

Distribution Statement

Distribution A: Public Release.

The views presented here are those of the author and are not to be construed as official or reflecting the views of the Uniformed Services University of the Health Sciences, the Department of Defense or the U.S. Government.

Enhanced Recovery for Elderly Surgical Patients Receiving General Anesthesia

Joseph Dimarucut and Sarah Faris

Daniel K. Inouye Graduate School of Nursing

Uniformed Services University

Naval Medical Center San Diego

April 1, 2022

Copyright Acknowledgement Statement

The authors hereby certify that the use of any original work by another author or copyrighted material used in the DNP project entitled: "Enhanced recovery for elderly surgical patients receiving general anesthesia," is either appropriately cited within the manuscript or used with formal written permission of copyright release by the owner of the original work.

DIMARUCUT.JOSEPH
PH.J.1292202535

Digitally signed by
DIMARUCUT.JOSEPH.J.129220
2535
Date: 2022.03.10 16:50:31 -08'00'

LCDR Joseph Dimarucut
Daniel K. Inouye Graduate School of Nursing
Uniformed Services University

Sarah Faris

Digitally signed by Sarah
Faris
Date: 2022.03.10
19:11:48 -08'00'

LCDR Sarah Faris
Daniel K. Inouye Graduate School of Nursing
Uniformed Services University

Table of Contents

Disclaimer	5
Abstract	6
Introduction	8
Problem Synthesis	8
Relevance to Military Nursing	11
PICOT/Clinical Question	12
Search Strategy/Results.....	12
Solution Synthesis	14
Focus Areas	21
Business Case Analysis.....	21
Organizing Framework	22
Project Design	23
General Approach	23
Setting and Population	23
Procedural Steps.....	24
Data Analysis Plan	24
Potential Barriers.....	25
Dissemination Plan.....	25
HIPAA Concerns/Ethical Considerations	26
Project Results.....	26
Analysis of the Results.....	29
Proposed Organizational Impact and Implications for Practice.....	31

Future Direction for Research and Practice	31
Conclusion.....	32
References	34
Appendices:	
Appendix A: PRISMA Diagram	43
Appendix B: Search History	44
Appendix C: John Hopkins Nursing Evidence-Based Practice Model	45
Appendix D: Evidence Table	47
Appendix E: Enhanced Recovery for Elderly Patients Pathway.....	53
Appendix F: Orientation Memory Cognitive Test	59
Appendix G: Data Analysis Plan and Table.....	60
Appendix H: Business Case Analysis Worksheet.....	74
Appendix I: Project Timeline.....	86
Appendix J: Team Mentor Agreement Form	88
Appendix K: CITI Certificates.....	89
Appendix L: USU Notice of Project Approval	90
Appendix M: MTF IRB/PI Letter of Determination.....	91
Appendix O: DNP Project Completion Verification Form.....	92

Disclaimer

The views expressed in this report are those of the authors and do not necessarily reflect the official policy or position of the Uniformed Services University, Naval Medical Center San Diego, the Department of Defense, or the United States Government. There are no financial relationships that exist between the speakers and a commercial entity.

ABSTRACT

Phase II Site: Naval Medical Center San Diego

Project Title: Enhanced Recovery for Elderly Surgical Patients Receiving General Anesthesia

Authors: Dimarucut, J. & Faris, S.

Background: Nearly 30% of surgeries are performed on elderly adults (age 60 and older).

Consequently, 11% to 51% of this rapidly growing patient population will develop postoperative delirium (POD), and 12% will likely develop long-term postoperative cognitive dysfunction (POCD). Prior to implementing this project, the Naval Medical Center San Diego Anesthesia Department did not utilize a standardized protocol that specifically addressed POCD and POD occurrence in the elderly.

Clinical Question: Will introducing an enhanced recovery after surgery (ERAS) protocol aimed at decreasing the rate of POD and POCD in elderly surgical patients undergoing general anesthesia change the practice of anesthesia providers?

