfaction, exhaustion, and required overtime. The gaps in skill levels led to the hiring of temporary positions and overutilization of Per Diem personnel. Limited personnel working for longer hours increases the risk of fatigue and reduces focus and attention to detail. These conditions significantly increase quality gaps exposing the team to increased risk for errors, harms, and injuries. In addition to affecting patient care outcomes, these injuries result in significant costs to the organization. There is a need to highlight ergonomic safety to reduce and prevent work-related injuries for the benefit of both the staff and employer.

The Goals for the Project:

To foster a safe work environment for surgical patients and personnel by reducing the incidence of workplace-related injuries in the Operating Room:

1. To create a better work environment by involving the team in process improvement initiatives that directly impact their workflow and care delivery.
2. To reduce the departmental injury count and injury rate to meet the employer set goal.
3. To minimize organizational costs related to loss of employee work hours, operational productivity, accepted injury claims, and a lengthy recovery.
4. To improve team morale directly related to dissatisfaction from a colleague's absence from work or team member returning with modified work accommodations.
5. To stimulate a culture of improvement and teamwork through the participation of unit-based teams in both OR and SPD departments to perform small tests of change.
6. To improve efficiency and quality of work with the sterile processing department by implementing more streamlined contents in instrument trays, decreasing time in instrument cleaning, preparation, and assembly.

Project Team Members:

Sponsor	C. M. (Peri-op Interim Director) A. W. (Safety Specialist/Operation leader)
Preceptor	C. P. (AAMG)
Project Leads	W. L. H. (OR Manager) M. F. (SPD Manager)
Support Leads	G. F. (SPD Assist Manager) R. V. and P. M. (OR ANMs)
OR Change Agents	R. P., C. F., and K. A (OR STs)
SPD Change Agents	D. Y. and L. M. (SPD techs))

Process Measures:

Measures	Measure Definition	Data Source	Goal
Outcome Measure			
No. of upper extremity strain injuries	Surgical Techs reported injuries in the Main OR compared to PY 2018 (2) and 2019 (2)	Supervisor's First Report of Injury (SFR)	50% (1 injury)
Process Measures			
Surgical Tray assessment	Baseline data of all intended surgical trays (physical defects, weight, ergo limitation, usage) Lap cholecystectomy tray = 10 / Lap gynecology advance = 6	Sterile Processing Microsystem (SPM) Observation audit	90%
Quality Improvement on surgical trays and the modified ring stand	Rapid test cycles on improved surgical trays and lowered ring stand N = no of staff who gave feedback / No of trays improved D = total no of ST's regularly works at MOR (16) / Total No. of trays (16)	Observation audit Sterile Processing Microsystem (SPM)	90%
Biweekly safety huddle for team engagement and effective communication	Incorporate safety huddle biweekly to daily readiness board in order to capture safety events and near-misses.	Feedback form	8 huddles /month)
Surgical Tech's assessment/engagement	N = no. of surgical tech's participation D = total no. of surgical techs (survey 1 = 20 and survey 2 = 16)	Survey Monkey	75% overall response rate
Balancing Measure			
Operational Impact on SPD	Project improvement on 2-tier laparoscopic trays on processing time (efficiency) and safety Sustainability = SPD's consistency on correct and complete tray assembly	Survey Monkey Weekly random audit	75% (22 / 30 staff) 75% (16/20 trays)

Measurement Strategy:

Each service specialty trays will be inspected for physical defects and poor design in a timeframe of two weeks. Overweight trays will be identified during the process. The response time from providers and the availability of replacement products are potential challenges on the timely completion of the project. A pre-survey questionnaire will provide baseline on education and effectiveness will be measured by improvement in the post-survey questionnaire.

Data Collection Tool:

Service Specialty	Total no. of Instrument trays available	No of trays included in the assessment	No of defective containers identified	No of inner trays reconfigured	No of overweight trays corrected	No of count sheets changed	Comments
General							
Robotic							
H&N							
Gynecology							
Urology							

Other Data Collection Source:

1. Workplace Injury Information System (WIIS) dashboard reflects reported data on injury rate, injury count, and productive hours. This tool provides insights about performance, areas/locations of highest risk, and detailed analysis of accepted workers' compensation claims.
2. Supervisors First Report (SFR) of injury is a comprehensive reporting tool for managers/supervisors presenting initial root cause analysis and mitigation plans. SFR will capture all reported injuries by employees and provide a baseline for injury count.
3. Sterile Processing Microsystem (SPM) is a computerized asset management system that uses barcode technology to track location and movement of instrument sets. It also provides proactive sterilization quality assurance, instrument usage analysis, and staff productivity using event logs.

Population Criteria: Staff RN's and surgical techs working in medical center Main Operating Room (MOR) will be participating in the huddle and escalation process. The change agents will be involved in the surgical instrumentation trays assessment and correction process.

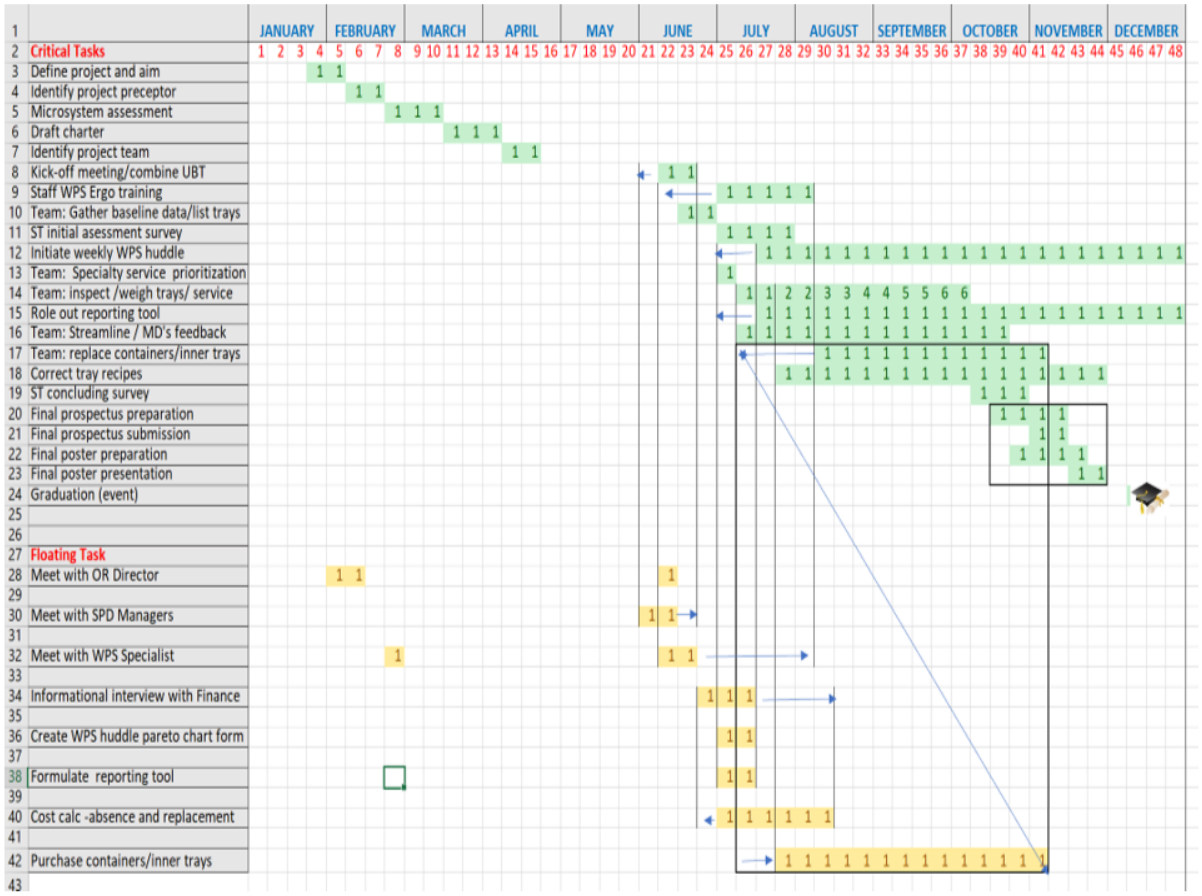
Data Definitions:

