Reducing Unsecured Medications in Anesthetizing Area

Christine Bergesch

Kate Manuel
Reducing Unsecured Medications in Anesthetizing Areas

Christine Bergesch BSN, RN, CCRN and Kate Manuel BSN, RN, CCRN

Goldfarb School of Nursing

Barnes-Jewish College

Chair: Sarah Perez

Project Team Member: Julie Spencer

Project Team Member: Rachel Wolfe, Pharm. D., BCCCP

Date of Submission: December 7, 2023
# Table of Contents

Abstract ........................................................................................................................................... 5

Reducing Unsecured Medications in Anesthetizing Areas ......................................................... 7
   Background .................................................................................................................................. 7
   Problem Statement ..................................................................................................................... 9
   Purpose, Aims, and Objectives .................................................................................................. 10
   PICOT Question: ....................................................................................................................... 11
   Significance ................................................................................................................................. 12

Review of the Literature ................................................................................................................... 13
   Search Strategies ...................................................................................................................... 13
   Cost-effectiveness ..................................................................................................................... 14
   Waste and Sustainability .......................................................................................................... 15
   Diversion ..................................................................................................................................... 16
   Safety .......................................................................................................................................... 17
   Effectiveness of Checklists ........................................................................................................ 18
   System Needs ............................................................................................................................. 20
   Evidence for the DNP Project .................................................................................................... 21

Conceptual/Theoretical Framework ................................................................................................. 22
   Methodology .............................................................................................................................. 22
Project Design ................................................................................................................. 22
Health Promotion and Disease Prevention ........................................................................ 24
Stakeholders .................................................................................................................... 24
Resources and Cost-Effectiveness .................................................................................... 25
Project Site ........................................................................................................................ 27
Recruitment/Sampling Strategies ..................................................................................... 28
Ethical Considerations .................................................................................................... 28
Measurement Instruments .............................................................................................. 29
Data Collection Procedure .............................................................................................. 31
Data Analysis .................................................................................................................. 34
Procedures for Project Implementation ........................................................................... 35
Outcomes and Evaluation ................................................................................................. 36
Results .............................................................................................................................. 36
Survey Results ................................................................................................................ 36
Discussion of Findings ..................................................................................................... 40
Strengths and Limitations of Findings ............................................................................ 43
Evaluation of the Process ................................................................................................. 44
System and Practice Impacts .......................................................................................... 46
Implications for Organization and Systems Change ...................................................... 46
Sustainability and Recommendations for Nursing Practice .......................................... 47
Abstract

Background and Review of Literature: Anesthetic medications should be secured consistently to prevent adverse outcomes such as medication errors, drug diversion, and financial loss. Standardized practice for medication stewardship is not established by Washington University Department of Anesthesiology (WUDA). Anesthesia providers’ imprudent medication stewardship practices are a continuous challenge due to the controlled and time-sensitive drugs they provide.

Purpose: The purpose of this quality improvement (QI) project was to decrease the number of medications left behind unsecured in anesthetizing areas, describe the most frequently encountered barriers and category of medications left behind unsecured, and improve knowledge and utilization of the clean-sweep principle.

Methods: Implementation of a clean-sweep visual/cognitive checklist aid supplemented with educational in-services and emails was proposed to prevent unsecured medications from being left behind unsecured in anesthetizing areas. The independent variable was a visual/cognitive checklist aid with educational in-services and emails for providers; the dependent variables were the number and most frequent categories of medications left behind unsecured, the most frequently encountered barriers, and providers’ knowledge and utilization of the clean-sweep principle.

Implementation Plan/Procedure: The implementation plan consisted of pre-intervention, intervention, and post-intervention stages. Pre- and post-intervention data collection included pre- and post-surgical case audits in Barnes-Jewish Hospital (BJH) Pod 3 operating rooms (OR) and the cardiac catheterization lab (cath lab) to be conducted for three weeks to quantify the magnitude of the problem of medications left behind unsecured and to determine post-
intervention case medication practices. A pre- and post-intervention survey was sent to all anesthesia providers to assess perceived barriers to and knowledge of best practices for medication stewardship. Education for the clean-sweep intervention was conducted through educational handouts, disseminated by mass distribution email and in-person education inservices. During the intervention period, visual/cognitive checklist aids emphasizing the clean-sweep were posted in all ORs in Pod 3 and the cath lab.

Implications/Conclusion: The outcome of the clean-sweep intervention aimed to promote medication safety and institutional sustainability by reducing medications left behind unsecured after surgical cases, identifying perceived barriers, and improving providers’ knowledge of medication stewardship practices.

Keywords: waste, return, unused, sustainability, medication stewardship, diversion and secure
Reducing Unsecured Medications in Anesthetizing Areas

At an institutional level, it is essential for healthcare providers to make a cognizant effort to follow hospital guidelines regarding medication stewardship practices while prioritizing patient care. Most hospital policies focus on ensuring patient medication safety by maintaining medications in locked locations; however, anesthesia providers must always have emergency medications available that are essential in a crisis. Despite the organizational promotion of compliance with medication safety policies, medications are frequently left behind unsecured in anesthetizing areas after surgical cases, leading to waste and posing significant safety risks. Policies for promoting medication returns are established to benefit hospital safety, sustainability, finances, and accreditation standards. A knowledge-practice gap is prevalent as anesthesia providers continue unsafe and wasteful habits of leaving medications behind after surgical cases.

Background

Key terms include: waste, return, unused, sustainability, medication stewardship, diversion, secure, unsecure, pods, and Pod 3. Pharmaceutical wastes are defined as drugs and medicines that can no longer be used (Mohammed et al., 2021). Medications that are returned and unused are defined as packages brought back to the pharmacy completely intact (Bekker et al., 2019). Sustainability is defined as the practice of preventing harm to future generations by utilizing resources to fulfill current needs while preserving and enhancing natural resources (U.S. Department of Health & Human Services, 2023). Medication stewardship is an imperative component of nursing education which promotes the safe prescription and administration of medications by focusing on the five rights: right drug, right route, right dose, right time, and right
patient (MLMIC Insurance Company, 2021). For the purposes of this project, medication stewardship is defined as the medication practices that promote the safety and security of anesthetic medications stored in and around the anesthesia workstation (AWS). Diversion is the transfer of a controlled substance from a lawful state to intentional misuse to achieve a desired altered condition (Perry & Vanderhouten, 2019). Medications carry inherent risks because they can be misused, abused, improperly prescribed, and poorly handled. The Joint Commission (2021) defines secure as medications protected from unauthorized access including theft, tampering, or diversion; therefore, unsecured is defined as not protected from theft, tampering, or diversion (Joint Commission, 2021). Throughout this project, the phrase “left behind unsecured” is equivalent to medications left behind and unsecured in and around the AWS. Pods are defined as separate sections of ORs at BJH based on surgical specialty. Pod 3 focuses on the specialty cases including thoracic, cardiac, vascular, hepatobiliary, and transplant cases. Pod 3 expands to the cath lab which serves as a remote anesthesia location in the hospital.

Medication stewardship is a longstanding challenge in healthcare. Barbariol et al. (2021) established that 20-50% of the medications prepared for a patient in emergency scenarios are left unused. The present aim in healthcare for advanced providers is to reduce waste and costs while providing uncompromised patient care (American Association of Nurse Anesthesiology, 2019). The American Society of Anesthesiologists (2018) recognizes a medication stewardship barrier of a lapse in time between transferring the patient after the case and returning or wasting medications. During these lapses, medications are often left
unattended and unsecured in the OR posing a major risk to staff, patients, the institution, and the environment.

The consequences of medications left behind unsecured have patient safety, institutional finance, and environmental implications. There is the potential for medication errors if patients are administered medications not prescribed to them or indicated for their health status; the risk of drug diversion amplifies when medications are left behind leading to impaired providers or insufficient analgesia in patients, all with potential associated patient harm (Fan et al., 2019). Additionally, the institution could face negative financial and accrediting implications related to medication errors and drug diversion. There are independent institutional financial repercussions of unused medications being left behind or wasted improperly, and not returned to the pharmacy. The provider faces consequences as a result of potential punitive institutional repercussions, provider-driven medication errors, and licensure implications related to diversion. Lastly, providers leaving unused medications behind leads to excessive waste, poor sustainability efforts, and environmental detriment.

**Problem Statement**

Washington University Department of Anesthesiology (WUDA) does not have a defined process for reducing medications left behind unsecured. Currently, the WUDA medication safety citations recommend a clean-sweep after each surgical case (see Appendix A), but a process for completing this recommendation or assessing compliance is not established. While pharmacists have noted medications left behind in the OR by WUDA anesthesia providers, the magnitude of the problem has not been fully elucidated. A quality improvement (QI) project in ORs, located in
Pod 3, aims to assess the problem by developing a visual/cognitive checklist aid and educating clinicians on the clean-sweep process.

Best practice for OR medication stewardship involves acquiring medications for the anesthesia provider’s next OR case. Medications are retrieved from the pharmacy and the automated medication dispensing system called the Pyxis and should be secured in the interim. To clarify, Pyxis systems contain life-saving emergency resuscitation medications and clinicians can be weary and reluctant to rely solely on this technology to properly function in the event of an emergency. The Pyxis warning label recommends that emergency medications should be readily available outside the Pyxis (see Appendix B). After the case, all unused medications should be promptly returned to the pharmacy and used medications should be wasted appropriately. Specific strategies that are useful tools for best practice involve automation of processes, labeling medications, utilizing barcode technology, employing pharmacists’ guidance, and system design changes (Meyer & McAllister, 2018). Per discussions with pharmacy leadership, imprudent and inconsistent medication stewardship among WUDA providers in Pod 3 was revealed. Certified Registered Nurse Anesthetist (CRNA) leaders in Pod 3 also indicated that practices of leaving medications behind were apparent in the cath lab. Pod 3 has a high patient acuity requiring a greater volume and variety of medications to be collected for each case and creates a greater risk of leaving medications behind and unsecured.

**Purpose, Aims, and Objectives**

The purpose of this QI project was to improve medication stewardship practices among providers in Pod 3 through a reduction in the number of medications left behind unsecured in between cases (during room turnover) and after surgical cases completed for the day by four
weeks post-intervention. The aims for the project were as follows: 1. Gain clarity on the providers’ perceived barriers to best medication stewardship practices, 2. Complete 50 pre-intervention assessments to quantify the amount and type of medications left behind unsecured in Pod 3 ORs, 3. Administer pre- and post-intervention surveys to collect data on knowledge of the clean-sweep/best practices and perceived barriers, 4. Complete four in-person educational sessions along with emailed educational materials for all anesthesia providers on the clean-sweep initiative and best practices for medication stewardship, and 5. Conduct 50 OR assessments post-education at one-, three, and five weeks to quantify the number and type of medications left unsecured.

The objectives for the project were as follows: 1. To describe the most frequent categories of medications left behind and unsecured pre- vs. post- intervention, 2. To decrease the number of medications left behind by 20%, 3. To describe the most frequently encountered barriers (ranked always, often, sometimes, rarely, or never) pre- vs post-intervention, 4. Increase the number of survey respondents who are aware of the clean-sweep principle to 80%, and 5. Increase the number of survey respondents who utilize the clean-sweep principle to 50%.

**PICOT Question:**

In anesthesia healthcare providers working in Pod 3 at Barnes Jewish Hospital (P), will a clean-sweep visual/cognitive checklist aid supplemented with educational sessions, handouts and emails compared to no checklist (I), reduce the number of medications left behind unsecured in
anesthetizing areas, identify and reduce perceived barriers, and improve knowledge of best practices (O) over a three-month period (T)?