Project Design: An ERAS protocol was created based on a review of current evidence-based guidelines. Staff education was conducted prior to departmental implementation. Electronic medical records (EMRs) were reviewed from 3-months prior to protocol introduction and 3-months afterward to observe the frequency in which providers used intraoperative processed electroencephalography (EEG), meperidine, morphine, dexmedetomidine, and midazolam. The utilization of pre and postoperative neurocognitive assessments was also measured.

Analysis of the Results: 646 EMRs met the criteria for review. Group A (n=306) was a collection of EMRs from the three months prior to protocol introduction, and group B (n=340) consisted of EMRs from three months afterward. The latter showed a clinically significant increased use of four ERAS interventions with statistical significance in two. These interventions

include preoperative cognitive assessments ($p<0.001$), postoperative cognitive assessments ($p=0.386$), processed EEG use ($p<0.001$), and intraoperative dexmedetomidine administration ($p=0.163$).

Organizational Impact: Increased utilization of an evidence-based ERAS protocol to address the risk of POD and POCD in the elderly population at NMCS D. Projected savings of 1 million dollars per 1000 cases. Multi-site adoption will benefit over 2.3 million elderly Military Health System (MHS) beneficiaries.

Enhanced Recovery for Elderly Surgical Patients Receiving General Anesthesia

Hospital and ambulatory surgery centers perform over 30% of all their procedures on elderly adults (age 60 and older) (Centers for Disease Control, 2010). Consequently, 11% to 51% of this rapidly growing patient population will develop postoperative delirium (POD) (Inouye et al., 2013; Raats et al., 2015), and 12% will likely develop long-term postoperative cognitive dysfunction (POCD), which can lead to further complications and in some cases death (Engelhard & Werner, 2005; Monk et al., 2008; Schupf et al., 2005). This complication rate is twice as high as any other age group (Krenk & Rasmussen, 2011). Prior to implementing this project, the Naval Medical Center San Diego (NMCS D) anesthesia department did not utilize a standardized protocol that specifically addressed minimizing POCD and POD occurrence in the elderly. Given the large population of retired veterans and elderly Tricare beneficiaries eligible for care at NMCS D, it would be beneficial to adopt a standardized enhanced recovery after surgery (ERAS) protocol supported by literature and tailored to ameliorate the frequency of POCD and POD in the elderly. The following paper explores the current topic of perioperative neurocognitive disorders (PND), specifically focusing on the two subgroups, POCD and POD, among the elderly and provides an evidence-based ERAS protocol that addresses the most significant perioperative interventions that speak to these specific concerns.

Problem Synthesis

This project focused on two potential postoperative neurocognitive disorders: POCD and POD. POCD refers to a deterioration in cognition following surgery and presents with subtle symptoms, leading to difficult detection. It is defined (not diagnosed) by research methodology and a prolonged course of symptoms (Cole & Kharasch, 2018). Due to the subtle nature of POCD, it is often the patient and or family who recognize the cognitive change after surgery.

POCD occurrence is determined by neuropsychological tests, preferably performed prior to surgery to reference baseline cognition (Fitzpatrick & Owen, 2018). POCD changes may last months to years after surgery and are associated with increased morbidity and mortality in the elderly (Engelhard & Werner, 2005). POD involves disturbances in attention, arousal, cognition, and hallucinations and delusions that occur during the initial postoperative period (1-3 days) (Benhamou & Brouquet, 2016). POD is recognized as a diagnosis in the International Classification of Diseases and is listed in the Diagnostic and Statistical Manual. POD is an acute and fluctuating mental status change of inattention and an altered level of consciousness (Wong et al., 2010). POD is diagnosed through clinical surveillance by utilizing a confusion surveillance scale such as the confusion assessment method (CAM) scale (Wong et al., 2010). POD is associated with more extended hospital stays, increased morbidity and mortality, and higher health care costs (Inouye et al., 2014).