Data Element	Data Definition
Workplace Safety	policies and procedures in place to ensure the safety, health, and well-being of employees within a workplace. It involves hazard identification and control according to government standards and ongoing safety training and education for employees
Workplace-related injury	injuries that occurred as a result of the environment in which an employee works.
Upper extremity strain	Overuse, fatigue, or improper use of the muscles or tendons from fingers to shoulders resulting in overstretching or tear
Claimed injuries	reported injuries that resulted in employee's loss of work hours or productivity and any cost associated with treatment
Accepted Claim	work injury claim which the claims administrator agrees is covered under the employer's workers' compensation insurance
Workers Compensation	a form of insurance providing wage replacement and medical benefits to employees injured in the course of employment in exchange for mandatory relinquishment of the employee's right to sue an employer for the tort of negligence
Ergonomics	improvement process removing risk factors that lead to musculoskeletal injuries and allows for improved human performance and productivity.
Change agents	frontline staff directly involved and participating in the planning, assessment, implementation of the improvement project

Changes to Test:

- The current state of surgical instrument trays
- The volume of surgical trays that need changes
- Projected no of surgical trays that need to be streamlined or reduced in weight
- Providers response time to review and approve changes in instrument tray contents
- Available product readily available to use as recommended changes in tray design
- Surgical and SPD techs engagement in providing valuable feedback or information on instrument trays risk concerns

Project Timeline: Gantt Chart



Lessons Learned:

A microsystem assessment utilizing the 5P's (Purpose, Patient. Professionals, Processes, and Pattens) will help provide a more profound knowledge of essential tools and methods within the microsystem (Nelson et al., 2007). The microsystem analysis will help the CNL understand and have a deeper awareness of what the organizational and departmental framework looks like,

the resources available within the system, and the quality and safety gaps that would highlight the need for process improvement.

Learning and creating a Gantt Chart would be useful to do as early as possible in helping develop a timeline with communication presentation, result planning, and monitoring progress.

Lack of robust process and incomprehensive root cause analysis resulted in additional injuries on surgical technicians. Risks were mitigated mainly on the affected trays. A thorough and complete inspection of the quality and design of all instrument trays will prevent future lifting injuries. In June 2018, foldable handles on ortho trays were installed as a result of a twisting wrist injury. In January 2019, outer containers and inner baskets were reconfigured as a solution for another lifting injury. In August 2019, an elbow injury prompted the immediate replacement of outer container and internal baskets, as well as reducing the tray contents. These interventions seemed to be effective, and no additional reported upper extremity strain injuries were reported.

There is a need to have conducted a detailed assessment of the team and processes and develop an in-depth process improvement initiative to mitigate safety risks in ensuring that staff and surgical trays are in a safe and quality state, improving workplace-related injuries. Seeking resources from key individuals, remaining curious, patient and flexible were gained and found beneficial in gathering data.

CNL Competencies:

The Clinical Nurse Leader (CNL) functions at the microsystem and is best positioned to influence point of care innovations and improvements to achieve high-quality care outcomes and focused on evidence-based practice, safety, risk reduction, and cost containment. The CNL was

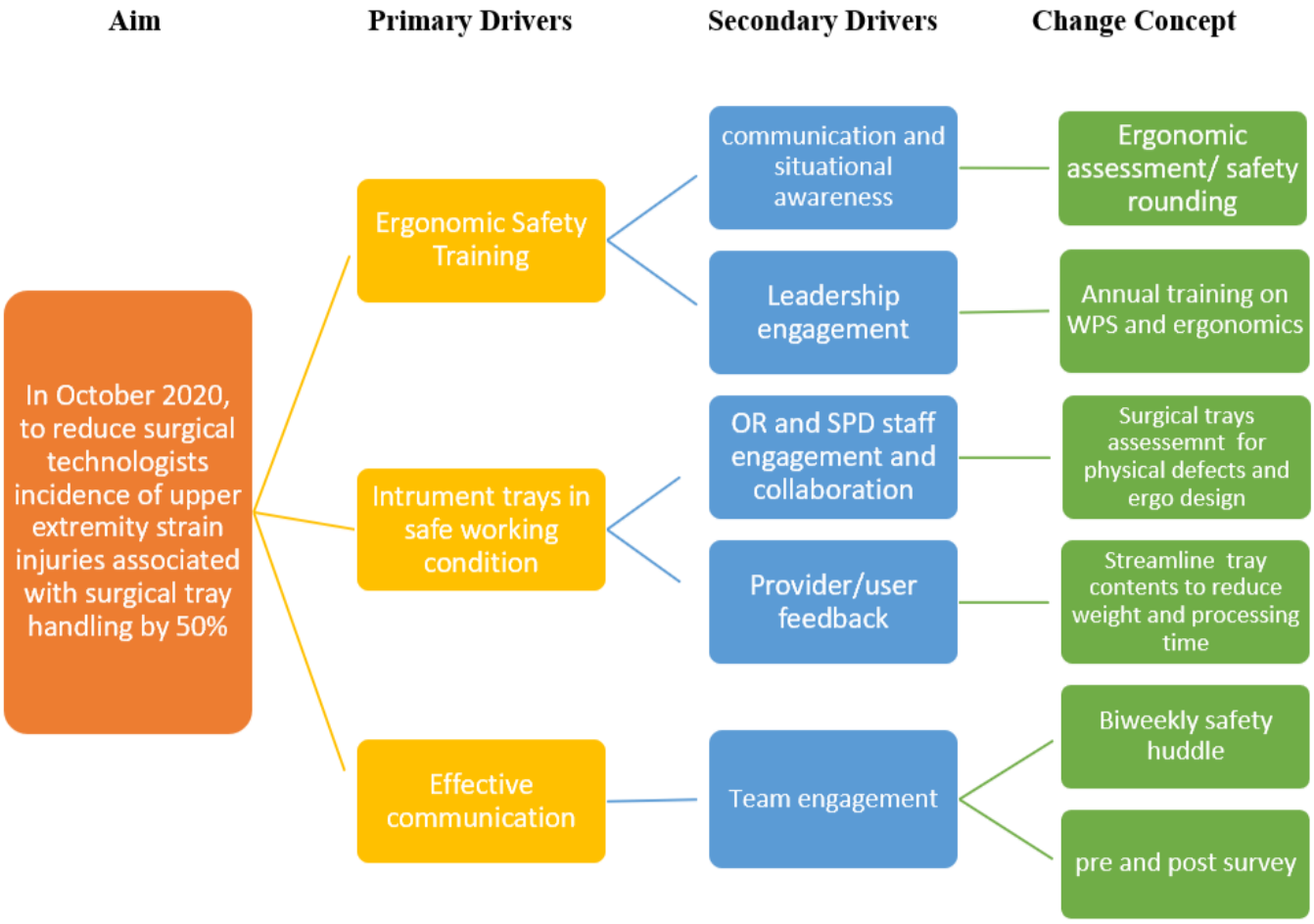
developed by the American Association of Colleges of Nursing (AACN) in response to the complexities of health care environments and in meeting diverse client and health care environment needs. CNL is master's prepared advanced generalist serving as a lateral integrator who facilitates, coordinates and oversees health café system within the microsystem and collaboration with macrosystem (American Association of Colleges of Nursing [AACN], 2007) AACN added that a CNL collects and evaluates patient outcomes, assesses cohort risk, and has the decision-making authority to change care plans when necessary.

There are seven master's essential with corresponding CNL competencies providing a comprehensive view of expected outcomes of CNL education and facilitating curriculum development (American Association of Colleges of Nursing [AACN], 2013). Essential 3: Quality Improvement and Safety would be the focus of the CNL in the following competencies: using performance measure to assess and improve the delivery of safest practices; perform comprehensive microsystem assessment to provide context for identification of a problem with needed actions; implement quality improvement strategies based on current preparation and risk anticipation; establish effective communication process, and promote continuous quality improvement within the microsystem.

Generally, the CNL roles fall into these nine following categories: clinician, outcome manager; client advocate; educator; information manager; system analyst/risk anticipator, team manager, member of a profession, and lifelong learner (King et al., 2019). For this project, the CNL will serve as a team leader for the assessment of issues and will collaborate measures to reduce work-related upper extremity strain "claim" injuries in the OR. The CNL will be focusing on the three leading roles of risk anticipator/system analyst, educator, and outcome manager.