**Significance**

Medication stewardship is a consistent and fundamental problem in hospitals. Medications left behind unsecured by anesthesia providers in ORs lead to adverse outcomes. Risks associated with medications left behind unsecured include medication errors and diversion impacting the patient and provider. Unused medications that are wasted increase hospital costs and negatively affect the environment due to increased production of waste. Not properly returning unused medications to pharmacy after a case places anesthesia providers at risk of giving the wrong medication to the wrong patient. Among the 105 medication errors identified in one study, incorrect dose (55%) and incorrect medication (28%) were the most frequently observed errors (Leahy et al., 2018).

When medications are left behind unsecured and/or not returned to pharmacy or wasted properly, this creates opportunity for drug diversion. Van Pelt et al. (2019) estimate that 1 in 10 CRNAs will misuse medications or alcohol in their careers. Providers who divert drugs face the dangers of overdose and death, along with professional repercussions involving license censure, criminal prosecution, and lawsuits for professional misconduct. (Van Pelt et al., 2018). Patients suffer when they receive inadequate pain relief due to insufficient analgesia or substandard care provided by impaired anesthesia providers (Fan et al., 2019). The disease of addiction can cause anesthesia providers to divert drugs from their patients, placing the patient at risk for pain and remembering events while under anesthesia (Van Pelt et al., 2019).

The financial burden of poor medication stewardship is estimated at more than $5 billion in institutional losses annually (Smale et al., 2021). The financial impact of preventable
anesthetic drug waste is over $185,000 for medical institutions but can be decreased by reducing specific medication wastage (Atcheson et al., 2016). Selecting the proper medications for patients in the OR requires precise and timely decisions. These judgments require hypervigilance and forethought to be prepared for potential patient complications. Considering that 10-13% of a hospital’s pharmacy budget is consumed by anesthesia departments, the identification of contributing medication costs is imperative to explore (Barbariol et al., 2021).

Medical waste also has a profound effect on the environment. The United Nations has shown evidence of the earth’s gradual warming resulting in increased wildfires and droughts as a result of human activity (Kushnir, 2020). Medical facilities play an immense role in medical waste. Of the 5.9 million tons of waste created by hospitals annually, 20-33% was from ORs alone (Kushnir, 2020). Anesthesia provider’s pharmaceutical waste is a major contributor to OR wastage. Improving provider cognizance of the implications of their unproductive waste can create a constructive impact in the field of anesthesia to benefit healthcare organizations and the planet globally.

Review of the Literature

Search Strategies

Google Scholar, PubMed, and CINAHL journal databases were searched. Search criteria were limited to the past five years and written in the English language. Key search terms were medication stewardship, unsecured medications, operating room, medications left behind, medication waste, medication errors anesthesia, operating room checklist, medication checklist, safety checklist and anesthesia checklist. Boolean Operators “and” and “or” were used to combine terms. Articles were rated for strength of evidence and quality using the John Hopkins Evidence Level and Quality Guide (Hopkins Medicine, n.d.). The search terms
yielded 82 articles which were further refined by evidence strength and applicability to the project to include 17 articles in the review of literature. The resulting evidence led to five themes: cost-effectiveness, waste and sustainability, diversion, safety, and effectiveness of checklists.

**Cost-effectiveness**

Five articles illustrated the cost of specific anesthetic medications, with propofol being the most consistent contributor. Kaniyil et al. (2017) and Peker et al. (2020) examined drug loss at the end of each OR day. Kaniyil et al. (2017) conducted a prospective study with strengths in the volume of OR cases and limitations of excluding drugs rarely voided in the sharps bin and volatile anesthetics. The amount of medication left behind was multiplied by unit prices to calculate the results (Kaniyil et al., 2017; Peker et al., 2020). Peker et al. (2020) attributed the greatest total medication waste to rocuronium ($493.75), propofol ($454.27), and thiopental ($317.49). Peker et al. (2020) conducted a prospective observational study with strengths of the anesthetists being blinded to the study and limitations of excluding volatile agents. In comparison, a prospective study found that vecuronium generated the greatest fiscal loss of $20,997 (Kayinyil et al., 2017). Kayinyil et al. (2017) also found propofol to be a major contributor to drug wastage, with costs totaling over $19,867 (Kayinyil et al., 2017). Gordon (2020), Barbariol et al., (2020) and Atcheson et al., (2016) confirm these studies, finding that propofol was the most wasted and costly medication by volume.

Routine anesthesia practice involves preparing atropine and ephedrine for almost every OR patient case. Atcheson et al., (2016) detail that medications prepared for emergency situations are wasted over 50% of the time. The preparation of atropine and ephedrine emergency medications not used leads to consistent financial losses (Kaniyil et al., 2017; Peker
et al., 2020). Atcheson et al. (2016) confirmed that ephedrine accounted for 59.5% of emergency medication financial loss. Gordon (2020) validates these findings that atropine and ephedrine exhibit the highest waste fractions for emergency management.

**Waste and Sustainability**

Medication wastage is unavoidable in anesthesia (Gordon, 2020). The United States (U.S.) ranks as the world’s second-largest producer of greenhouse gas emissions with the healthcare industry accounting for 10% of its total emissions (Gordon, 2020). Environmental implications of improper waste disposal include loss of biodiversity, increases in atmospheric carbon dioxide emissions to unprecedented levels, and spread of infectious diseases leading to the declining health status of the population (Gordon, 2020). Barbariol et al. (2021) conducted an observational multicenter study evaluating drug wastage in 12 hospitals’ ORs over 1 month. Results revealed significant drug wastage including evidence that 38% of drug syringes are wasted without use (Barbariol et al., 2021).

Barbariol et al. (2021) recorded 7.9 L of propofol waste throughout the observational study over 11 months. Atcheson et al. (2016) observed that propofol accounts for 45% of wasted anesthetic medications. Propofol is a detriment to the environment because it does not degrade, accumulates in living organisms, spreads easily in soil, and is highly toxic to aquatic life. Since propofol cannot break down in water or without oxygen, it must be burned for complete destruction in the disposal process (Barbariol et al., 2021). With consideration of the environmental toll that incurs when medications are left behind and wasted, it was paramount that this issue was addressed, and a viable solution is found. Barbariol et al. (2020) and Atcheson et al. (2016) conducted a prospective observational multicenter study with limitations
of being a retrospective design and strengths included minimized selection bias and generalizability.

**Diversion**

There is an increased risk for provider diversion and consequences to patients when medications are left behind unsecured. Van Pelt et al. (2019) offered a workshop with informational presentations by diverse stakeholders and a multidisciplinary panel of experts that provided information on patient and healthcare worker safety related to drug diversion. Diversion of controlled substances is a multi-victim crime that negatively affects patients, coworkers, providers, institutions, and the public (Van Pelt et al., 2019). Unfortunately, the disease of addiction poses the greatest risk for anesthesia providers (Van Pelt et al., 2019).

Before the peak of the opioid epidemic, 80% of U.S. anesthesiology residency programs reported an experience with opioid-impaired residents (Bryson et al., 2008). However, self-diagnosis is rare and substance use disorders are often undiscovered until overdose occurs or CRNAs are reported by colleagues (Van Pelt et al., 2019).

Diversion has a system-wide impact on organizations including costs for internal investigations and providing ongoing care for affected patients and providers (Fan et al., 2019). Fan et al. (2019) conducted a scoping review with strengths of generalizability and limitations of reviewing articles published no later than the past 15 years. Institutions can be subject to penalties of over $4 million for insufficient safeguards (Fan et al., 2019). To maintain safeguards, screening suspected providers can cost up to $290 for a urine sample and more than $1,000 for a hair sample (Bryson et al., 2008). Bryson et al. (2008) conducted a study for residents treated for addiction attempting reentry into clinical practice with limitations of a small sample size. When safeguards fail, opioids may be altered by healthcare professionals.
(Schaefer & Perz, 2014). Schaefer & Perz (2014) reviewed records at the Centers for Disease Control and Prevention related to drug diversion infection outbreaks with strengths of the longer length of time for outbreaks to be identified and limitations including lack of meta-analysis. In a multicenter study, a hospital revealed gram-negative bacteremia in 34 patients when their patient-controlled analgesia pumps were tampered with by opioid addicted nurses (Schaefer & Perz, 2014). The community also suffers due to decreased confidence in healthcare organizations (Fan et al., 2019).

**Safety**

Medical errors are the third leading cause of death in the U.S. (Leahy et al., 2018). The errors create harm including death and severe disability for over 1.5 million patients per year (Anderson & Townsend, 2015). Anesthesia providers’ imprudent practice of leaving medications behind can contribute to the administration of the wrong medication for the wrong patient. During an 8.5-year study, 105 pediatric anesthesia medication errors were examined, and 28% of them were a result of the incorrect medication given (Leahy et al., 2018). Connor et al. (2016) examined 124 medication errors that occurred over one month in a critical care cardiac unit (CCU) and found that administration of the wrong medication was among the highest-ranking errors. This study illustrates that over 4 medication errors occurred per day in the CCU. Throughout a direct observation study, 153 preventable medication errors took place from 3,600 medication administrations (Nanji et al., 2016). Almost half of these errors resulted in direct patient harm or had the opportunity to create patient harm (Nanji et al., 2016).
Anderson & Townsend (2015) and Leahy et al. (2018) conducted retrospective studies with strengths of the number of cases reviewed and limitations of the voluntary reporting system.

Effectiveness of Checklists

Standardizing performance allows tasks to be completed systematically without relying on human memory and by reducing interruptions and error. Aviation checklists are created to streamline a single process and create optimal performance (Linskens et al., 2021). Checklists are created in aviation for emergencies, “non-normal” and “normal” procedures. In anesthesia, checklists have been adopted as effective tools in vital everyday operations (Linskens et al., 2021). In a human experiment, twelve commercial pilots improved completion time with the electronic checklist by over 10% when electronic and hydraulic failure occurred (Linskens et al., 2021). An example of a checklist improving patient care and safety is a visual safe surgery checklist that improved the administration of antibiotics before induction, before incision and prior to the patient leaving the OR (Singh, 2009). Singh (2009) conducted a case report with strengths of experiential reporting and limitations of the limited evidence provided. Additionally, among acute care hospitals surveyed on the World Health Organization (WHO) Surgical Safety Checklist implementation, 77% reported an increase in teamwork, 68% reported improved safety, and 41% prevented potential errors (Collins et al., 2014). Collins et al. (2014) conducted a literature review with strengths of the number and variety of databases utilized and limitations of the details of analysis. The use of cognitive aids allows aviation and healthcare to operate effectively while maintaining safety.

Saxena et al. (2020) conducted a quasi-experimental, quantitative meta-analysis with over 874 identified articles on anesthesia-specific checklists and strengths of heterogeneity between studies and limitations of the number of subjects of the studies. Provider handoffs and
routine anesthesia procedures were evaluated with and without the use of checklists. While there was heterogeneity between these studies, Saxena et al. (2020) found 92% of the studies have shown that the use of checklists in anesthesia can decrease human error, improve patient safety, enhance teamwork, and increase quality of care. Merali et al. (2008) conducted a medication safety project for ORs with strengths of numerous specific recommendations made to enhance safety and limitations of the efficacy of the recommendations not yet proven by formal research. Merali et al. (2008) demonstrates that a system without double-checks must employ a check-list system for high-alert medications and prompted the development of checklists for any high-risk procedures. Further, 20% of the studies reported improvement in clinically relevant outcomes, 12% of studies reported a decrease in perioperative mortality, and 8% of studies reported a decrease in perioperative complications related to the use of checklists (Saxena et al., 2020). Additionally, 15 of the 17 studies in the meta-analysis that examined routine anesthesia procedure checklists (88%) revealed a benefit of checklist implementation (Saxena et al., 2020).