The relationship between POD and POCD is not well established, however they share common risk factors such as age, frailty, high comorbidity burden, pre-existing cognitive dysfunction, poorly controlled postoperative pain, use of anticholinergic medications. In addition, current literature suggests POD occurrence is a risk factor for the onset of POCD (Youngblom et al., 2014; Rengel et al., 2019). With the rapid growth of the elderly surgical population, medical facilities need to address this concern. NMCSD leadership was aware of this issue and sought out a standardized anesthesia protocol to mitigate risk for POCD and POD among elderly surgical patients.

Elderly Patients at Increased Risk

The increased susceptibility of elderly patients has been studied in research as early as 1998. In an international multicenter study of 1218 patients greater than 60 years of age, POCD

was present in 25.8% of patients one week after surgery and 9.9% of patients three months after surgery, compared with the control groups (UK and international control groups) of 3.4% one week after surgery and 2.8% at three months postoperative (Moller et al., 1998). In 2008, a prospective cohort study of 1064 patients aged 18 years and older were monitored for POCD occurrence in the immediate postoperative period of major noncardiac surgery and up to three months afterward (Monk et al., 2008). On discharge, POCD was detected in 36.6% of the young (18-39), 30.4% of the middle-aged (40-59), and 41.4% of the elderly (60 years or older) (Monk et al., 2008). In contrast, three months after surgery, POCD was present in 5.7% of the young, 5.6% of the middle-aged, and 12% of the elderly (Monk et al., 2008). This literature suggests all age groups exhibit POCD at the time of discharge, but patients aged 60 years or older are at greater risk of POCD continuing for up to three months or longer postoperatively. Additionally, the risk factor most strongly associated with the occurrence of POCD and POD is increasing age (Rengel et al., 2019).

Debilitating Comorbidities

POCD is associated with an increased mortality rate within the first year after major noncardiac surgery (Monk et al., 2008). Patients with POCD at hospital discharge are more likely to die before the three-month testing time (6.5%) compared with patients without (3.4%) (Monk et al., 2008). Patients who exhibit POCD at both discharge and at three months after surgery are at increased risk of death in the first year (10.6%) compared with non-POCD patients (2.1%) (Monk et al., 2008). There is also a correlation between the swift cognitive decline from POCD and an increased mortality rate in the elderly (Schupf et al., 2005). Additionally, decreased cognition from POCD has been associated with early withdrawal from employment, leading to financial hardship (Besch et al., 2018). Longitudinal studies of normal aging without

surgery suggest any sudden decline in cognitive function has been correlated to a loss of independence and withdrawal from society and is a significant predictor of mortality (Vizcaychipi, 2016). Cognitive decline experienced by elderly patients after surgery has been linked to increased vulnerability for further complications.

NMCSD Quality Improvement Initiative

According to the NMCSD webpage, more than a quarter of a million military health care beneficiaries (active duty, dependents, and retirees) reside in the San Diego region and are eligible for care at NMCSD (About us, n.d.). A large portion of these beneficiaries are retired and elderly. Prior to this project, the anesthesia department at NMCSD did not utilize a standardized approach to minimize the occurrence of POCD or POD in any age population, specifically the elderly. Therefore, the leadership within the anesthesia department at NMCSD requested an evidence-based approach to mitigating the risk for POCD and POD among this vulnerable population.

Relevance to Military Nursing

NMCSD is one of the three most extensive Navy medical treatment facilities (MTFs) in the U.S. and the only one located on the west coast. Patients with POCD and POD following major orthopedic, vascular and abdominal surgery have a prolonged mean length of stay greater than five days, an average of 2 additional inpatient days, and institutional discharge and readmission within 30 days, which leads to increased medical care costs (Gleason et al., 2015). In nearly 2.4 million Medicare patients, the presence of a PND was associated with an increase of \$17,275 in payments in the 1st year after the initial surgical procedure (Boone et al., 2020). In this study, a total of 6846 patients (15.2%) experienced mild cognitive impairment in isolation, and 18,221 patients (40.5%) experienced delirium alone (Boone et al., 2020). Mild cognitive