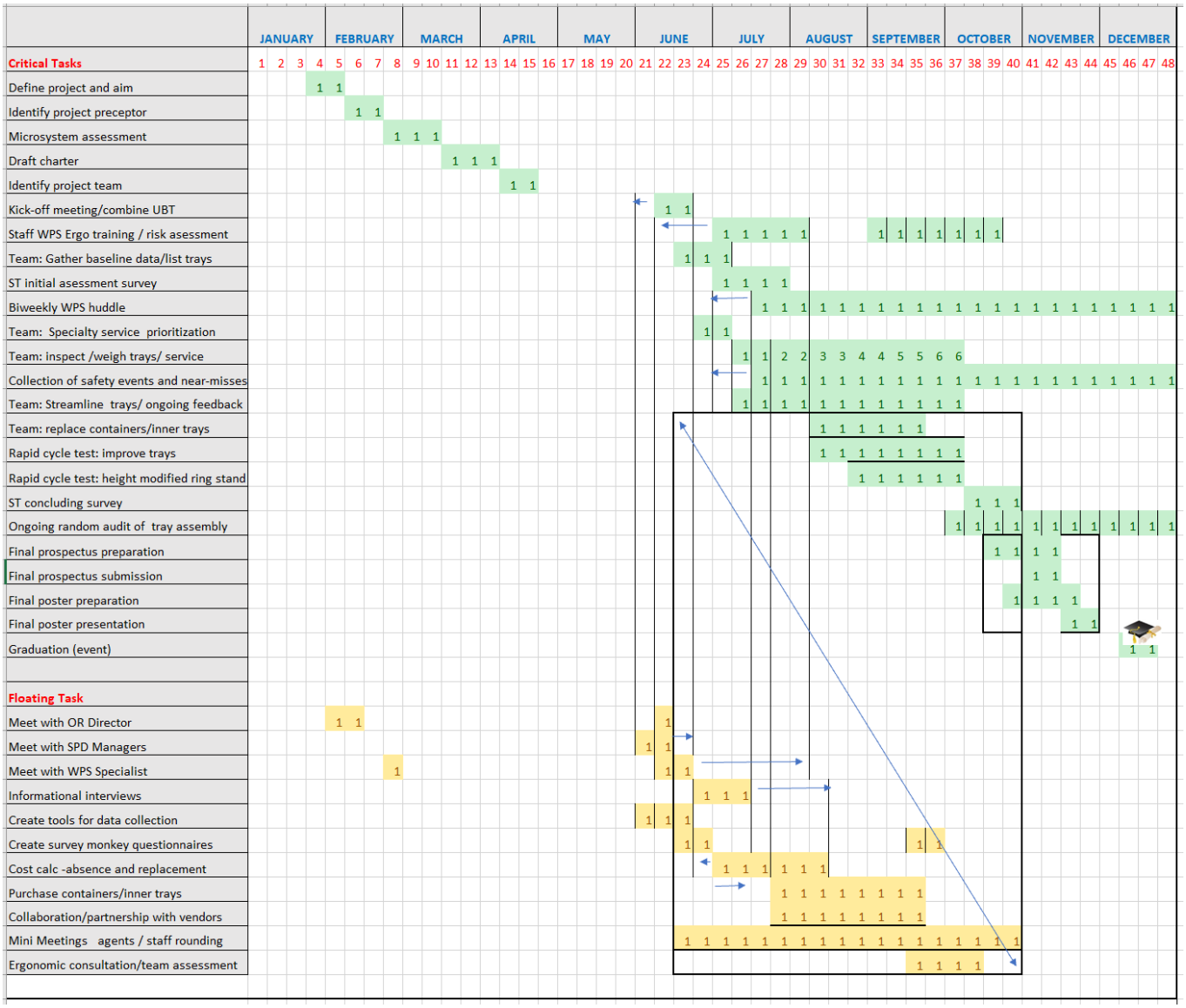
Appendix G

Driver Diagram



Appendix H

Gantt Chart

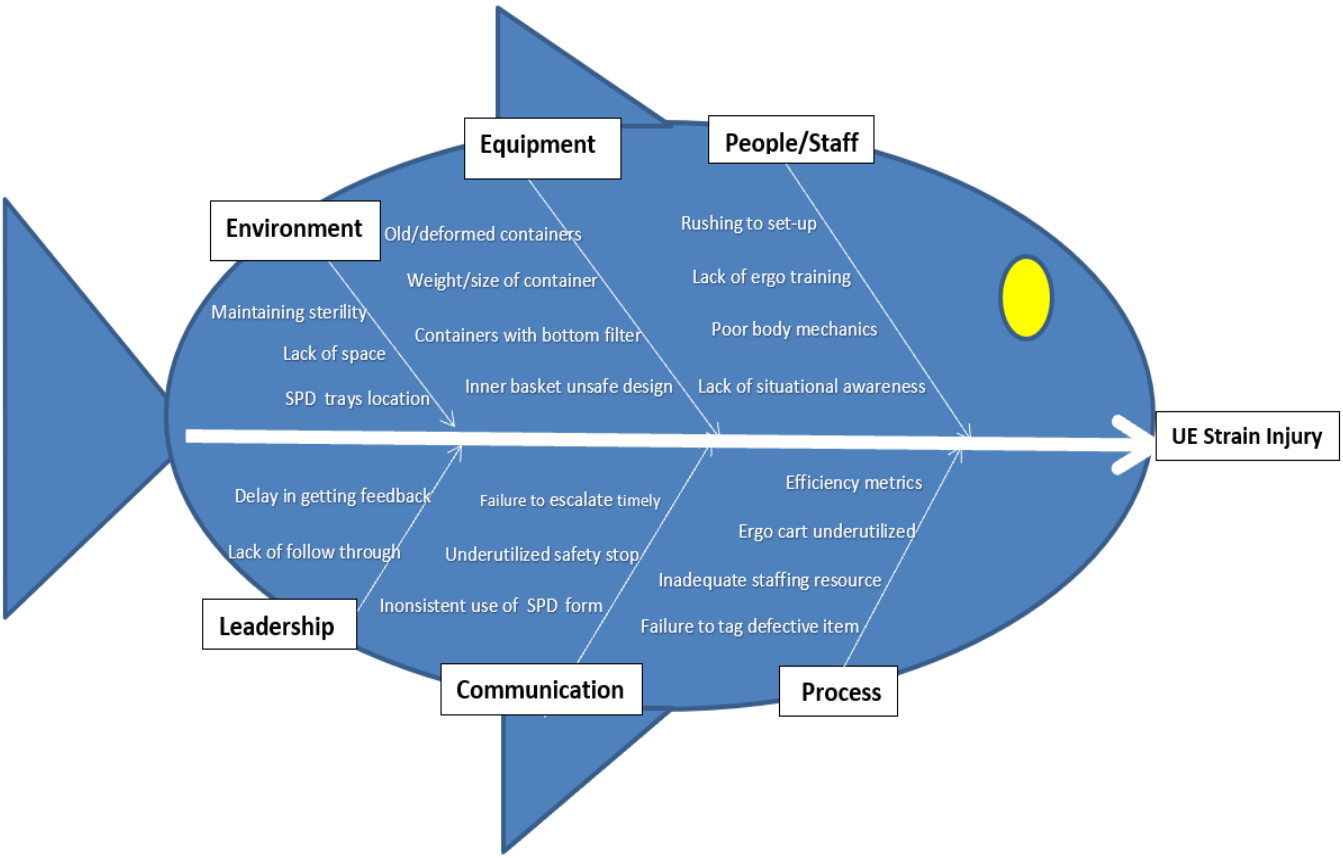


Appendix I

SWOT Analysis

Appendix J

Fishbone Diagram



Appendix K

IRB Exemption for Non-Research Statement of Determination

Student Name: Wilhelmina Lu Hofilena

Title of Project:

Quality Improvement Project to Reduce Upper Extremity Strain Injuries in the OR related to Surgical Instrumentation Handling

Brief Description of Project:

There were four reported upper extremity strain injuries related to instrument handling in WPS PY 2018-2019. Initial measures to improve the quality of the surgical instrumentation trays were implemented to address the cause of each injury. This improvement project will involve extensive and complete assessment of surgical trays in medical center main operating room for defects, design, and weight. The surgical tray specialties included in the project are general, robotic, head and neck, cardio-vascular, gynecology, and urology.

A) **Aim Statement:** By October 2020, to reduce injuries by 50% in the Main Operating Room that are caused by upper extremity strain concerning instrument handling by surgical technicians.

B) Description of Intervention: The combine OR and SPD Unit-Based Teams will have a partnership in this safety project. A pre- and post-survey will be conducted to determine baseline knowledge and effectiveness of education. SPM will be used to obtain a baseline list of surgical trays. Team change agents will inspect and assess the quality of all trays in each service specialty every two weeks. Surgical containers and inner trays that are defective and have poor design will be identified and replaced. Instrument trays that are overweight will be streamlined in collaboration with surgeon providers. Staff engagement and feedback will be obtained through weekly huddles and establishing a tool for timely reporting.