Weaknesses of the systematic review were based on limited studies with small sample sizes that led to selection and performance biases as well as publication bias especially for studies with negative reviews, leading to a lack of consensus regarding checklists (Saxena et al., 2020). Due to the limited articles and reliability and validity testing available from these small-scale studies, large-scale studies are needed to identify the optimal checklist and implementation methods (Saxena et al., 2020). The positive effects of using checklists in
healthcare included enhanced communication, operations, and patient safety (Linskens et al., 2021; Saxena et al., 2020; Singh 2009).

**System Needs**

Quantifying the number of medications left behind unsecured was not currently measured at the hospital where this project was completed. The Joint Commission requires “the hospital stores all medications, including controlled (scheduled) medications, in a secured area to prevent diversion and locked when necessary, in accordance with law and regulation” (see Appendix I). While leadership was accompanying the surveyor at BJH in 2022, it was noted that albumin 10% was stored in the unlocked anesthesia supply computer cart which is against organization policy. Outside of standard Joint Commission accreditation standards, there are no clearly articulated anesthesiology department policies regarding correct medication stewardship. Absent policies regarding the proper storage and placement of medications allowed medication stewardship to continue unregulated. The depth of the current problem was communicated to staff members during the four provider education sessions through handouts and emails, after being identified by assessment and analysis.

If imprudent medication stewardship continues unabated, then patients are at risk for medication safety errors which can lead to direct patient harm. The clean-sweep visual/cognitive aid checklist can decrease medications left behind unsecured throughout the
hospital. Increased provider adherence may create unit and departmental change to improve medication stewardship.

**Evidence for the DNP Project**

The benefits of checklists in healthcare have been extensively documented from the literature which informed the development of the visual/cognitive checklist aid for the QI project. The six studies expanded on above, consistently demonstrated the positive impact of checklists on healthcare practices. More specifically, Saxena et al. (2020) and Merali et al. (2008) studies were used as the evidence for this QI initiative because they distinctly demonstrated an improvement in patient safety and increased quality of care in anesthesia with checklist use. A key advantage of checklists is the ability to promote a standardized process with optimal performance. By outlining a clear set of steps, checklists ensure healthcare professionals follow a consistent, evidence-based approach to patient care. This standardization in practice helped reduce variation and ensured essential actions are taken, leading to improved quality of care and better patient outcomes (Linskens et al., 2021). Further, checklists play a crucial role in error reduction and patient safety. While anesthesia providers are extensively educated and experienced, their unique sole responsibility of prescribing, dispensing, and administering anesthetic medications while monitoring patients places them at greater risk for error (Merali et al., 2008). By providing a structured framework, checklists act as cognitive aids for providers to remember critical steps, verify information, and avoid mistakes (Linskens et al., 2021). Additionally, checklists contribute to enhanced communication and teamwork leading to increased efficiency. By providing a common language for discussions, all team members become aligned and aware of responsibilities, reducing misunderstandings, and fostering an efficient, collaborative environment. By streamlining workflows with checklists, redundancies
were prevented, which improved resource allocation and allowed providers to focus on critical
tasks contributing to more timely patient care (Saxena et al., 2020). Based on the vast evidence
presented, the decision to create a visual/cognitive checklist aid was a logical, necessary step to
improve medication stewardship, reduce the number of medications left unsecured, enhance
safety and quality of care, and optimize processes.

**Conceptual/Theoretical Framework**

The Institute for Healthcare Improvement (IHI) utilizes the Model for Improvement
which includes 4 steps: Plan, Do, Study, Act (PDSA) (see Appendix C). Plan was preparing the
survey and Excel spreadsheet, collaborating with project chairs and creating education for
anesthesia providers. Do was pre-education audits, survey and education, and post-education
audits and survey. Study was audit and survey data analysis to determine if there was sustained
improvement. Act was implementing the improvement in the organization (Institute for
Healthcare Improvement, 2023). The PMs planned to accomplish a reduction in medications left
behind unsecured, identification of perceived barriers, and improvement in provider knowledge.
Post-intervention assessments revealed a decrease in medications left behind unsecured and
surveys showed a decrease in perceived barriers and improved knowledge when compared to
pre-intervention assessments. Introducing a visual/cognitive checklist aid was a deliberate
change aimed at achieving improvement. The Model’s steps of evidence-based project
implementation, PDSA, will be discussed in Methods.

**Methodology**

**Project Design**

The QI project utilized an intervention of a visual/cognitive checklist aid supplemented
with provider education on the clean-sweep initiative to address the imprudent medication
stewardship practice in Pod 3 ORs. First, quantitative methods of 50 OR observations were used to collect pre-intervention data at the identified practice site, Pod 3 ORs including the cath lab. Audits of medications left behind were performed with medications categorized and quantified and the pyxis was assessed as locked or unlocked. Next, the pre-intervention survey was emailed to all anesthesia providers practicing at WUDA. Pre-intervention data collection was completed prior to emailing the survey in order to minimize bias. This survey tool collected data on provider current practices, barriers and safety implications of medication stewardship. After pre-intervention data collection was complete, the clean-sweep visual/cognitive aid checklist was implemented along with the educational sessions. Education was in-person as well as distributed via email to all WUDA members. The education sessions entailed the current policy, background information on patient, provider, institution, and environment safety implications, as well as the data findings and current clean-sweep initiative. The clean-sweep cognitive/visual aid checklists were placed on all Pyxis in Pod 3 and cath lab. Post-intervention data collection audits occurred in the same fashion as pre-education to collect quantitative data on medications left behind and unsecured. The same survey that was distributed pre-education was emailed to anesthesia providers post-education to assess provider beliefs and barriers post-education intervention. One additional question was added post-intervention asking providers to report if they received education on the clean-sweep initiative and medication stewardship and the route, (in person or email). Comparisons of data evaluated the effectiveness of the visual/cognitive checklist aid and education.

Throughout the project, PDSA was the guiding framework. The “plan” included survey and Microsoft Excel spreadsheet preparation, collaboration with project chairs, and education creation for anesthesia providers. The aim of the project plan was to reduce the number of
medications left behind unsecured, reduce perceived barriers, and provide education on the clean-sweep process.

*Health Promotion and Disease Prevention*

Implementation of the clean-sweep initiative provided a dual opportunity for health promotion, benefitting both providers and patients. Medications left behind unsecured create tempting opportunities for diversion, which could have resulted in independent physical harm, legal license implications, and criminal charges (Van Pelt et al., 2018). By improving medication stewardship practices, providers have fewer opportunities for drug diversion, thus promoting patient and provider health. Patients suffer from provider diversion when they receive inadequate pain relief due to insufficient analgesia or substandard care provided by impaired anesthesia providers (Fan et al., 2019). Moreover, when medications are left behind, the heightened risk for medication errors to occur compromises patient safety. Imprudent medication stewardship leads to leftbehind medications, putting anesthesia providers at risk of giving the wrong medication to the wrong patient (Leahy et al., 2018). By decreasing medications left behind unsecured, the incidence of errors can be reduced, promoting patients’ health.

*Stakeholders*

While anesthesia providers were hesitant to alter their practices, stakeholders had a positive influence on providers and favored change due to the impact on safety, finances, and stewardship. Institutional stakeholders included providers employed by WUDA, especially CRNAs and anesthesiologists within Pod 3. Project stakeholders included Kate Manuel and Christine Bergesch, who are Student Registered Nurse Anesthetists (SRNAs) and Project Managers (PMs). The project team chair and members included Dr. Sarah Perez, Dr. Julie
Spencer, and Dr. Rachel Wolfe. Leadership stakeholders included David Eisenbath and Erin Herrera who are directors for CRNA operations at WUDA. Support and buy-in from Pod 3 leaders was crucial to encourage the adoption of the intervention by anesthesia providers in the department.

**Resources and Cost-Effectiveness**

Budget analysis was conducted by analyzing direct costs, material and supply costs, technology hardware and software necessary for data analysis. Direct costs were associated with professionals’ salaries and anticipated time expenditure dedicated to the project. Ultimately, required resources such as software, laminated posters, printed fliers, and baked goods were low-cost. The greatest expense was the professional’s hourly salary required for education time. As identified in the review of literature, this QI project has safety and medication error implications. Medication errors cause at least one death daily and injury to 1.3 million people each year in the U.S. Globally, the costs associated with medication errors is estimated to be $42 billion annually (World Health Organization, 2017). In addition, the cost of drug diversion to public and private medical insurers alone is estimated to be greater than $72 billion per year according to the U.S. Department of Justice National Drug Intelligence Center (Giuffre, 2020). Further, the costs to the environment from medication waste total over $5 million annually (Vaccari et al., 2018). Costs must be considered along with the project aims to reduce financial burden and the disastrous environmental detriment. Project objectives, which include reduction of medications left behind unsecured as well as perceived provider barriers and promotion of best practices for medication stewardship, align with the mission and vision of WUDA to promote safety and sustainability. The anticipated and expected benefits of the project outweighed the cost incurred.
Direct cost benefits included increased institutional financial savings as a result of less medications left behind unsecured. Intangible cost benefits included improved provider morale.
due to refined organization of workspaces. Competitive cost benefits included being a leader of change in medication stewardship among other teaching hospitals.

**Project Site**

The project was conducted within the Washington University in St. Louis School of Medicine (WUSM) Department of Anesthesiology at BJH, a metropolitan, level I trauma academic institution with 1,273 staffed beds that serves the community of Saint Louis, Missouri (BJC HealthCare, 2022). Specifically, this project took place at BJH’s south campus ORs and anesthetizing locations in Pod 3 and the cath lab. The BJH ORs are separated based on surgical specialty and patient acuity into Pods. Pod 3 performs thoracic, cardiac, vascular, hepatobiliary and transplant cases. Pod 3 expands to the cath lab, which serves as a remote anesthesia location in the hospital. Based on stratified random sampling from EPIC, on average, 18 cases occur per day in POD 3 and 30 cases occur per day in the cath lab. Pod 3 was examined and chosen as the implementation unit due to the numerous and various medications that are used. Higher patient acuity and high-risk surgeries allow for more adverse intra-operative events to occur and require more medications to be prepared and stored preemptively. Discussions with leaders at both WUDA and BJH pharmaceutical divisions corroborated these facts revealing that medications are frequently found left behind unsecured in Pod 3 ORs and found by pharmacy technicians at end-of-day rounding. Observation of medication stewardship practices was not impeded by short staffing or workload variance.

**Population**

Participants in this project design included all anesthesia providers; this was inclusive of CRNAs, attending anesthesiologists, residents, fellows, and SRNAs working in Pod 3. The
hospital provides valuable personnel resources that are trained and engrained in a continuous learning environment. Personnel that have a natural propensity for education are more likely to be receptive to changes in practices. This project design excluded external surgery-based healthcare providers, including anesthesia technicians, registered nurses, pharmacy technicians, environmental services, surgical technicians, medical device representatives, and surgeons.

**Recruitment/Sampling Strategies**

Recruitment procedures included advertising the educational sessions through mass email distributions, flyer postings, and subsequent email reminders with dates, times and locations. The email list of all currently practicing anesthesia providers was acquired through Microsoft Office and reviewed by Maureen Arends to ensure the inclusivity of all employed providers. The email directory of “ANEST ALL” email included all anesthesia providers and students. This email recruitment strategy was utilized for both pre- and post-intervention surveys, announcing the educational sessions as well as online dissemination of educational materials.