impairment (POCD) and delirium occurred in combination in 448 patients (1.0%), delirium and dementia together occurred in 18754 patients (41.7%), and 705 patients (1.6%) experienced all 3 PND subtypes (Boone et al., 2020). PND results in increased medical care costs for military treatment facilities and increased morbidity and mortality for this patient population. Integration of an elderly perioperative neurocognitive disorder ERAS protocol for military retirees and dependents aligns with the Military Health System (MHS) quadruple aim framework for better care, better health, increased readiness, and lower cost (DHA, 2019). Standardizing anesthesia care with evidence-based ERAS guidelines will increase staff knowledge and patient satisfaction while preventing costs associated with prolonged hospital stays by decreasing the incidence of POCD and POD. The ERAS protocol can eventually be adopted and adjusted by other MTFs that serve a similar population.

PICOT/ Clinical Question

For the anesthesia providers at NMCS D (P), will the education and the implementation of an evidence-based ERAS protocol aimed at decreasing POCD and POD in noncardiac surgical patients age 60 and older (I), compared to current practice based on individual provider preference (C), alter the practice of providers when administering general anesthesia to noncardiac surgical patients age 60 and older (O) in 3 months (T)? Essentially, this project seeks to answer the question: "Will introducing an enhanced recovery after surgery (ERAS) protocol aimed at decreasing the rate of POD and POCD in elderly surgical patients undergoing general anesthesia change the practice of anesthesia providers?"

Search Strategy/Results

Our PICOT/clinical question, guided the literature search for this project and the development of an evidence-based ERAS protocol. Electronic databases such as PubMed,

Power Search, Elsevier, and Google Scholar, were searched for peer-reviewed articles with language restriction of English, full text, human subjects only, study group population age 60 and older, studies within the last ten years, and manually reviewed reference lists for relevant articles. Exclusion criteria were non-English, age groups below 60 years old, articles greater than ten years old, and studies strictly involving cardiac surgery. Search terms were initially identified by scanning systematic reviews on POCD and POD prevention strategies and examining index terms. Search keywords included the following were conducted using variations of the following terms: “postoperative cognitive dysfunction” OR “POCD” OR “postoperative delirium” OR “POD” OR “perioperative neurocognitive dysfunction” OR “PND” OR “noncardiac surgery” OR “elderly” OR “60 years and older” OR “enhanced recovery after surgery” OR “ERAS” OR “POD + prevention” OR “POCD + prevention” OR “POD + BIS monitoring” OR “POD + dexmedetomidine” OR “POCD + POD + noncardiac surgery + elderly” OR “POCD enhanced recovery” OR “enhanced recovery after surgery + elderly” OR “POCD + BIS monitoring” OR “dexmedetomidine + POCD” OR “neurocognitive tests + POCD” OR “montreal cognitive assessment” OR “MoCA + POCD” OR “mini mental status exam” OR “MMSE” OR “MoCA” OR “Telephone MoCA” OR “60 years and older + POCD + POD.”

The search process is shown in the PRISMA diagram (Moher, 2009) (Appendix A) and the history of searches (Appendix B). The above search strategy retrieved 837 articles from PubMed, 1780 from Google Scholar, 1326 from Power Search, 81 articles from Elsevier, and 26 citations from referenced relevant articles. Records were further narrowed down to 168 articles by adding the inclusion as mentioned earlier and exclusion criteria and removing duplicate studies from April 10 to April 18, 2020. Of these, 50 articles were screened and excluded because of irrelevance after scanning titles and abstracts. In addition, articles available

as full-text were reviewed, and 77 additional studies were excluded. Finally, 41 articles were collected for the systematic review (Appendix A).