C) How will this intervention change practice? Improving the quality of the surgical trays, and addressing the anticipated risks of container defects, the ineffective layout of inner trays and overweight trays greater than 25 pounds will help reduce the incidence of upper extremity strain injuries. Establishing a standard workflow in reporting will promote a consistent escalation process. Incorporating data collection and feedback during huddles will influence staff engagement and lesson sharing. These interventions will change practice by increasing safety awareness through proactive hazard risk mitigation, ergonomic training, and having an effective communication of reporting and escalation.

D) Outcome measurements:

Outcome measure: reported upper extremity strain injuries related to instrument handling by surgical technicians will be obtained from Supervisor's First Report of Injury (SFR) and electronic reporting. Target is 50% by October 2020 compared to reported in juries in WPS PY 2018 to 2019.

Process Measure: Weekly assessment of surgical instrument trays for container defects, inner basket design and weight. Improving communication by conducting weekly huddle to gather feedback from frontline staff using a pareto chart and creating a workflow process/ tool for spontaneous reporting of hazard risks. Improving knowledge/education by conducting pre and post survey questionnaire.

Balancing Measure: improvement to surgical trays measured by the number of count sheets updated by the Sterile Processing Department, and the number of purchased containers to improve and correct defects identified.

To qualify as an Evidence-based Change in Practice Project, rather than a Research Project, the criteria outlined in federal guidelines will be used: (http://answers.hhs.gov/ohrp/categories/1569)

X This project meets the guidelines for an Evidence-based Change in Practice Project as outlined in the Project Checklist (attached). Student may proceed with implementation.

☐This project involves research with human subjects and must be submitted for IRB approval before project activity can commence.

Comments:

EVIDENCE-BASED CHANGE OF PRACTICE PROJECT CHECKLIST *

Instructions: Answer YES or NO to each of the following statements:

Project Title: Quality Improvement Project to Reduce Upper Extremity Strain Injuries in the OR	**YES**	**NO**
The aim of the project is to improve the process or delivery of care with established/ accepted standards, or to implement evidence-based change. There is no intention of using the data for research purposes.	**X**	
The specific aim is to improve performance on a specific service or program and **is a part of usual care**. ALL participants will receive standard of care.	**X**	
The project is **NOT** designed to follow a research design, e.g., hypothesis testing or group comparison, randomization, control groups, prospective comparison groups, cross-sectional, case control). The project does **NOT** follow a protocol that overrides clinical decision-making.	**X**	

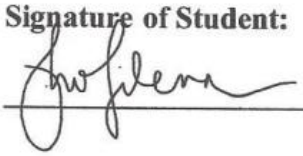
develop paradigms or untested methods or new untested standards.		
The project involves implementation of care practices and interventions that are consensus-based or evidence-based. The project does **NOT** seek to test an intervention that is beyond current science and experience.	**X**	
The project is conducted by staff where the project will take place and involves staff who are working at an agency that has an agreement with USF SONHP.	**X**	
The project has **NO** funding from federal agencies or research-focused organizations and is not receiving funding for implementation research.	**X**	
The agency or clinical practice unit agrees that this is a project that will be implemented to improve the process or delivery of care, i.e., **not** a personal research project that is dependent upon the voluntary participation of colleagues, students and/ or patients.	**X**	
If there is an intent to, or possibility of publishing your work, you and supervising faculty and the agency oversight committee are comfortable with the following statement in your methods section: *"This project was undertaken as an Evidence-based change of practice project at the medical center operating room and as such was not formally supervised by the Institutional Review Board."*	**X**	

ANSWER KEY: If the answer to **ALL** of these items is yes, the project can be considered an Evidence-based activity that does NOT meet the definition of research. **IRB review is not required. Keep a copy of this checklist in your files.** If the answer to ANY of these questions is **NO**, you must submit for IRB approval.

*Adapted with permission of Elizabeth L. Hohmann, MD, Director and Chair, Partners Human Research Committee, Partners Health System, Boston, MA.

STUDENT NAME: Wilhelmina Lu Hofilena

Signature of Student:



DATE_06/17/2020

SUPERVISING FACULTY MEMBER NAME: Dr. Cathy Coleman

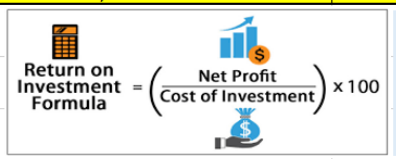
Signature of Supervising Faculty Member

Catherine M Coleman, DNP, CRX **DATE** 6/17/2020

Appendix L

Finance / Cost Analysis

Financial Analysis of Safety Quality Improvement Project			
ST 1 (7/2019 to 6/2020)	**Workman's Compensation Incurred**	**Temp Employee @ $66/hr**	**Injury Cost**
Medical	27, 161.00		
Indemnity	71,064.52		
Misc Expense	3,481.13		
Total Cost			101,706.65
Traveler (Sept-June) x 40 weeks		105,600	105, 600.00
TOTAL			**207,286.65**
ST 2 (02/2019 to 12/2019)			
Medical	5,800.50		
Indemnity	22, 724.92		
Misc Expense	989.39		
Total Cost			29,514.81
Per Diem (backfill modified work) x 8 weeks	x 38/hr	12, 160.00	12, 160.00
Traveler x (Mar - Nov) x 34 weeks			89,760
TOTAL			**131,434.81**
Container System Project	**Targeted Project**	**Project Spread**	**Total**
Solid bottom containers @ 265.31	x18 = 4,775.58	x10 = 2, 653.10	7, 428.68
Perforated 4" wire basket @ 105.29	x18 = 1, 897.02	x4 = 421.16	2,318.18
Lid with retention silver plates @ 152.24	x16 = 2,425.84	x10 = 1522.40	3, 948.24
Perforated silicone mats @133.64	x18 = 2,405.52	x10 = 1,336.40	3,741.92
Endorack @ 422.64	x3 = 1,267.92	x4 = 1, 690.56	2, 958.48
Total	12, 771.88	7,623.62	**20, 395.50**
Ring Stand Project			
Double ring stand x 9	1,768.00		
Single ring stand x 10	1,854.90		
Caster Replacement x 76 pcs	250		
Total			**3872.90**
Training/Assessment on Ergonomics			
Safety Leader @ approx 46/hr	x 6 hours = 276.00		
Ergonomic Consultant @ approx 40/hr	x 18 hours = 720.00		
Total			**996.00**
Incurred Cost associated with 2 Injuries	**Estimated Average Cost per Injury**	**Project Initiative Cost**	**Avoidance Cost**
338, 721.46	169, 360.73	25, 264.40	**144, 096.33/injury**