**Ethical Considerations**

This project underwent evaluation by the Human Research Protection Office (HRPO), during the proposal phase and the project was determined to be a QI initiative. With this QI designation, submission to the Washington University Institutional Review Board (IRB) was not necessary. Project approval through a written letter was received by the Director of Perioperative Safety and Quality at BJH prior to implementation. The PMs and other project facilitators followed the Standards of Care for practice within BJH and related departments. Aggregate data was collected in a fashion that did not include patient identifiers or patient data from surgical cases. This QI project did not interact with patients or interfere with patient care. No patient-
protected health information was obtained, therefore, risks to patient confidentiality were minimal to zero. The survey question regarding gender ensured inclusivity by including options for male, female, non-binary, prefer not to answer, and an option to free-text. Demographic information was used to describe the project sample. Any indication of specific provider identifiers were reviewed and securely eliminated immediately after the survey. No provider identifiers were collected on the survey; surveys were assigned a number for recording purposes only. The language on the survey was in English, easy to understand for everyone, and inclusive of all age groups, cultures, and genders. While completing the assessment of medications left behind in ORs, there was not any exclusion of anesthesia providers or rooms within Pod 3.

**Measurement Instruments**

To measure the outcomes of this QI project, an electronic quantitative survey with a Likert-type scale (see Appendix D) and an Excel spreadsheet for data collection (see Appendix E) was developed and employed. All anesthesia providers, including anesthesiologist attendings, fellows, residents, CRNAs, and SRNAs, were emailed the survey. The survey was administered pre- and post-intervention in electronic format using Qualtrics software. The survey tool collected demographic information of the respondent including gender, age, type of provider (CRNA, resident, anesthesiologist, SRNA), years in anesthesia practice, and specialty area. The Likert-type scale was used to assess providers' knowledge, attitudes, and barriers to evaluate medication stewardship practices. The survey included statements on knowledge of medication protocols and practices with options for providers to choose from including strongly agree, agree, neither agree nor disagree, disagree or strongly disagree. Questions were also included to allow the respondent to rank the perceived barriers and priorities. The content of the survey was
developed in response to current WUDA protocols and observed practices and attitudes of anesthesia providers. This was conducted as a joint survey with the Propofol Disposal project group due to the similarity of subjects and to encourage participation by reducing the provider burden of completing multiple individual surveys. The pre- and post-surveys reflected the same questions, while the post-survey included an additional question to indicate if providers received the education, whether in-person or online. To establish survey content validity, three unbiased experts in education and anesthesiology conducted individual assessments of the survey tool. Once survey validity was ascertained, the tool was integrated into Qualtrics. Qualtrics was chosen to input survey questions and allows electronic data collection. To establish reliability of the tool in Qualtrics the test-retest method was utilized. This was accomplished by having the three anesthesia providers take the survey twice, one week apart, to evaluate the consistency of responses.

A data collection tool was developed by the PMs to standardize the OR audit process for both pre- and post-intervention data collection. A Microsoft Excel spreadsheet was developed to quantify and categorize medications left behind unsecured pre- and post-intervention (see Appendix E). For each assessed case, the spreadsheet addressed the following components that were then recorded: 1. Overall number of medications left behind, 2. type of medication (i.e., local anesthetic), 3. Pre-mixed or pharmacy compounded and 3. Pyxis security—locked or unlocked. In order to not duplicate data, each individual case could only be counted once. The
Excel spreadsheet was developed to reflect BJC pharmacies and Goldfarb School of Nursing’s categorization of medications.

**Data Collection Procedure**

*Pre-Intervention*

Pre-Intervention data collection occurred via medication audits by entering Pod 3 ORs (including the cath lab) only after the patient and providers exited the room; in essence, room turnover time was utilized for data collection. The PMs did not interfere with patient care. Timing of OR entry by the PMs was facilitated by monitoring the status board. The status board provided a visual indication of room turnover as well as an overhead speaker indicating to ancillary departments the need for room turnover. The PMs observed the status board and Pod 3 staff to correctly time post-case assessment of medications left behind unsecured and ensured assessments were occurring during room turnover time when providers exited the room. The goal was to complete data collection over 2 weeks with a minimum of 50 OR cases audited. The PMs collected data through convenience sampling mid-day during room turnover and at the end of PMs’ clinical days on Wednesday, Thursday, and Friday as well as on non-clinical days on Monday and Tuesday. The PMs ensured data collection occurred approximately half of the time in Pod 3 ORs and approximately half of the time in the cath lab. A systematic, consistent process of data collection was utilized by both PMs to observe and document medications left behind unsecured which included looking at these areas in the following order: first the top surface and drawers of the AWS, next, the main surface of the Pyxis, and last, the main surface of the anesthesia supply cart (see Appendix F).

Inter-rater reliability was used to ensure consistent and reliable means of data collection. A PM mobilized to an OR, conducted their counting, left the OR and then the other PM
completed the same procedure in the same OR. After completing their counts separately, PMs compared their assessments to ensure an exact match. PMs audited each other’s data collection on 3 incidences. Two incidents occurred in separate Pod 3 ORs, and one incident occurred in the cath lab.

Throughout data collection, PMs did not interfere with provider’s practice and did not manipulate left behind medications. After quantifying and categorizing left over unsecured medications in each OR, the data was carefully documented on the Excel spreadsheet. The Excel spreadsheet organized the PMs data, to act as the ongoing record of medications left behind and was reviewed by both PMs to confirm accurate recording of entries. The PMs ensured the quantification of medications without interference of patient care or removal of medications found.

After pre-intervention medication audits were completed, an electronic pre-intervention survey was distributed via email to establish the anesthesia providers’ current medication removal, disposal practices, and their perceived barriers to and knowledge of best practices. Anesthesia providers had two weeks to complete the survey.

Intervention

As discussed previously, the PDSA was incorporated throughout the project as a guiding framework. “Do” included pre-education audits, survey and education, and post-education audits and survey. In-person educational services occurred after completion of the pre-intervention survey. Since all anesthesia providers practicing in Pod 3 ORs were targeted for this QI initiative, four 60-minute in-service education sessions were conducted in three different anesthesia break rooms and lounges. Flyers were posted one-week in advance that detailed the
timing and location of education sessions throughout highly trafficked anesthesia areas to encourage participation (see Appendix G). Three different break rooms located across BJH campus were utilized for educational sessions in an attempt to reach as many providers as possible. The location consisted of south campus (2nd and 3rd floor anesthesia lounge and resident lounge), as well as one break room in Parkview Tower. The clean-sweep visual/cognitive checklist aid cards were displayed, laminated and placed on Pyxis work areas in Pod 3 and the cath lab (see Appendix G). To further encourage participation, breakfast and other snacks were offered at the educational sessions. An email included a summary of the clean-sweep initiative that was sent to all providers coinciding with the timing of in-person education. The same emailing method for the survey was used to ensure all providers received the education via email. At conducted educational sessions, utilizing clean-sweep education handouts, providers received education to prevent medications left behind unsecured. The handouts included education on the current established policy, background patient, provider, institution and environment safety implications, as well as PM’s data findings and the clean-sweep initiative (see Appendix G).

Post-Intervention

The PMs monitored the status board and Pod 3 staff to time post-case assessment of medications left behind. Post-case room turnover time was utilized for data collection. Post-intervention data collection occurred at one-week, three-week and five-weeks post-intervention. During each week of post-collection data, the goal was to complete data collection in 17 ORs to incrementally reach the goal of 50 OR cases. After 17 ORs have been assessed each week, data collection will stop for the week. The PMs collected data by convenience sampling at the end of PMs’ clinical days on Wednesday, Thursday, and Friday and non-clinical days on Mondays and
Tuesdays. Each week the PMs ensured data collection occurred approximately half of the time in Pod 3 ORs and approximately half of the time in the cath lab. The systematic, consistent process of data collection was utilized once again by both PMs to observe medications left behind unsecured. Proper securement of medications in the Pyxis was assessed by checking if the Pyxis had been locked. Due to the pre-intervention assessment procedure established, the inter-rater reliability practice was not conducted for post-intervention. The post-survey assessment was distributed through e-mail immediately after completion of one-week post-intervention audits and was open for two weeks.

Data Analysis

In conceptual framework, the PDSA cycle was referenced as our guiding principle. The “Study” portion was to audit and survey data analysis to determine if there was sustained improvement and SPSS Statistics version 28.0.1.0 was used to analyze data. Inferential and descriptive statistics were utilized for this project. The visual/cognitive checklist aid was the independent variable. The number and category of medications left behind unsecured, and the number of perceived barriers and provider knowledge were the dependent variables. Nominal provider demographic data and provider experience level were described as percentages, and percentages for each age group of providers were calculated. Data collection for the project included the survey responses as well as pre- and post-intervention data of numbers and categories of medications left behind per case. Survey responses pre- and post-intervention were analyzed using descriptive statistics, chi-square and Mann-Whitney tests. Chi-square and Mann-Whitney tests were utilized to assess statistically significant changes between categorical and ordinal variables, respectively, in the pre- and post-intervention groups. The level of statistical significance was set at .05 ($\alpha = .05$). Numbers and categories of medications were analyzed
using proportions and chi-square tests. Data analysis included relationships among variables which determined how effective the intervention was at meeting the project’s objectives. A bar chart, histogram and line graft were utilized to display the data results.

**Procedures for Project Implementation**

The timeline of the project from start to completion spanned one year (see Appendix I). All project timeline components were planned to be completed in 2023. To summarize the timeline, the clean-sweep project proposal was presented in March to the WUDA/BJH Science Garage Committee. The pre-intervention baseline assessment of medications left behind unsecured occurred over two weeks and pre-intervention survey data was sent and collected over 2 weeks. Evaluation of results of pre-intervention assessments also occurred at this time. Analysis of survey data and email invitations for in-services occurred for 2 weeks. Clean-sweep education distribution to providers took place for 1 week. Post-intervention assessment of medications left behind unsecured was conducted over 3 weeks. Audit sessions occurred at one-week, three-week, and five-week intervals. Post-intervention survey distribution and collection occurred for 2 weeks. Statistical analysis, presentation of the project to key stakeholders, and final documentation occurred between September to December.

All education and assessment instruments were inclusive of all age groups, cultures and genders. During the intervention process, in-service meetings were inclusive of all cultures and beliefs on the topic. There was no exclusion by role, language, gender, and culture. All present entities were treated equally during the meetings conducted. The language was in English and clear, designed for easy understanding to ensure literacy and inclusivity among all age groups.
and genders. Clinician's use of the clean-sweep was not influenced by provider's religion or culture.

**Outcomes and Evaluation**

*Results*

*Survey Results*

For the pre-intervention survey, there were 73 respondents compared to 46 respondents for the post-intervention survey. Demographic data collected through survey respondents included gender, age, type of provider (CRNA, resident, anesthesiologist, student), years in anesthesia practice and speciality area. In terms of the pre-intervention sample (N = 73) the majority was female (56%, n = 41), in the 31 to 45 age group (56.2%, n = 41), working for 10+ years in the anesthesia profession (35.6%, n = 26) as a CRNA (52.7%, n = 39) in the specialty area known as float (39.4%, n = 28). For the post-intervention sample (N = 46), the majority were female (48%, n = 22), between 31 to 45 age (54.3%, n = 25), in practice for 2-5 years (32.6%, n = 15) as a CRNA (73.9%, n = 34), and in the float specialty area (50%, n = 22). Chi-Square calculations revealed no statistically significant difference between pre- and post intervention groups (p > 0.05), hence allowing comparison of survey respondents pre versus post.