The John Hopkins Nursing Evidence-Based Practice Tool (Appendix C) was utilized to assign evidence level and quality guide (John Hopkins Hospital, 2017). The project's evidence table resulted in levels and quality designations of IA, IB, IIA, IIB, IIIA, IIIB, IVA, VA, VB (Appendix D). For distribution of evidence level for studies utilized in the formulation of the solution synthesis, there were two IA articles, nine IB articles, one IIA article, three IIB articles, one IIIA article, two IIIB articles, two IVA articles, three VA articles, and two VB articles (Appendix D). The literature review demonstrated that patients 60 years and older undergoing noncardiac surgery might benefit from an evidence-based supported ERAS protocol to decrease the risk of PND subgroups, POCD and POD.

Solution Synthesis

The solution to minimizing the risk of developing POCD and POD among the elderly surgical patients of NMCS is to establish and implement an ERAS protocol compiled of evidence-based interventions associated with detecting or decreasing the occurrence of POCD and POD in the elderly. An ERAS protocol is a patient-centered, evidence-based, multidisciplinary team-developed intervention pathway for a surgical specialty and facility (American Association of Nurse Anesthetists, 2017). Effective protocols reduce the patient's surgical stress response, optimize their physiologic function, and facilitate recovery (Paton et al., 2014). Each element of an ERAS protocol is beneficial; however, the combination of multiple interventions throughout the entire perioperative continuum makes them more effective (Paton et al., 2014). The following perioperative pathway is a formulation of practices supported by

current research and geared towards decreasing the prevalence of POCD and POD in elderly patients. The pathway is divided into preoperative, intraoperative, and postoperative phases.

Preoperative Phase

The prevention of PND subgroups, POCD and POD, begins in the preoperative phase with neurocognitive assessment, patient education, and planning (Berger et al., 2018; Needham et al., 2017). Neuro-cognitive assessment allows the provider to identify higher-risk patients—patient education elicits active participation in perioperative planning and recovery.

Neurocognitive Assessment

Preoperative assessment of neurocognitive function and risk factor identification are essential steps in identifying patients at increased risk for developing POCD and determining baseline function (Needham et al., 2017). Literature delineates the importance of this recommendation since nearly all anesthetic and analgesic drugs target the central nervous system (CNS), and POCD is a CNS dysfunction that can only be diagnosed by a cognitive change from baseline (Berger et al., 2018). Examples of neurocognitive tests include The 4 A's Test (4AT) and The Montreal Cognitive Assessment (MoCA). The 4AT is a short (<2 min) four-item test of delirium detection that is utilized internationally in clinical settings and does not require special training to perform (Saller et al., 2019; Tieges et al., 2020). The 4AT tool has high specificity and sensitivity for the detection of POD and cognitive changes (Saller et al., 2019; Tieges et al., 2020). The MoCA is currently used by the neurology department at NMCS D and has “high sensitivity and specificity” for detecting various cognitive dysfunctions (Smith et al., 2016, p. 1). The MoCA assesses the domains of attention/concentration, executive functions, memory, language, visuo-constructional skills, conceptual thinking, calculation, and orientation in less than 10 min (Smith et al., 2016). Staff will assess applicable patients on the day of surgery or

during the anesthesia prescreening interview using a neurocognitive exam. An anesthesia provider will further evaluate patients with a high risk of delirium or baseline cognitive disorder. Preoperative utilization of a neurocognitive exam such as the 4AT and MoCA can measure baseline cognitive function, detect mild cognitive impairment, and inform providers of increased POCD and POD risk (Lonie et al., 2010; Saller et al., 2019; Tieges et al., 2020).

Patient Education and Planning

The 5th International Perioperative Neurotoxicity Working Group recommends informing elderly patients that they are more likely to develop PND disorders such as POCD and POD (Berger et al., 2018). Verbal and written communication of PND risk during the preoperative interview and informed consent for anesthesia discussion will provide patients and their families perspective on the possible outcomes of surgery. Addressing this information will allow patients to prepare an advanced directive and living will. An adequate discussion should also encourage patients to recruit a familiar support person to help with re-orientation and bedside assistance after surgery as those interventions have been shown to decrease PND risk (Berger et al., 2018).