$$ROI = \frac{144,096.33}{25,264.40} \times 100 = 570.35\%$$

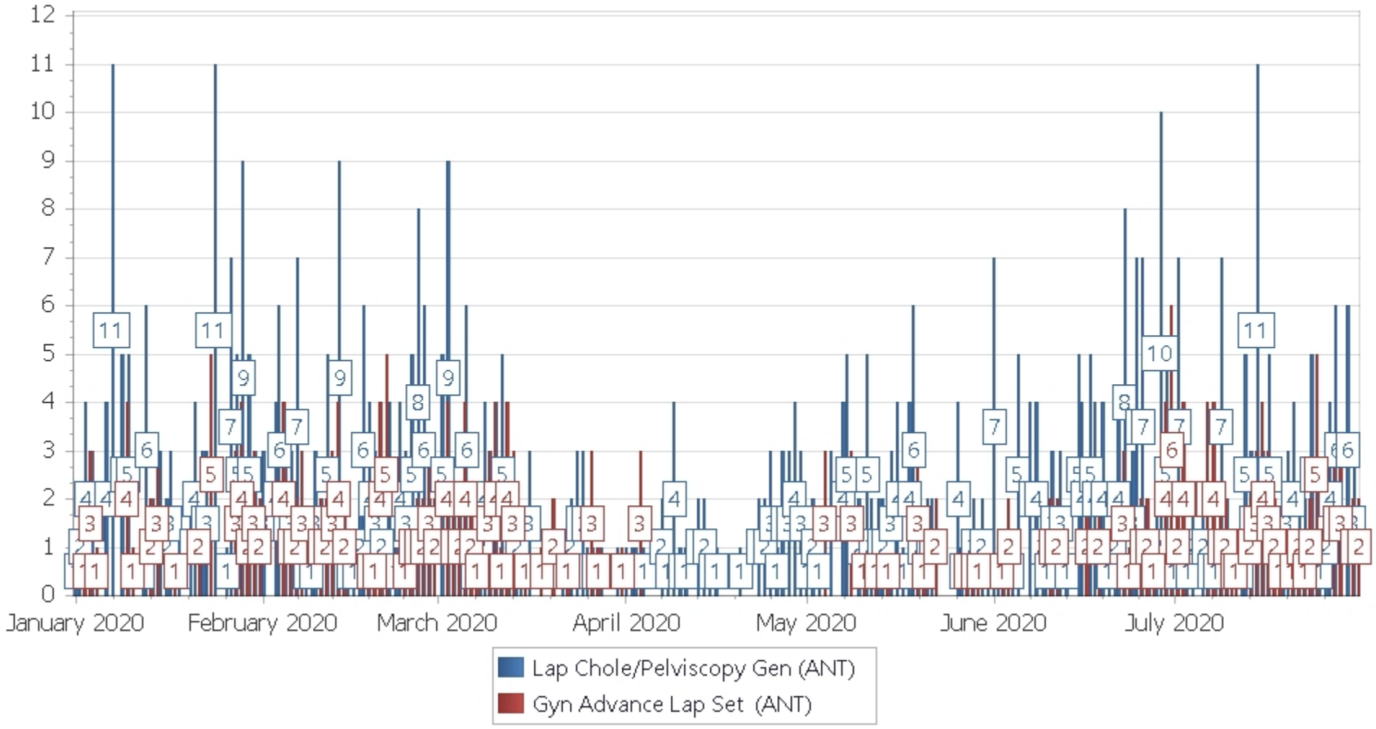
Appendix M

Data Display Method

Laparoscopic Trays Utilization Trend

Product Usage Histogram by Day

Date From: 1/1/2020 12:00:00 AM (PDT)
Date To: 7/31/2020 11:59:59 PM (PDT)
Products: Gyn Advance Lap Set ,Lap Chole/Pelviscopy Gen



SPM Product Usage Trend

Date From: 1/1/2020 12:00 AM Date To: 07/31/2020 11:59:59 am (PDT)

Sites: MOR 2-Tier Laparosopic Instrument Sets

Products: Advance Gen Lap, Complete Robotic Instrument, Gyne Lap Advance, Lap Chole/Pelviscopy, Urology Lap Advance

Uses		Month/Year							
Product Name	**Inventory**	**Jan-20**	**Feb-20**	**Mar-20**	**Apr-20**	**May-20**	**Jun-20**	**Jul-20**	**Grand Total**
Advance Gen Lap	2	4	5	4	0	3	5	1	22
Complete Robotic Instrument	4	55	48	46	26	45	52	48	318
Gyne Lap Advance	**6**	37	47	40	3	18	30	56	**231**
Lap Chole/Pelviscopy	**10**	106	101	63	41	64	105	94	**574**
Urology Lap Advance	2	2	1	6	2	1	1	3	16
Grand Total		204	202	159	70	131	193	202	1161

Appendix N

Data Collection Forms

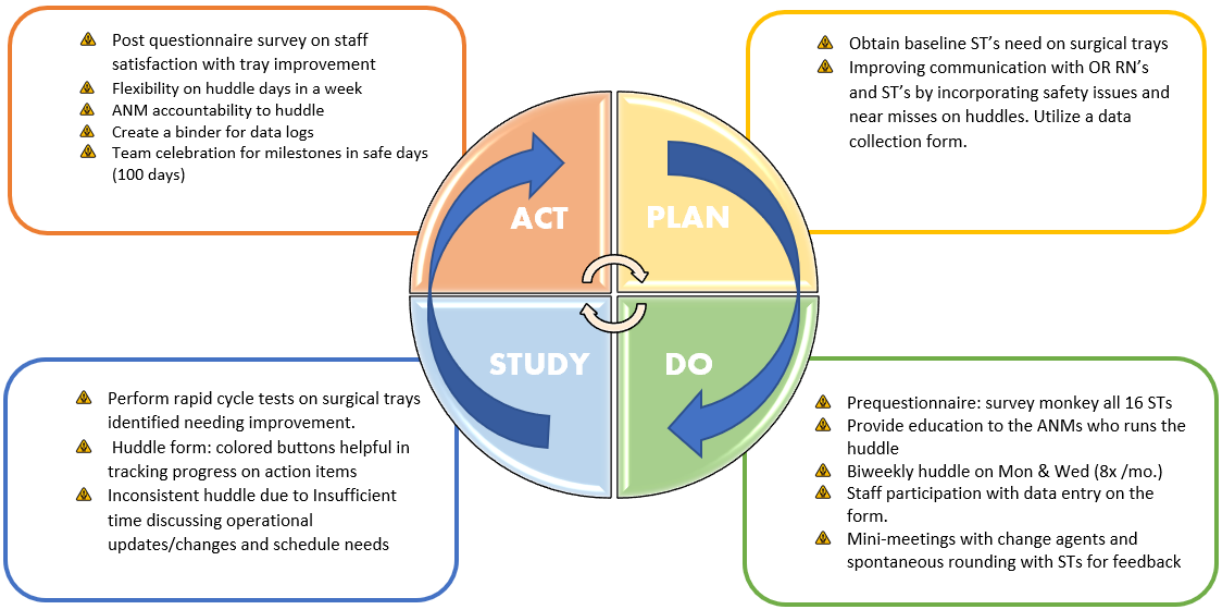
MOR SAFETY ESCALATION (Events/Near Misses)					
Huddle Topic : MONDAYS AND WEDNESDAYS/ ALL SHIFTS					
Status Code: RED= In Progress BLUE= Near Completion GREEN===RESOLVED					
Date	Problem	Action	Owner	Completion Date	Status

Rapid Cycle Test: Lowered Ring Stand from 33 to 31 inches (2")					
Purpose: A lowered height might help reduce strain on upper extremities when lifting surgical instruments trays					
Start Date: July 27, 2020					
End date: August 31, 2020					
Staff	Date Used	OR Rm No.	Service Specialty	Feedback	Yes / No