For the pre- and post-intervention survey, providers were asked to respond to statements pertaining to their perioperative medication stewardship best practices on a Likert-type scale with the five options: strongly agree (1), agree (2), neither agree nor disagree (3), disagree (4), and strongly disagree (5). The majority of providers (pre: 68.9%, n = 40, mean = 2.3; post: 86.4%, n = 32, mean = 1.81) strongly agreed or agreed that they were aware of the current WUDA best practices or procedures for perioperative medication stewardship for both the pre- and post-intervention survey. The mean for pre-intervention survey is correlated with agree and mean for
post-intervention survey is correlated with agree. For the question, “I believe current policy and procedures of WUDA at BJH allow anesthesia providers appropriate time and space to properly secure medications between operative cases,” the majority strongly agreed or agreed with this statement (pre: 41.3%, n=24, mean: 2.33; post: 51.4%, n=19, mean: 2.65). A mean 2.33 for pre-intervention would be interpreted as agree nor disagree and a mean of 2.65 for post-intervention would be interpreted as neither agree or agree nor disagree. For the statement, “I have heard of the WUDA at BJH principle called clean-sweep,” evaluation of the majority of providers responses identified that they were indifferent by answering agree nor disagree (pre: 63.8%, n=37, mean = 3.53) to this statement for the pre-intervention survey, while the post-intervention survey, revealed that a majority of providers strongly agreed (post: 32.4% , n=12) or agreed (post: 56.7%, n=21) that they have heard of the WUDA at BJH principle called the clean-sweep (mean =1.89). The mean for pre-intervention data would be interpreted as neither agree nor disagree or disagree while the mean for post-intervention data would be interpreted as agree. When asked pre-intervention if providers “currently utilize the clean-sweep principle to reduce medications left behind and unsecured in and around the anesthesia workstation”, the majority (39.6%, n=23, mean=2.81) of providers neither agreed nor disagreed with the statement. In contrast, when asked the same statement for post-intervention, the majority of providers (94.6%, n=35, mean=1.78) strongly agreed or agreed that they currently utilize the principle of the clean-sweep (see Appendix J, J8). The mean for pre-intervention data would be interpreted as neither
agree nor disagree while the mean for post-intervention data demonstrates that providers strongly agree or agree to currently utilizing the clean-sweep principle.

Providers were then asked to rate barriers to medication stewardship practices (safety and security of anesthetic medications) pre- and post-intervention including the frequency in which providers encountered barriers on a Likert-type scale of five for always, four for often, three for sometimes, two for rarely, and one for never. The most frequently encountered barriers remained consistent for both pre- and post-intervention survey respondents. The top three barriers where providers responded always, often, or sometimes were time constraints and production pressures (pre: 84%, n=42; post: 63%, n=24), transport of patients to PACU or ICUs (pre: 78%, n=39; post: 37%, n=14), and absence of allocated space for secured medications (pre: 64%, n=32; post: 50%, n=19) (see Appendix J, Table J7).

**Pre-Education Assessment Results**

Pre-education medication data collection was conducted over 3 weeks with a total of 50 cases audited. A total of 71 pharmacy compounded and 92 pre-mixed medications were found for a total of 163 medications left behind unsecured. The majority of pharmacy compounded medications left behind were cardiovascular drugs, with a total of 42 medications found (63.6%,
The second most frequently left behind unsecured pharmacy compounded medication was antimicrobials, accounting for a total of 12 medications (17%, n=12). The majority of pre-mixed medications found were also cardiovascular drugs, totaling 34 medications (37%, n=34). The second most common pre-mixed medication category found were anticoagulant/procoagulant drugs, accounting for 24 medications (26%, n=24). The pyxis was found unlocked on 7 and locked on 43 out of 50 occasions (see Appendix J, J5).

**Post-Education Assessment Results**

A comparison between the fifty pre-education OR cases and fifty post-education cases was completed over 6 weeks, with a total of 50 cases audited. A total of 21 pharmacy compounded and 36 pre-mixed medications were found left behind unsecured for a total of 57 medications left behind. A majority of pre-mixed medications were cardiovascular medications, accounting for 14 medications (39%), which created the most consistently left behind unsecured category of medications. The second most frequently left behind unsecured pre-mixed drugs were neuromuscular blocking drugs, accounting for 9 medications (25%, n=9). The most commonly encountered pharmacy compounded medications were cardiovascular medications (76%, n=16).
and second most commonly found were antimicrobials (19%, n=4). The pyxis was found unlocked on 2 and locked on 48, out of 50 cases.

**Discussion of Findings**

Given that no statistically significant differences were noted between pre- and post-intervention respondents’ demographic data, it remained appropriate to compare responses. The first objective of describing the most frequent categories of medications left behind and unsecured pre- vs. post-intervention was completed. The most frequently found medication category for both pre- and post-intervention was cardiovascular medications. The second most encountered medications were anticoagulants and procoagulants for pre-intervention data, and NMB agents for post-intervention data. Pre and post-intervention data consistently found that IV sedative/hypnotics were the third most encountered type of medication. Both pre- and post-intervention data resulted in the similar discovery of the number of anticholinergics, local anesthetics, pulmonary and endocrine categories of medications found. The most significant improvement between pre- and post-intervention data (besides reduction in overall number of cardiovascular medications) was between antimicrobial findings. In pre-intervention data 15 antimicrobial medications were found, while post-intervention data revealed only 4 antimicrobials suggesting that post educational intervention providers took steps to improve medication stewardship with antimicrobials such as returning unused antimicrobials to pharmacy.

The second objective was to decrease the number of medications left behind by 20%. The pre-education assessment results revealed 163 medications that were found left behind unsecured. In comparison, the post-education assessment resulted in 57 medications left behind and unsecured. The pre vs. post-intervention assessments resulted in 106 fewer medications left
behind and unsecured, creating a 65% reduction post-intervention. This QI project far surpassed this goal by achieving a 65% reduction in medications left behind unsecured pre-versus post-intervention. The significant decrease in medications left behind unsecured was sustained over time as shown by the post-intervention data points at one, three, and five weeks. Given the results over five weeks post-intervention, the educational in-services, visual/cognitive aids and handouts were considered a successful intervention to create sustained institutional change.

The third objective was to describe the most frequently encountered barriers to medication stewardship practices (safety and security of anesthetic medications), ranked always, often or sometimes. Pre- and post-intervention responses were consistent that the top three barriers were time constraints and production pressures, transport of patients to PACU or ICUs, and absence of allocated space for secured medications. The most frequently answered “always” barrier of time constraints and production pressures illustrates the provider's perception that they do not have time to lock and secure medications while adhering to starting, ending and completing turnaround time institutional requirements. The absence of allocated space for secured medications barrier was consistent among the survey responses and was a consistent barrier verbally expressed by providers during education sessions. Providers verbalized over and over at the in-person sessions their frustration that
in the absence of a dedicated space in the Pyxis they were placing their secured medications in bins that were labeled for other medications or on top of intravenous fluids. A consistent recommendation in the educational sessions made by various providers was to move a large medication out of the Pyxis to create space and allow for proper medication securement. A barrier that was not explicitly stated but is prevalent in any healthcare workplace culture is provider burnout and could be impacting medication stewardship compliance (Agency for Healthcare Research and Quality, 2023).

The fourth objective was to increase the number of survey respondents who are aware of the clean-sweep principle to 80%. The majority of providers agreed that they were aware of the clean-sweep principle for both the pre- and post-intervention survey with an increase from 68.9% pre-intervention to 86.4% post-intervention, surpassing the objective to reach 80%. The most notable change was seen between the number of post-intervention respondents that chose “always” or “often” in comparison to pre-intervention results. In the post-intervention survey, no respondents chose disagree and only 4 total respondents answered either strongly disagree or neither agree nor disagree to being aware of the Clean-sweep principle. These results assert that in-person education, visual/cognitive aids, and emailed educational materials increased respondents awareness of the clean-sweep principle significantly. In essence increasing awareness of the clean-sweep principle with
visual/cognitive aids and providing education both in person and online was an effective means to enhance knowledge of best practices for medication stewardship.

The fifth and final objective was to increase the number of survey respondents who utilize the clean-sweep principle to 50%. When asked pre-intervention if providers currently utilize the principle of the clean-sweep, 37.9% (n=22) of survey respondents strongly agreed or agreed with the statement compared to post-intervention, 94.6% respondents (n=35) strongly agreed or agreed that they currently utilize the principle of the clean-sweep, increasing by greater than 50% and exceeding the objective. Increasing knowledge of best practices for medication stewardship was indirectly measured through both an increase in awareness of the clean-sweep principle (outcome achieved) and survey respondents who employ the clean-sweep with every anesthetic (outcome achieved). Evidently, an increase in knowledge of best practices in medication stewardship was achieved through this QI initiative as evidenced by successful completion of both outcome objectives.

**Strengths and Limitations of Findings**

Analysis of the collected survey revealed a few limitations of findings. Post-intervention surveys were disseminated and collected after anesthesia providers had received multiple emails regarding surveys from fellow classmates DNP Projects. The subsequent surveys could have created provider fatigue because the number of providers that participated in the pre- vs. post-assessment survey decreased from 75 to 46 which was a possible limitation of survey findings due to an unequal number of responses. To reduce this incongruence, a reminder email was sent before the second week of the post-intervention to improve survey responsiveness and remind providers to participate. Strengths of the survey included results with p-values <1, indicating consistency and allowed comparison in pre- vs post- demographic data among providers. An
additional strength of the survey was combining surveys and questions with the Propofol Disposal group (two group surveys sent out as one) to improve provider responsiveness and reduce survey burnout among providers.

The findings of this project revealed several strengths. First, this project demonstrated a statistically significant decrease in the number of medications left behind unsecured and provider’s compliance with locking the pyxis. These findings provided a firm foundation that the clean-sweep should remain in WUDAs guidelines and policies for improving medication stewardship. Second, data collection analyzed the specific categories of medications that were frequently left behind and unsecured and provided detailed data to create an in-depth understanding of a complex problem. Collecting and analyzing this data can enhance future studies and provides insight for providers and the institution to identify the medications causing the greatest wastage.

Limitations of this project included convenience sampling method for evaluating ORs due to the limited availability of the PM’s full time-graduate schedules within the project time frame. Despite using convenience sampling, the exact same number of OR cases in the pre- and post-intervention data were assessed (50). Additional limitations include sustainability of the clean-sweep intervention to decrease medications left behind in ORs without incremental reminders and educational sessions from PM’s. Future projects could be focused on addressing sustainable solutions for long-term improvements in medication stewardship through required re-education on the clean-sweep.

**Evaluation of the Process**

Project strengths from start to completion were divided by the PDSA steps of Plan, Do, Study, and Act to detail each portion of the project. Plan project strengths included collaboration,
communication and support from the project team through consistent engagement in team online meetings and email communication. The Excel spreadsheet development created a systematic and straightforward process for documenting medications that was easily accessible on our phone and laptop for documentation. The key on our spreadsheet provided a category for every medication encountered to be grouped in the appropriate section. The Qualtrics survey allowed for easy accessibility on provider’s laptops or smartphones and unbiased experts confirmation of content validity improved the overall quality and consistency. Collaboration with the Propofol Disposal DNP group for survey development was cohesive and was conveniently completed before or after class time. Do project strengths included consistent timing of cases in Pod 3 and cath lab that allowed for continuous data collection and general provider enthusiasm for participating in clean-sweep education. Breakfast pastries and appropriate timing of education sessions, such as during grand rounds, when providers gather in the break rooms, facilitated provider interest. Do limitations included challenges of across campus clinical rotations and assignments at Parkview Tower (Pod 1) and the Center for Advanced Medicine (Pod 4). Study strengths included effective and efficient analysis of survey data through Qualtrics results review. Act strengths included positive results indicating an improvement in provider complicity through a decreased number of medications left behind unsecured. Survey responses indicated improvement in clean-sweep awareness and implementation. Collaboration with the Propofol Disposal group for our joint survey enhanced the quality and improved provider participation.