Table 1

Preoperative PND ERAS Recommendations

Preoperative PND ERAS Recommendations	
Establish baseline neurocognitive assessment	Berger et al., 2018; Lonie et al., 2010; Needham et al., 2017; Saller et al., 2019; Tieges et al., 2020
Ensure patients are aware of PND risks	Berger et al., 2018

Intraoperative Phase

Claims were attributing POCD to intraoperative transient hypoxia, hypotension, volatile anesthetic type, or anesthetic administration technique currently lack overt statistical support (Berger et al., 2018; Moller et al., 1998; Needham et al., 2017). Current literature supports favorable outcomes with optimizing anesthetic depth with the utilization of processed electroencephalography (EEG) monitor and intraoperative administration of dexmedetomidine (Alam et al., 2018; Chan et al., 2013). Avoiding deliriogenic medications and initiating measures for postoperative pain control have also been associated with PND reduction (Rengel et al., 2019).

Processed EEG and Bispectral Index Monitoring

Intraoperative cerebral monitoring by processed EEG increases provider precision in assessing and maintaining a patient's level of anesthesia (Palanca et al., 2009). Bispectral Index (BIS) is the latest processed EEG device at NMCS. Processed EEG-guided anesthesia reduces anesthetic exposure and decreases the risk of POCD three months after surgery by about 3% (Bocskai et al., 2020; Chan et al., 2013). Additionally, it can reduce propofol delivery by 21%, volatile anesthetic delivery by 30%, and intraoperative fentanyl delivery by 31% (Chan et al., 2013; Recart et al., 2003). Processed EEG can also reduce the incidences of intraoperative awareness incidence when utilized for intravenous anesthesia administration, but there was no advantage found in its utilization with inhalation anesthesia (Gao et al., 2018). Anesthetic delivery titrated to achieve a BIS range between 40 and 60 would prevent 23 out of 1000 elderly major surgery patients from developing POCD and 83 patients from developing delirium (Chan et al., 2013). Anesthetic depths with BIS values less than 20 is an independent predictor of POD occurrence which is associated with an increased length of hospital stay and higher incidence of

POCD at seven days and three months postoperatively (Radtke et al., 2013). BIS value of 45 is generally regarded as the dividing line between “light” anesthesia and “deep” anesthesia and the intraoperative goal is to maintain desired values for more than 80% of the total time from the induction to the cessation of anesthesia (An et al., 2011). Quan et al. (2019) found that the deep anesthesia group with BIS target of 30-45 had a better outcome with decreased occurrence of POCD at 7 days after surgery vs the light anesthesia group with BIS target of 45-60, there was no difference of POCD rates at 30 days postoperative.

Intraoperative Medications

The Beers Criteria Update Expert Panel recommends minimizing or avoiding the use of opioids during surgery (American Geriatrics Society 2019 Beers Criteria Update Expert Panel, 2019). Morphine, and meperidine are more often associated with delirium than alternative agents such as propofol, dexmedetomidine, and fentanyl (Morrison et al 2003; Sieber et al., 2011; Maldonado et al., 2009). Dexmedetomidine is an alpha-2 adrenoceptor agonist effective in reducing opioid use (Zhang et al., 2019). It also abates the intraoperative stress response and decreases pro-inflammatory cytokines (Zhang et al., 2019). Post-surgical neuroinflammation is an independent factor often leading to the occurrence of POCD (Barrientos et al., 2012), but there is evidence that supports the anti-inflammatory and immunomodulatory effects of dexmedetomidine in animal models (Carr et al., 2018). Intraoperative use of dexmedetomidine in adults reduces the relative risk and incidence of POCD and POD (Alam et al., 2018; Zhou et al., 2016). A meta-analysis of 10 randomized control trials, encompassing 2,286 patients, associated the use of dexmedetomidine infusion with a reduction in the occurrence of POD when compared to other sedation techniques (saline, propofol, or midazolam alone) (Ming et al., 2020). In the same study, dexmedetomidine infusion rates higher than 0.2 µg/kg/h were associated with a 34%

reduction in the relative risk of developing postoperative delirium. When the infusion rate was less than 0.2 µg/kg/h, POD occurrence was reduced by 62% (Ming et al., 2020).