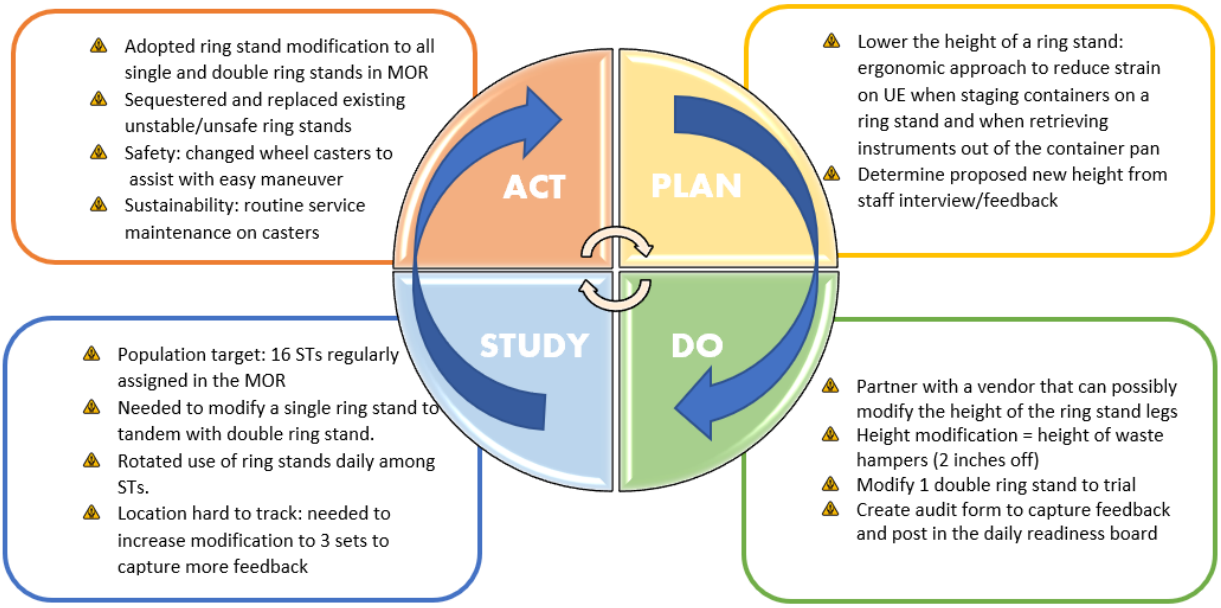
Appendix O

PDSA Cycles

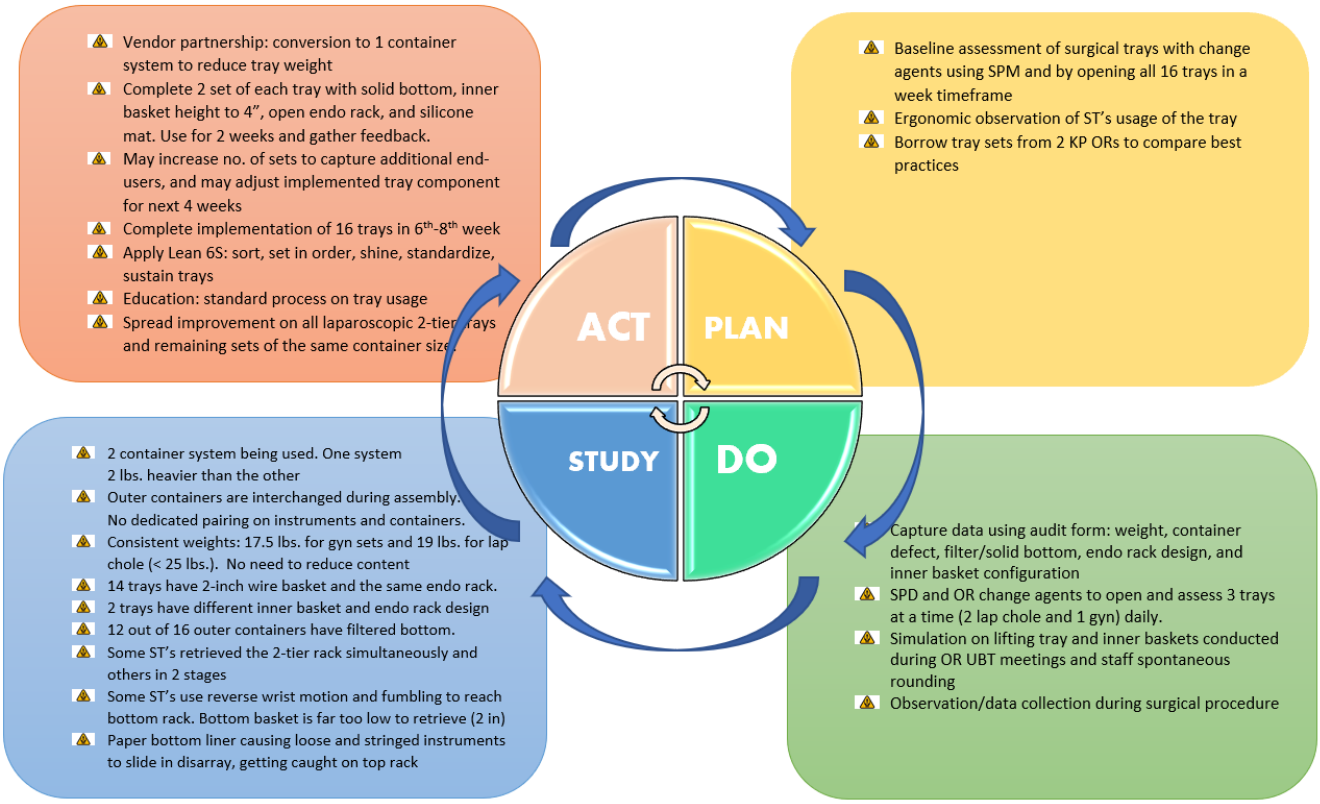
PDSA CYCLE – COMMUNICATION/ENGAGEMENT



PDSA CYCLE – MODIFIED RING STAND

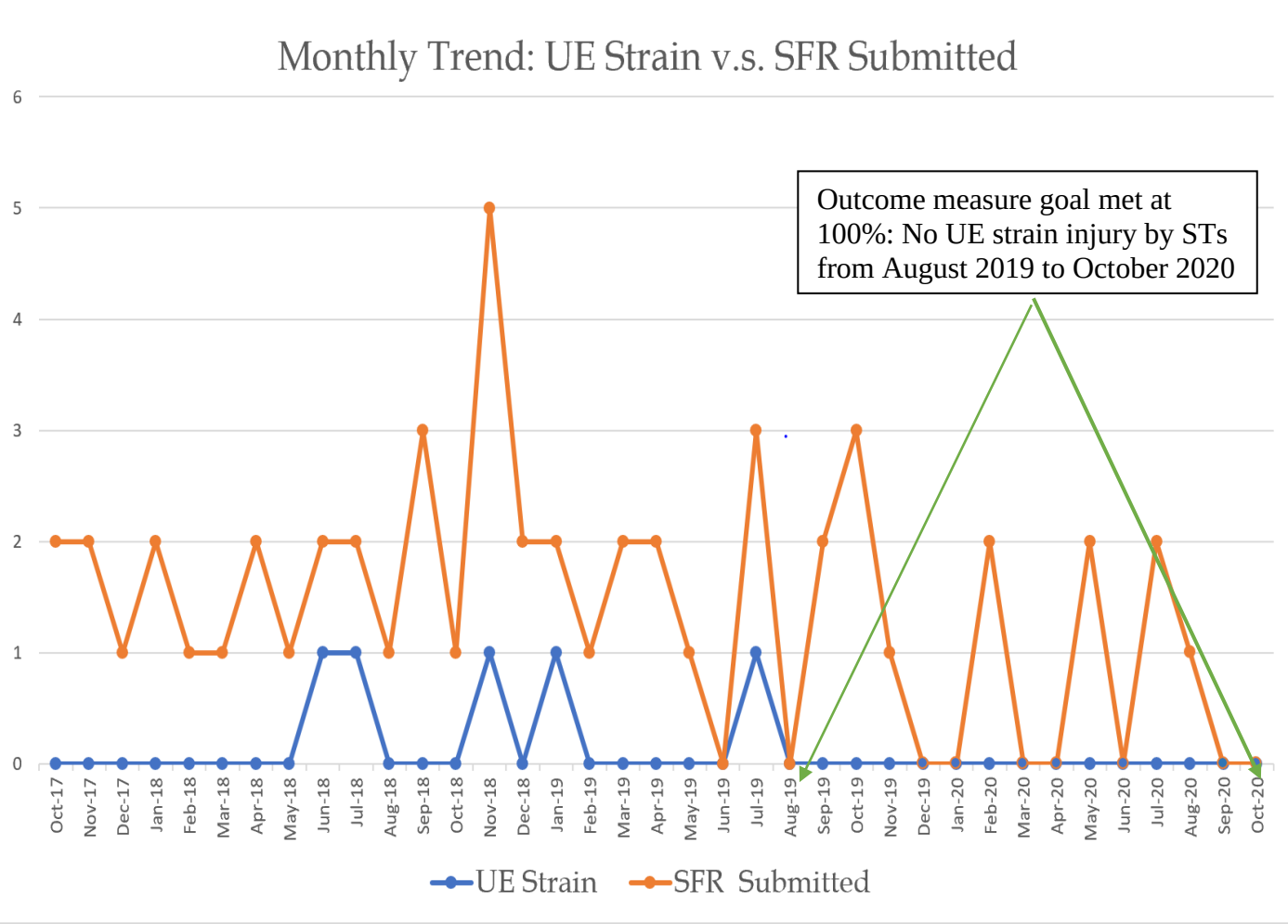


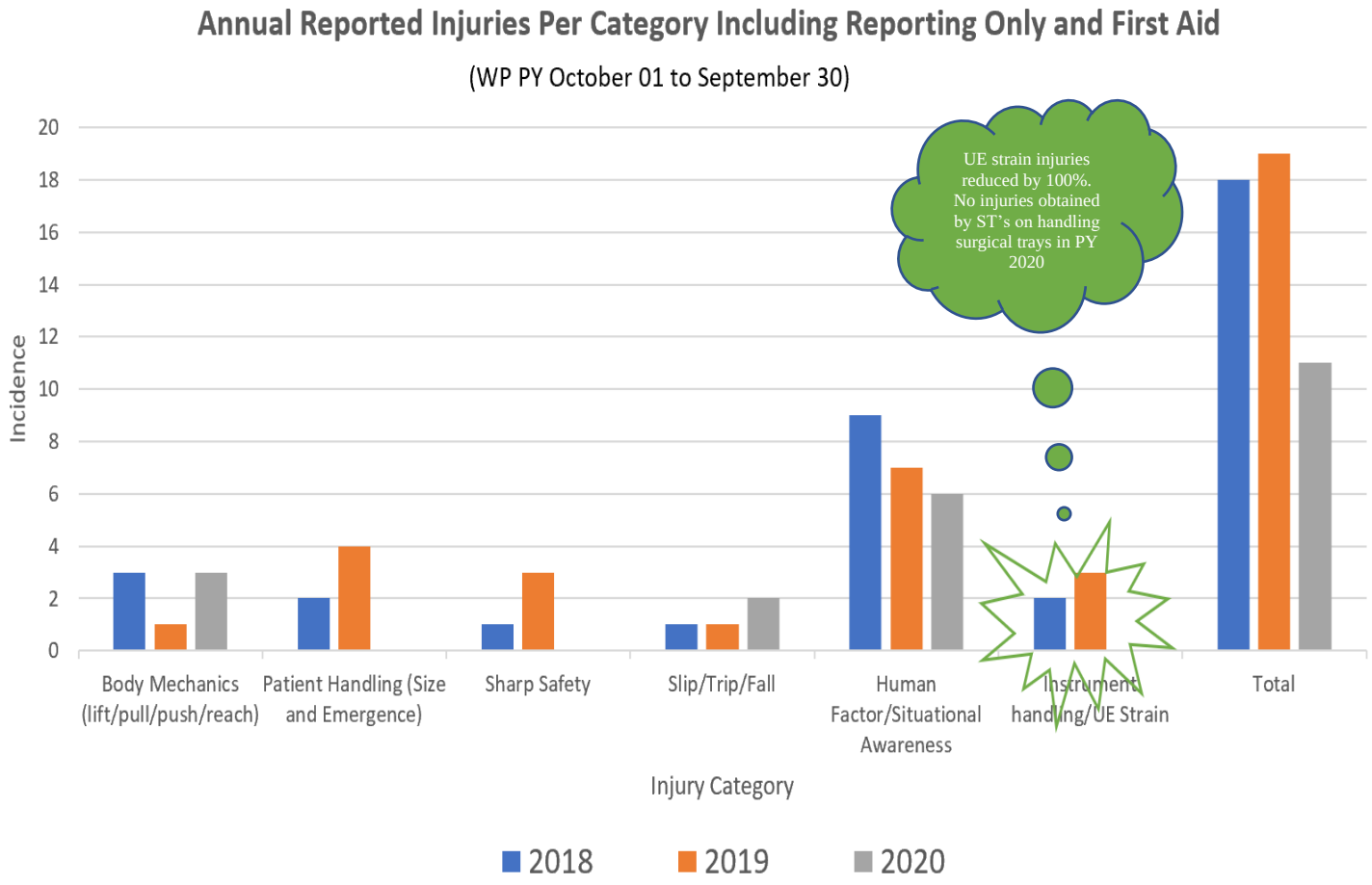
PDSA CYCLE – SURGICAL INSTRUMENT TRAYS

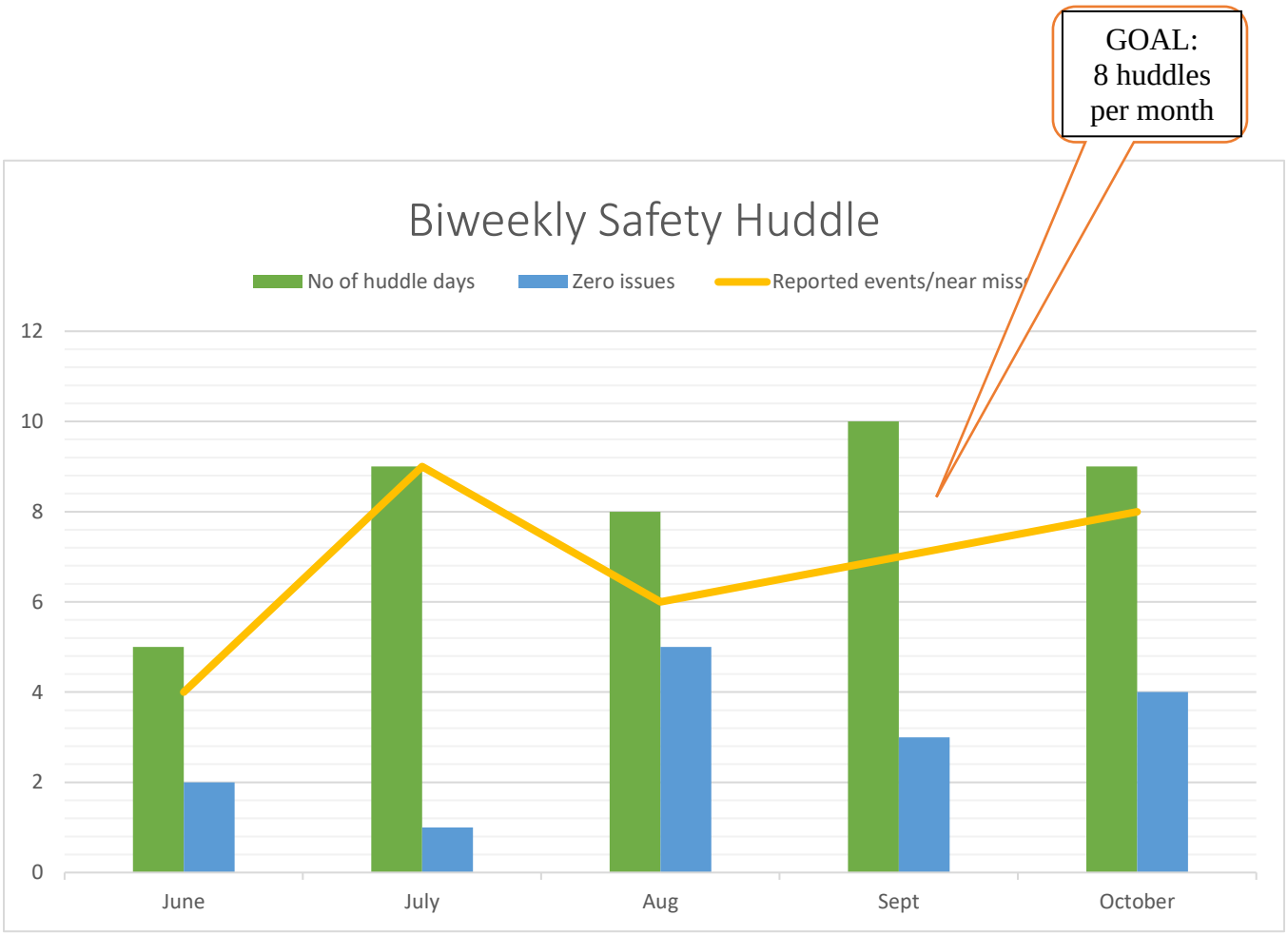


Appendix P

Results Reporting / Data Display



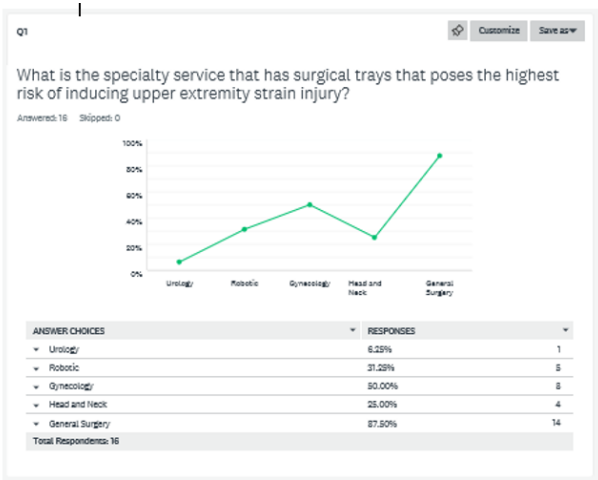

Annual Reported Injuries Per Category Including Reporting Only and First Aid
(WP PY October 01 to September 30)