The project design created a realistic and systematic way to assess and evaluate the effect of provider clean-sweep education on decreasing the number of medications left behind and unsecured and the pyxis unlocked status. An increased sample size of ORs and extended
timeframe for data collection and education sessions could have provided more statistically significant data. This data would have allowed the findings to be generalized to the broader healthcare community.

System and Practice Impact

Implications for Organization and Systems Change

Per the Joint Commission’s citation, the current policy regarding medication safety at BJH is as follows: “1. At shift change or break relief, all medications and solutions must be reviewed during handoff by entering and exiting personnel. This must include review of the medication and/or solution labels for the medication name, strength/concentration, and if applicable, expiration date and/or time in addition to the amount already administered. 2. Do a clean-sweep after your case is over: Decrease the chance that Case A’s medications are accidentally given to case B. Please do not keep a mini-pharmacy in your anesthesia machine drawer,” (see Appendix A). The PMs identified an educational gap among providers concerning the clean-sweep policy, resulting in insufficient awareness and knowledge regarding medication stewardship and safety best practices. Consequently, the PMs designed an intervention centered around provider education, utilizing in-service sessions, distribution of informative handouts and emails, and the implementation of visual/cognitive checklist aids. These aids serve the dual purpose of reinforcing the education received by providers and ensuring the enduring adoption of these essential practices in the future.

The clean-sweep policy has the potential for multifaceted benefits. Firstly, by reducing financial losses caused by a decrease in discarded or wasted medications, cost-effectiveness has the opportunity to be enhanced. Secondly, it promotes medication stewardship, thus contributing to improved environmental sustainability by reducing drug wastage. Lastly, its system-wide
implementation may reduce opportunities for provider diversion, resulting in possibilities for improvements in patient and provider safety. Moreover, the clean-sweep presents a decreased risk of medication errors by offering providers a standardized checklist as a visual/cognitive aid and education on best practices for medication management.

**Sustainability**

Data collection post-education at intervals of one, three, and five weeks served as a comprehensive assessment of the intervention’s sustainability and feasibility. The encouraging trend of a continued decrease in medications left behind during the later data points strongly implies the long-term sustainability of this initiative. These promising findings will be actively shared with providers to raise awareness of the project’s success, ensuring that the positive impact of the clean-sweep is widely recognized.

To ensure ongoing support for this intervention, the educational handouts will remain accessible as a valuable reference for providers. Further, the visual/cognitive checklist aids will continue to be readily available in Pod 3. As the PM’s look to the future, it would be advantageous to extend the use of these aids to all anesthesia-utilized Pyxis machines, enhancing their effectiveness across the facility. To maintain the sustainability of the clean-sweep principle, it is recommended to implement follow-up education and periodic reminders emphasizing the importance of the clean-sweep and the significant benefits of improved medication stewardship. This proactive approach will help to engrain the principles of responsible medication management and waste reduction in the long-term practices of BJH.

**Recommendations for Nursing Practice**

The substantial decrease in medications left behind unsecured, assessment of type of medications left behind and evaluation demonstrated that provider education and visual/cognitive
checklist aids improve medication stewardship. Our findings suggest that providing staff
education and visual/cognitive checklist aids is an obtainable means to improve anesthesia
provider adherence to the clean-sweep and provides an excellent recommendation for nursing
practice. In the future, an anesthesia department-wide adoption of the clean-sweep policy can
further encourage providers to utilize this practice in their daily routine. By sending out reminder
emails every 6 months with the educational information on the clean-sweep policy and placing
the visual/cognitive aid checklists on all anesthesia-utilized Pyxis machines throughout BJH, this
policy has the opportunity to continue unabated with lasting impacts on medication stewardship and safety for providers and patients.

**Summary and Conclusion**

**Project Summary**

In conclusion, medication stewardship is a significant ongoing issue in the OR that can contribute to negative patient, provider, and system-wide outcomes. This QI project is aimed to address the critical issue of unsecured anesthetic medications to enhance medication safety, reduce perceived barriers, and improve provider knowledge of medication stewardship practices. The results demonstrated significant success in achieving its objectives and creating lasting positive change within the institution. Overall, the results suggest that the clean-sweep intervention, accompanied by educational efforts, led to substantial improvements in medication stewardship practices within the WUDA. These findings have important implications for promoting medication safety and institutional sustainability, with the potential to reduce adverse outcomes associated with unsecured medications in anesthetizing areas. Continued efforts to address the identified barriers and maintain high awareness and utilization of the clean-sweep principle will be crucial for sustaining these positive changes in the long term.

**Plan for Dissemination**

A summary of the QI project and results will be shared with key stakeholders, project members, Goldfarb School of Nursing (GSON) faculty, staff, students and other interested members within the WUDA community through a PowerPoint and oral presentation. Further dissemination of the project findings will occur with a poster presentation at the 2024 GSON
Spring Research Day. Invitations to attend both oral and poster presentations will be inclusive of all interested members of GSON and WUDA communities.
References


American Association of Nurse Anesthesiology. (2019). *Operating room waste reduction.* [https://nurseanesthesiology.aana.com/operating-room-waste-reduction#:~:text=One%2Dfourth%20of%20all%20operating,in%202%20separate%20OR%20environments](https://nurseanesthesiology.aana.com/operating-room-waste-reduction#:~:text=One%2Dfourth%20of%20all%20operating,in%202%20separate%20OR%20environments)


According to the U.S. Department, more than $72 billion per year.


[https://www.hopkinsmedicine.org/evidence-based-practice/_docs/appendix_c_evidence_level_quality_guide.pdf](https://www.hopkinsmedicine.org/evidence-based-practice/_docs/appendix_c_evidence_level_quality_guide.pdf)


[https://www.ihi.org/resources/Pages/HowtoImprove/default.aspx](https://www.ihi.org/resources/Pages/HowtoImprove/default.aspx)


[https://repository.library.georgetown.edu/bitstream/handle/10822/1059687/Kushnir_georgetown_0076D_14503.pdf?sequence=1](https://repository.library.georgetown.edu/bitstream/handle/10822/1059687/Kushnir_georgetown_0076D_14503.pdf?sequence=1)


https://www.hhs.gov/about/sustainability/index.html


 years#r-text=Globally%2C%20the%20cost%20associated%20with%20medication%20related%20errors%20in%205%20years%20Director%20WHO
%20Director%20DGeneral.

Zip Recruiter. (2023). *Nurse anesthetist salary in St. Louis, MO.*
https://www.ziprecruiter.com/Salaries/Nurse-Anesthetist-Salary-in-St-Louis,MO
Appendix A

Current Clean-Sweep Policy

Medication Safety-TJC Citation #2

Per observation by TJC in S800 L&D OR, it was noted that Albumin was stored in the unlocked anesthesia supply computer cart. This storage was against organization policy. This observation was noted by the leadership accompanying the surveyor.

Reminder:
1. At shift change or break relief, all medications and solutions must be reviewed during handoff by entering and exiting personnel. This must include review of the medication and/or solution labels for the medication name, strength/concentration, and if applicable, expiration date and/or time in addition to the amount already administered.
2. Do a clean sweep after your case is over:
   - Decrease the chance that Case A’s medications are accidentally given to Case B
   - Please do not keep a mini-pharmacy in your anesthesia machine drawer

Pharmacy Involvement

- Increased pharmacy prepared medications
  - Vasoactives, Antibiotics, Epoprostenol, etc.
- Clean sweep
  - Reason:
    - Decrease the chance that Case A’s medications are accidentally given to Case B
    - Please Do Not keep a mini-pharmacy in your anesthesia machine drawer
- Reporting
  - If there is an Error or ADR please report it so we can evaluate the cause/situation

Washington University School of Medicine in St. Louis

Department of Anesthesiology
Appendix B
Pyxis Warning Label

CareFusion strongly recommends making a “code-box” or “crash cart” of medications that are readily available outside of an automated storage device in the event of an emergency. Facility policies and procedures should clearly identify when it is appropriate to access emergency medications. Refer to product user guide for additional information.
Appendix C
Model for Improvement

What changes are we going to make based on our findings?

What exactly are we going to do?

What were the results?

When and how did we do it?
# Appendix D

**Excel Spreadsheet**

<table>
<thead>
<tr>
<th>Category of Medication</th>
<th>Pharmacology Components</th>
<th>Pre-Mixed</th>
</tr>
</thead>
<tbody>
<tr>
<td>Veterinary</td>
<td>Infections/Infectious</td>
<td></td>
</tr>
<tr>
<td>Anesthetic/Anesthesia</td>
<td>Dermatological</td>
<td></td>
</tr>
<tr>
<td>Analgesic</td>
<td>Antihistaminic</td>
<td></td>
</tr>
<tr>
<td>Antimicrobial</td>
<td>Antimicrobial/Preservative</td>
<td></td>
</tr>
<tr>
<td>Antimicrobial/Preservative</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Categories of Medications</th>
<th>Medication Class</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Antimicrobial</td>
</tr>
<tr>
<td></td>
<td>Benzodiazepines</td>
</tr>
<tr>
<td></td>
<td>Nonsteroidal Antiinflammatory</td>
</tr>
<tr>
<td></td>
<td>Local Anesthetic</td>
</tr>
<tr>
<td></td>
<td>Analgesics</td>
</tr>
<tr>
<td></td>
<td>Antihistaminics</td>
</tr>
<tr>
<td></td>
<td>Antimicrobials</td>
</tr>
<tr>
<td></td>
<td>Antimicrobials/Preservative</td>
</tr>
<tr>
<td></td>
<td>Antimicrobials/Preservative</td>
</tr>
<tr>
<td></td>
<td>Cardiovascular</td>
</tr>
<tr>
<td></td>
<td>Antineoplastic</td>
</tr>
<tr>
<td></td>
<td>Antineoplastic/Preservative</td>
</tr>
<tr>
<td></td>
<td>Antineoplastic/Preservative</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Medication Class</th>
<th>INN Name/Trade Name</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
</tr>
</tbody>
</table>

This Excel spreadsheet contains various categories of medications along with pharmacology components and pre-mixed categories. Each category is further divided into subcategories such as veterinary, in infections/infectious, and others.
## Appendix E

### Survey

<table>
<thead>
<tr>
<th>Medication(s)</th>
<th>Survey Question(s)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Propofol</td>
<td></td>
</tr>
</tbody>
</table>
What is your gender?
- Male
- Female
- Other:
- Prefer not to answer

What is your age?
- 18-30
- 31-45
- 46-59
- 60 +

How many years have you been in practice as an anesthesia provider?
- 1 year or less
- 2-5 years
- 6-10 years
- 11+ years
- I am an anesthesia student

What is your primary specialty area?
- POD 1
- POD 2
- POD 3
- POD 4
- POD 5
- Pediatrics
- Obstetrics
- Float

What is your title in anesthesia practice?
- Anesthesiologist (MD)
- Anesthesia resident (MD)
- Anesthesia fellow (MD)
- Nurse Anesthetist (CRNA)
- Student Nurse Anesthetist (SRNA)

The following items will pertain to prophylactic disposal practices:

What I can do with a nail, syringe, or IV tubing that has propofol inside, my most common practice for disposal: (Select all that apply)
- I discard the unexpired remnant into the brass pharmaceutical waste bin
- I discard the unexpired remnant into the red sharps container
- I discard the unexpired remnant into the brown control substance disposal system (CSS)
- I discard the unexpired remnant into the brass pharmaceutical waste bin
- I discard the unexpired remnant into the red sharps container
- I discard the unexpired remnant into the brown control substance disposal system (CSS)

My understanding of the manufacturer’s recommended practice for disposal of unexpired propofol vials, IV tubing, & syringes is:
- Discard the unexpired remnant into the brass pharmaceutical waste bin
- Discard the unexpired remnant into the red sharps container
- Discard the unexpired remnant into the brown control substance disposal system
- Discard the unexpired remnant into the red sharps container
- Other (please specify):

Barriers that prevent my use of the Stericycle CSS container include: (Select all that apply)
- Barriers do not prevent me from using the Stericycle CSS container – I see it as disposable propofol packaging
- I do not understand how to use the Stericycle CSS container
- I do not understand the Stericycle CSS container
- I do not use the Stericycle CSS container
- I do not have access to or cannot use the Stericycle CSS container
- Other (please specify):

I believe that it is preferable to use unexpired propofol vials, IV tubing, and syringes into the trash cans, brass pharmaceutical waste bins, or red sharps containers.
- Strongly agree
- Agree
- Neither agree nor disagree
- Disagree
- Strongly disagree

For the following items, diversion is defined as any act that alters the intended path of a prescription medication from the manufacturer to the patient.