UE strain injuries reduced by 100%. No injuries obtained by ST's on handling surgical trays in PY 2020
Incidence
20
18
16
14
12
10
8
6
4
2
0
Body Mechanics (lift/pull/push/reach)
Patient Handling (Size and Emergence)
Sharp Safety
Slip/Trip/Fall
Human Factor/Situational Awareness
Instrument handling/UE Strain
Total
Injury Category
2018
2019
2020

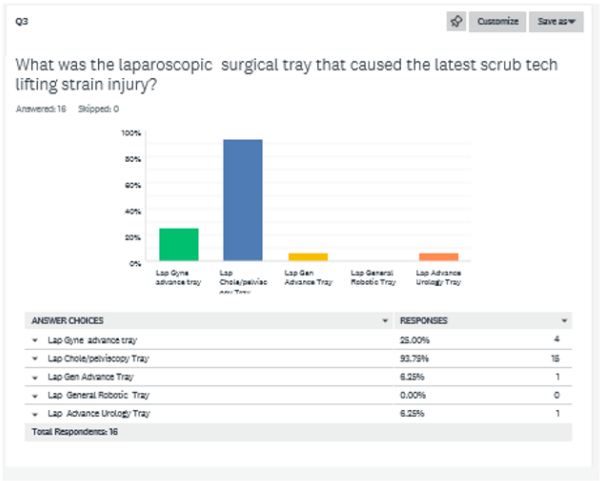

GOAL:
8 huddles
per month
Biweekly Safety Huddle
No of huddle days
Zero issues
Reported events/near miss
12
10
8
6
4
2
0
June
July
Aug
Sept
October