I believe that propofol diversion has the potential to negatively impact myself, other anesthesia providers or hospital staff, and patients.
- Strongly agree
- Agree
- Neither agree nor disagree
- Disagree
- Strongly disagree

I believe that using the Stericycle CSS container reduces the risk of propofol diversion and promotes the safety of myself, other anesthesia providers or hospital staff, and patients.
- Strongly agree
- Agree
- Neither agree nor disagree
- Disagree
- Strongly disagree

Rate the following barriers to medication stewardship practices (safety and security of anesthetic medications):

Frequency in which you encounter barriers:
Rating 1 = Always, 2 = Often, 3 = Sometimes, 4 = Unlikely, 5 = Never
- Time constraints and production pressures
- Absence of educational space for medical education
- Transportation to patients in PACU or ICU
- False claims or malpractice claims
- Medical errors not immediately available in the Psilos system (E.g., Psilos being out of sync)
- Other (please specify):

Past education
Select the education you received related to these QI projects: (Select all that apply)
- I attended an in-person education session on prophylactic disposal
- I attended an in-person education session on the Clean Sweep
- I reviewed the educational information on propofol disposal sent via email
- I reviewed the educational information on Clean Sweep sent via email
- I did not receive any education
Appendix F
Locations to Check for Medications Left Behind
Appendix G
Visual/Cognitive Checklist Aid Development, Education Reminder Flyer and Education Handout

**Clean-Sweep Initiative**
Christie Bergesch & Kate Manual
Goldfarb Name Anesthesia Class of 2004

**Current Policy**
- WICDA and BJH recommend the clean sweep post-case to decrease the chance that Case A’s medications are accidentally given to Case B and to reduce providers from keeping a mini pharmacy in their anesthesia machine drawer. However, the policy is not well established, utilized or enforced.

**Our Initiative**
- Clean sweep is a checklist reminder for providers to remove medications from surfaces and unlocked drawers in and around the anesthesia workstation.
  - Each floor will have a mini-poster displayed.
  - Medications should not be placed on the top surface and drawers of the AWS, the main surface of the Pyxis, and the main surfaces of the anesthesia supply cart.
  - Medications should be placed in the locked Pyxis drawers, locked anesthesia cart or AWS.
  - Medications that are unused should be promptly returned to the pharmacy.
  - Medications that are good should be wasted appropriately.
  - Medications that are expired should be retrieved immediately prior to the case and kept securely with the provider in the operative area.

**Background**
- Medications left behind in the OR are associated with:
  - Patient and Provider Implications: Medication Error and Diversion
  - Institutional and Environmental Implications: Financial burden due to institutional losses and anesthesia provider’s pharmaceutical waste impacts sustainability.
- A widely established practice or intervention for reducing medications left behind is not currently in place.

**Our Findings**
- Survey pre-assessment data:
  - 94% of providers have not heard of the clean sweep.
  - The majority of providers did not agree or disagree on utilizing the clean sweep, showing a degree of uncertainty and confusion of best practices.
### Appendix H

#### Timeline

Table 2

*Project Timeline*

<table>
<thead>
<tr>
<th>Event</th>
<th>Timeline</th>
</tr>
</thead>
<tbody>
<tr>
<td>Collecting pre-assessment Data</td>
<td>May 30\textsuperscript{th} - June 16\textsuperscript{th}</td>
</tr>
<tr>
<td>Survey sends out and collection</td>
<td>June 19\textsuperscript{th} - June 30\textsuperscript{th}</td>
</tr>
<tr>
<td>Send out education sessions and analyze</td>
<td>July 3\textsuperscript{rd} - July 7\textsuperscript{th}</td>
</tr>
<tr>
<td>survey data</td>
<td></td>
</tr>
<tr>
<td>Education sessions</td>
<td>July 17\textsuperscript{th} – July 21\textsuperscript{st}</td>
</tr>
<tr>
<td>One week audit session</td>
<td>July 31\textsuperscript{st} – August 4\textsuperscript{th}</td>
</tr>
<tr>
<td>Three-week audit session</td>
<td>Aug 7\textsuperscript{th} - Aug 11\textsuperscript{th}</td>
</tr>
<tr>
<td>Post-intervention survey</td>
<td></td>
</tr>
<tr>
<td>Five-week audit session</td>
<td>Aug 28\textsuperscript{th} – Sept 1\textsuperscript{st}</td>
</tr>
<tr>
<td>Post-intervention survey</td>
<td></td>
</tr>
<tr>
<td>Data analysis</td>
<td>September</td>
</tr>
<tr>
<td>Final project paper development</td>
<td>September - October</td>
</tr>
<tr>
<td>Dissemination of results</td>
<td>November</td>
</tr>
</tbody>
</table>
Appendix I
BJC Healthcare Evidence of Standards Compliance

**BJC HEALTHCARE**
**EVIDENCE OF STANDARDS COMPLIANCE (ESC)**

<table>
<thead>
<tr>
<th>Standard #</th>
<th>NMM 03.01.01</th>
</tr>
</thead>
<tbody>
<tr>
<td>EP #</td>
<td>3</td>
</tr>
<tr>
<td>Safety Designation Level:</td>
<td>LOW</td>
</tr>
<tr>
<td>Safety Designation Likelihood to Harm:</td>
<td>LIMITED</td>
</tr>
</tbody>
</table>

**OBSERVATION:**
The hospital stores all medications and biologicals, including controlled (scheduled) medications, in a secured area to prevent diversion and [linked](#) when necessary, in accordance with law and regulation. Note: 1. Scheduled medications include those listed in Schedules II-V of the Comprehensive Drug Abuse Prevention and Control Act of 1970.

1. It was noted that albuterol 10% was stored in the uncloaked anesthesiology supply cart. This storage was against organization policy. This observation was noted by the leadership accompanying the surveyor.

**Location:** 3000 Utilities

**PART II | ESC (Evidence of Standards Compliance) CORRECTIVE ACTIONS**

1. Assign Accountability

**Individual’s Title:** Director of Women and Infant Services

2. Correct the Non-Compliance ("Action Item")

Concisely describe the actions completed to correct each finding. This should include policies/procedures developed, revised, and approved. All corrective actions should also include staff training, communications, and/or spreading awareness. This description must illustrate the finding was fully corrected. (Notes: Do not copy and paste entire policies, bylaws, or other documents in this field. Even though the corrective action may encompass multiple dates please identify the final date that all corrective actions, including education and approvals were completed. The final date entered must be prior to your ESC submission due date and cannot be a future date.)

<table>
<thead>
<tr>
<th>#</th>
<th>Action Item</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>On 6/9/22, representation from Anesthesiology, pharmacy and nursing met to review the findings, discuss current processes, and create a plan for correction.</td>
</tr>
<tr>
<td>2.</td>
<td>Leadership reviewed the Medication Management in Perioperative Setting Policy to ensure it was up to date and no changes were needed.</td>
</tr>
<tr>
<td>3.</td>
<td>After the finding was observed by the surveyor, the Maternal-Fetal Medicine Clinical Pharmacy Specialist conducted a presentation to education to OB Anesthesia Residents with emphasis on medication security.</td>
</tr>
<tr>
<td>4.</td>
<td>The Anesthesiology Clinical Director/QI and QA Lead for Labor and Delivery reviewed and updated the OB Risk handbook to include information on medication safety and security (emphasizing that no medications may be removed). The revised handbook was given to all OB Residents on 6/9/22 and will continue to be given out with each new set of Residents.</td>
</tr>
<tr>
<td>5.</td>
<td>The Anesthesiology Clinical Director sent an email communication to all OB Anesthesia Providers outlining expectations for medication security and safety on 6/8/22.</td>
</tr>
<tr>
<td>6.</td>
<td>The Director of Clinical Anesthesiology/Perioperative Safety and Quality presented at the departments Mortality and Morbidity meeting on June 22nd. The presentation included topics on medication safety and security in the operating room.</td>
</tr>
<tr>
<td>7.</td>
<td>On 6/20/22 a clinical pharmacist presented information specific to medication safety and security to anesthesia leaders at the Pharmacy and Anesthesiology Steering committee.</td>
</tr>
</tbody>
</table>

PART II | ENSURING SUSTAINED COMPLIANCE

While correcting the noncompliance issue is important, the organization should also have a plan for ensuring and sustaining compliance with the element of performance across the organization. To support sustainability, a strong strategy to monitor compliance must be developed and implemented.

1. What procedures or activities have been identified to monitor your compliance with this element of performance? Example: **Anonymous staff members will perform hand hygiene observations and collect data across a sample of shifts and units within the organization. For instances of noncompliance observed, a corrective action plan is required to be submitted to the Chief Nursing Officer.**

A Clinical Pharmacy Specialist will perform audits of the Labor and Delivery Operating Room suites to ensure all medication is secured. For instances of non-compliance, the pharmacy specialist will inform the Anesthesiology Clinical Director/QI/QA Lead who will follow up individually with the Anesthesia provider to review expectations.

State frequency of the monitoring (data collection) and how often will the data be compiled and reviewed.

Example: The hand hygiene observations will occur on a weekly basis, and data from the observations will be entered and analyzed on a monthly basis.

Audits will be conducted monthly and compiled/analyzed monthly.

3. What data will be collected from these activities?

Beginning July 5, data will be collected and stratified as follows:

- **Denominator:** Total number of audits conducted assessing medication security
- **Numerator:** Total number of audits that are compliance with medication security (no unsecured meds)
- **Sample Size:** 4 minimum of 20 audits per month
- **Target Compliance:** 100% compliance for three consecutive months
- **Tapering process:** When target compliance is achieved, audits will taper to three per month for three months, followed by quarterly spot checks to ensure sustained compliance.

4. Describe to whom (by title or name of group), and how often will this data be reported for review, groupings and any follow up actions. As applicable, include how ongoing results will be communicated to frontline staff for feedback and awareness.

Data will be reported monthly to the Director of Women and Infant Services, The Director of Clinical Anesthesiology/Perioperative Safety and Quality and the Anesthesia QI/QA Anesthesia Lead for Labor and Delivery for review and analysis.
Appendix J
Data Tables and Figures

Table J1

Descriptive Demographics

<table>
<thead>
<tr>
<th>Demographic Variables</th>
<th>Pre-Education</th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>n</td>
<td>%</td>
<td>n</td>
</tr>
<tr>
<td>Gender 5 groups</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Male</td>
<td>29</td>
<td>39.7</td>
<td>21</td>
</tr>
<tr>
<td>Female</td>
<td>41</td>
<td>56.2</td>
<td>22</td>
</tr>
<tr>
<td>Non-binary</td>
<td>1</td>
<td>1.4</td>
<td>0</td>
</tr>
<tr>
<td>Other:</td>
<td>0</td>
<td>0.0</td>
<td>0</td>
</tr>
<tr>
<td>No Answer</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Prefer not to say</td>
<td>2</td>
<td>2.7</td>
<td>3</td>
</tr>
<tr>
<td>Total Responses</td>
<td>73</td>
<td></td>
<td>46</td>
</tr>
<tr>
<td>Age (years) 5 groups</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>18-30</td>
<td>12</td>
<td>16.4</td>
<td>9</td>
</tr>
<tr>
<td>31-45</td>
<td>41</td>
<td>56.2</td>
<td>25</td>
</tr>
<tr>
<td>46-59</td>
<td>12</td>
<td>16.4</td>
<td>7</td>
</tr>
<tr>
<td>60+</td>
<td>8</td>
<td>11.0</td>
<td>5</td>
</tr>
<tr>
<td>Prefer not to say</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total Responses</td>
<td>73</td>
<td></td>
<td>46</td>
</tr>
<tr>
<td>Experience in Anesthesia (years)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1 or less</td>
<td>8</td>
<td>11.0</td>
<td>9</td>
</tr>
<tr>
<td>2-5</td>
<td>22</td>
<td>30.1</td>
<td>15</td>
</tr>
<tr>
<td>6-10</td>
<td>13</td>
<td>17.8</td>
<td>4</td>
</tr>
<tr>
<td>10+</td>
<td>26</td>
<td>35.6</td>
<td>14</td>
</tr>
<tr>
<td>I am an anesthesia student</td>
<td>4</td>
<td>5.5</td>
<td>4</td>
</tr>
<tr>
<td>Prefer not to say</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total Responses</td>
<td>73</td>
<td></td>
<td>46</td>
</tr>
<tr>
<td>Primary Specialty Area</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>POD 1</td>
<td>3</td>
<td>4.2</td>
<td>1</td>
</tr>
<tr>
<td>POD 2</td>
<td>4</td>
<td>5.6</td>
<td>3</td>
</tr>
<tr>
<td>POD 3</td>
<td>6</td>
<td>8.5</td>
<td>6</td>
</tr>
<tr>
<td>POD 4</td>
<td>6</td>
<td>8.5</td>
<td>6</td>
</tr>
<tr>
<td>POD 5</td>
<td>11</td>
<td>15.5</td>
<td>5</td>
</tr>
<tr>
<td>Pediatrics</td>
<td>12</td>
<td>16.9</td>
<td>1</td>
</tr>
<tr>
<td>Obstetrics</td>
<td>1</td>
<td>1.4</td>
<td>0</td>
</tr>
<tr>
<td>Float</td>
<td>28</td>
<td>39.4</td>
<td>22</td>
</tr>
</tbody>
</table>
No Response

<table>
<thead>
<tr>
<th>Role</th>
<th>Total Responses</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Anesthesiologist (MD)</td>
<td>18</td>
<td>3</td>
</tr>
<tr>
<td>Anesthesia resident (MD)</td>
<td>7</td>
<td>6</td>
</tr>
<tr>
<td>Anesthesia fellow (MD)</td>
<td>4</td>
<td>0</td>
</tr>
<tr>
<td>Nurse Anesthetist (CRNA)</td>
<td>39</td>
<td>34</td>
</tr>
<tr>
<td>Student Nurse Anesthetist (SRNA)</td>
<td>6</td>
<td>3</td>
</tr>
</tbody>
</table>

No Response

<table>
<thead>
<tr>
<th>Role</th>
<th>Total Responses</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Anesthesiologist (MD)</td>
<td>18</td>
<td>3</td>
</tr>
<tr>
<td>Anesthesia resident (MD)</td>
<td>7</td>
<td>6</td>
</tr>
<tr>
<td>Anesthesia fellow (MD)</td>
<td>4</td>
<td>0</td>
</tr>
<tr>
<td>Nurse Anesthetist (CRNA)</td>
<td>39</td>
<td>34</td>
</tr>
<tr>
<td>Student Nurse Anesthetist (SRNA)</td>
<td>6</td>
<td>3</td>
</tr>
</tbody>
</table>

Note. MD – Doctor of Medicine

Table J2

*Pre- and Post-Assessment Data of Medications and Pyxis Reports*

<table>
<thead>
<tr>
<th>Medications</th>
<th>Pre-Education Data Collection, N=50</th>
<th>Pre-Mixed</th>
<th>( \chi^2 ) (df), p-value</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Pharmacy Compounded</strong></td>
<td>Number of Medications</td>
<td>Percentage of Total</td>
<td>Number of Medications</td>
</tr>
<tr>
<td>IV Sedative/Hypnotic Agents</td>
<td>0</td>
<td>0.0%</td>
<td>1</td>
</tr>
<tr>
<td>Neuromuscular Blocking Drugs</td>
<td>3</td>
<td>4.2%</td>
<td>0</td>
</tr>
<tr>
<td>Anticholinesterases</td>
<td>2</td>
<td>2.8%</td>
<td>0</td>
</tr>
<tr>
<td>Anticholinergics</td>
<td>0</td>
<td>0.0%</td>
<td>0</td>
</tr>
<tr>
<td>Local Anesthetics</td>
<td>2</td>
<td>2.8%</td>
<td>0</td>
</tr>
<tr>
<td>Opioids &amp; NSAIDs</td>
<td>0</td>
<td>0.0%</td>
<td>0</td>
</tr>
<tr>
<td>Anxiolytics</td>
<td>0</td>
<td>0.0%</td>
<td>0</td>
</tr>
<tr>
<td>Gastrointestinal</td>
<td>0</td>
<td>0.0%</td>
<td>0</td>
</tr>
<tr>
<td>Antimicrobials</td>
<td>12</td>
<td>16.9%</td>
<td>0</td>
</tr>
<tr>
<td>Anticoagulants/Procoagulants</td>
<td>0</td>
<td>0.0%</td>
<td>4</td>
</tr>
<tr>
<td>Cardiovascular</td>
<td>51</td>
<td>71.8%</td>
<td>16</td>
</tr>
<tr>
<td>Pulmonary</td>
<td>0</td>
<td>0.0%</td>
<td>0</td>
</tr>
<tr>
<td>Endocrine</td>
<td>1</td>
<td>1.4%</td>
<td>0</td>
</tr>
</tbody>
</table>

| Total                           | 71                      | 21          |                           |                       |         |

Pre-Mixed

<table>
<thead>
<tr>
<th>Medications</th>
<th>Number of Medications</th>
<th>Percentage of Total</th>
<th>Number of Medications</th>
<th>Percentage of Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>IV Sedative/Hypnotic Agents</td>
<td>17</td>
<td>18.5%</td>
<td>7</td>
<td>19.40%</td>
</tr>
<tr>
<td>Neuromuscular Blocking Drugs</td>
<td>8</td>
<td>8.7%</td>
<td>9</td>
<td>25%</td>
</tr>
<tr>
<td>Drug Class</td>
<td>Pre</td>
<td>Post</td>
<td>Mann Whitney U Score</td>
<td></td>
</tr>
<tr>
<td>--------------------------</td>
<td>-----</td>
<td>------</td>
<td>----------------------</td>
<td></td>
</tr>
<tr>
<td>Anticholinesterases</td>
<td>0</td>
<td>0</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Anticholinergics</td>
<td>0</td>
<td>0</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Local Anesthetics</td>
<td>3</td>
<td>3</td>
<td>8.30% 24(1), &lt;.0001</td>
<td></td>
</tr>
<tr>
<td>Opioids &amp; NSAIDS</td>
<td>0</td>
<td>0</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Anxiolytics</td>
<td>0</td>
<td>0</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Gastrointestinal</td>
<td>1</td>
<td>1</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Antimicrobials</td>
<td>3</td>
<td>3</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Anticoagulants/Procoagulants</td>
<td>24</td>
<td>3</td>
<td>8.30% 24(1), &lt;.0001</td>
<td></td>
</tr>
<tr>
<td>Cardiovascular</td>
<td>34</td>
<td>14</td>
<td>38.90%</td>
<td></td>
</tr>
<tr>
<td>Pulmonary</td>
<td>1</td>
<td>0</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Endocrine</td>
<td>1</td>
<td>0</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td>92</td>
<td>36</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Pyxis Locked or Unlocked</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Pyxis Locked</td>
<td>43</td>
<td>86.0%</td>
<td>48 96%</td>
<td></td>
</tr>
<tr>
<td>Pyxis Unlocked</td>
<td>7</td>
<td>14.0%</td>
<td>2 4%</td>
<td></td>
</tr>
<tr>
<td><strong>Total Responses</strong></td>
<td>50</td>
<td>50</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Table J3

*Pre- and Post- Survey Responses of Clean-Sweep*

<table>
<thead>
<tr>
<th>Survey Responses</th>
<th>Pre-Education Survey Responses</th>
<th>Mann Whitney U Score, p-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Providers awareness of WUDA best practices</td>
<td>n</td>
<td>%</td>
</tr>
<tr>
<td>Strongly Agree</td>
<td>7</td>
<td>12.1%</td>
</tr>
<tr>
<td>Agree</td>
<td>33</td>
<td>56.9%</td>
</tr>
<tr>
<td>Neither Agree nor Disagree</td>
<td>11</td>
<td>19.0%</td>
</tr>
<tr>
<td>Disagree</td>
<td>6</td>
<td>10.3%</td>
</tr>
<tr>
<td>Strongly Disagree</td>
<td>1</td>
<td>1.7%</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td>58</td>
<td>100%</td>
</tr>
<tr>
<td>Providers belief that there is appropriate time/space to secure medications</td>
<td>n</td>
<td>%</td>
</tr>
<tr>
<td>Strongly Agree</td>
<td>7</td>
<td>12.1%</td>
</tr>
<tr>
<td>Agree</td>
<td>17</td>
<td>29.3%</td>
</tr>
<tr>
<td>Neither Agree nor Disagree</td>
<td>15</td>
<td>25.9%</td>
</tr>
</tbody>
</table>
Disagree & 17 & 0.0% & 7 & 18.9%
Strongly Disagree & 2 & 3.40% & 2 & 5.4%

**Total** & 58 & 37

<table>
<thead>
<tr>
<th>Providers heard of WUDA at BJH principle called clean-sweep</th>
<th>n</th>
<th>%</th>
<th>Providers currently utilize the clean-sweep to reduce medications left behind/unsecured</th>
<th>n</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td>Strongly Agree</td>
<td>3</td>
<td>5.2%</td>
<td>12</td>
<td>32.8%</td>
<td></td>
</tr>
<tr>
<td>Agree</td>
<td>13</td>
<td>22.4%</td>
<td>21</td>
<td>56.8%</td>
<td></td>
</tr>
<tr>
<td>Neither Agree nor Disagree</td>
<td>5</td>
<td>8.6%</td>
<td>2</td>
<td>5.4%</td>
<td>2491, &lt;.0001</td>
</tr>
<tr>
<td>Disagree</td>
<td>24</td>
<td>0.0%</td>
<td>0</td>
<td>0%</td>
<td></td>
</tr>
<tr>
<td>Strongly Disagree</td>
<td>13</td>
<td>3.40%</td>
<td>2</td>
<td>5.4%</td>
<td></td>
</tr>
</tbody>
</table>

**Total** & 58 & 37

Table J4

Table J5
Table J6

Medications Left Behind

Total Pre-Intervention, N=50 cases  Total Post-Intervention, N= 50 cases

Table J7

Pre-Intervention Survey Barriers Ranking

Post-Intervention Survey Barriers Ranking

Table J7
Table J8

Number of Survey Respondents Aware of Clean Sweep

- Strongly Disagree
- Disagree
- Neither Agree nor Disagree
- Often
- Always

Respondents Pre-intervention
Respondents Post-Intervention
I currently utilize the principle of Clean Sweep in order to reduce medications left behind and unsecured in and around the anesthesia workstation.