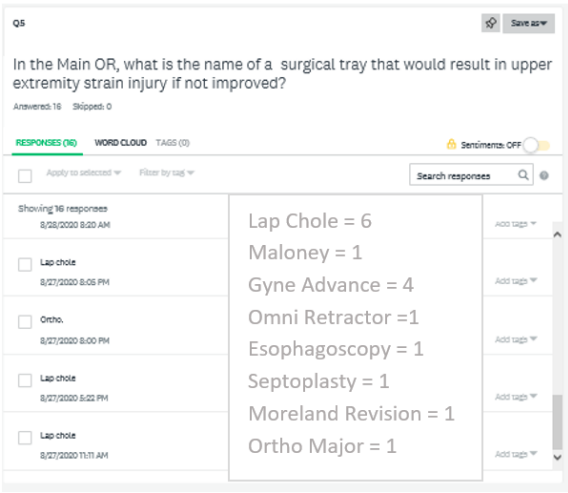
Appendix Q

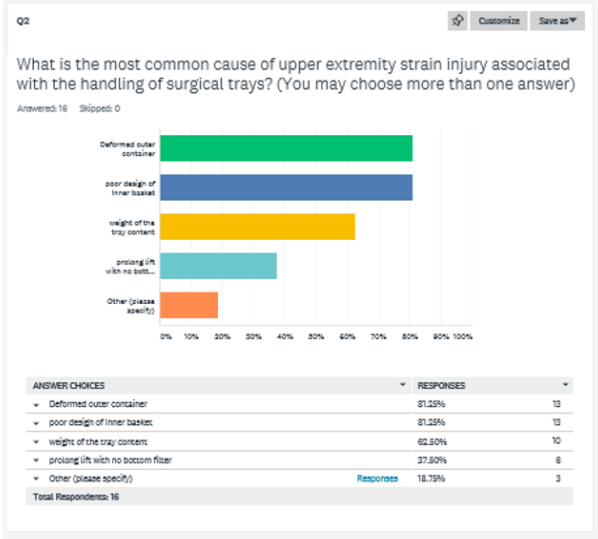
Survey Results

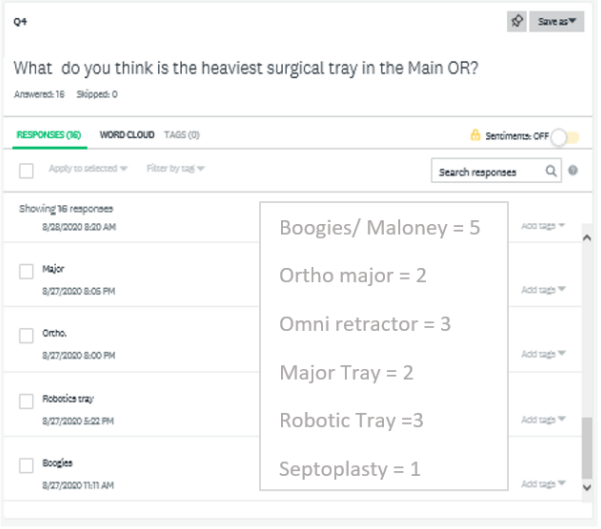
Pre-Survey Questionnaire

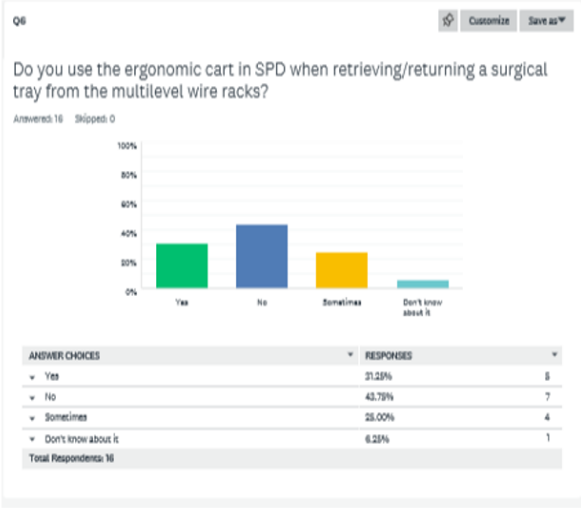












Post-Survey Questionnaire

Q1

Customize Save as

Does the height modification on the ring stand by 2 inches help in reducing the height of the arm lift and strain on the upper extremities?

Answered: 16 Skipped: 0

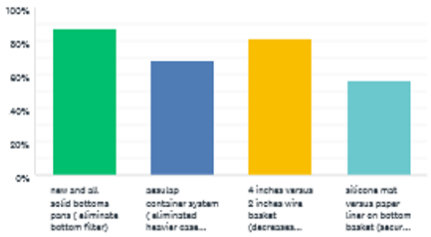
ANSWER CHOICES	RESPONSES	
Yes	100.00%	16
No	0.00%	0
TOTAL		16

Q2

Customize Save as

Which of the following improvements on the 2-tier laparoscopic trays do you find helpful in reducing the risk of injury? (you may choose as many)

Answered: 16 Skipped: 0



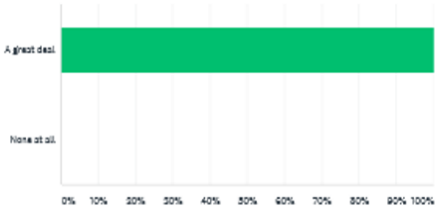
ANSWER CHOICES	RESPONSES	
new and all solid bottoms pans (eliminate bottom filter)	87.50%	14
aesulap container system (eliminated heavier case medical containers)	68.75%	11
4 inches versus 2 inches wire basket (decreases reaching into the tray)	81.25%	13
silicone mat versus paper liner on bottom basket (secures and prevents instrument shifting)	56.25%	9
Total Respondents: 16		

Q3

Customize Save as

Are the improvements in the Lap chole/pelviscopy and Lap Gyne advance trays helpful in reducing upper extremity strain injuries with Surgical Techs?

Answered: 16 Skipped: 0



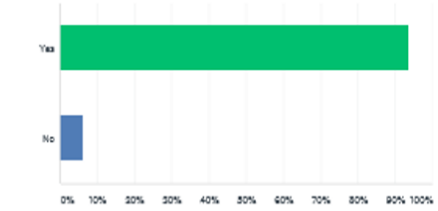
ANSWER CHOICES	RESPONSES	
A great deal	100.00%	16
None at all	0.00%	0
TOTAL		16

Q4

Customize Save as

Are you overall satisfied with the quality improvements made in all of the 2 tiered laparoscopic trays in the MOR?

Answered: 16 Skipped: 0



ANSWER CHOICES	RESPONSES	
Yes	93.75%	15
No	6.25%	1
Total Respondents: 16		

Appendix R

Project Pictures

Baseline Assessment on the Use of Laparoscopic 2-tier Surgical Trays

A deeper reach into the 2-inch basket may compromise sterility of gloves/gown. Fumbling through the instruments poses a high risk for sharp item injuries. Also, overreaching may result to over exertion of back and UE muscles.

Poor body mechanics with reverse wrist motion in retrieving instruments out of the container. This is done to reach deeper into the lower basket to grab the handle and also refraining away from the rim of the outer container to maintain sterility.

Presence of bottom filter encourages STs to retrieve the endorack and lower basket simultaneously while waiting for sterility indicators to be checked, including an intact filter

A paper liner on the bottom wire basket causes shifting of instruments during handling. Unstable surface causes instrument disarray and getting hooked on the endorack for ST's who retrieves the endorack and basket sequentially. This results to a higher lift and increasing strain on UE.

Surgical Trays Quality Improvements

Solid Bottom-
No more filter to check

One container system 2 lbs. lighter

Endo-rack Standardized

4 in taller bottom wire basket

Yellow silicone mat vs paper liner
6S standard set-up: shorter stringer, paper bag

Use of Ergonomic Cart and Improvised Ring Stands

Modifying the height of the ring stand by 2 inches reduces the strain and the lift on UE

Increase awareness and utilization of the ergo cart reduces strain on UE and back areas when handling surgical instrument trays