Table 2

Intraoperative POCD ERAS Recommendations

Intraoperative POCD ERAS Recommendations	
Utilize processed EEG guided anesthesia	An et al., 2011; Bocskai et al., 2020; Chan et al., 2013; Palanca et al., 2009; Gao et al., 2018; Quan et al., 2019; Woerschling, 2017
Administer intraoperative dexmedetomidine	Alam et al., 2018; Zhou et al. 2016; Ming et al., 2020
Minimize or avoid the use of meperidine and morphine.	American Geriatrics Society 2019 Beers Criteria Update Expert Panel, 2019
Avoid use of morphine and meperidine due to association with delirium. Alternative agents: propofol, dexmedetomidine, and fentanyl	Morrison et al., 2003; Sieber et al., 2011

Postoperative Phase

Postoperative utilization of non-pharmacological measures such as early mobilization, maintaining sensory input (glasses and hearing aids), providing cognitive stimulation with reorientation, avoiding dehydration, and controlling postoperative pain are associated with positive outcomes and decreased POD and POCD rates (O'Brien et al., 2017; Rengel et al., 2019). The American Geriatrics Society advocates minimizing or avoiding the perioperative use of medications such as opioids (particularly meperidine), anticholinergics, diphenhydramine, metoclopramide, and agents that may cause serotonin syndrome due to their associated risk of causing cognitive impairment (American Geriatrics Society 2019 Beers Criteria Update Expert Panel, 2019). Postoperative pain management strategies associated with reducing POD occurrence include multimodal techniques, regional anesthesia if indicated, and the application of opioid-sparing ERAS protocols (Rengel et al., 2019; Krenk et al., 2012). The early detection

and diagnosis of POD in the PACU are associated with delirium on the ward and early postoperative cognitive decline (Saller et al., 2019). Clinical surveillance for POD will be accomplished with the completion of a confusion surveillance scale in the post-anesthesia care unit and inpatient wards (Wong et al., 2010). NMCS-D will continue using the CAM-ICU in the intensive care unit (ICU) and the post-anesthesia care unit (PACU) will utilize the Orientation Memory Concentration Test (OMCT) according to this ERAS protocol.

Table 3

Postoperative POCD ERAS Recommendations

Postoperative POCD ERAS Recommendations	
Non-pharmacological interventions: • Early mobilization • Maintain sensory input (glasses and hearing aids) • Cognitive stimulation and reorientation • Avoid dehydration	O'Brien et al., 2017
Minimize or avoid medications associated with causing cognitive impairment: • Opioids (particularly meperidine) • Anticholinergics • Diphenhydramine • Metoclopramide Medications that may cause serotonin syndrome (tramadol and dextromethorphan)	American Geriatrics Society 2019 Beers Criteria Update Expert Panel, 2019
Postoperative pain control: • Multimodal pain technique • Use of regional anesthesia if indicated Opioid sparing (meperidine and morphine avoided)	Rengel et al., 2019; Krenk et al., 2012
Monitor POD occurrence through confusion surveillance scale: • Orientation Memory Concentration Test (OMCT) in PACU CAM-ICU in the ICU	Saller et al., 2019; Tieges et al., 2020; Wong et al., 2010

NMCSD Targeted Outcome

POCD and POD are multifaceted complications from surgery with a greater affinity for the elderly. This utilized ERAS protocol aims to improve the safety and management of elderly surgical patients by implementing evidence-based interventions throughout the perioperative continuum. Incorporating this standardized protocol into daily practice by the anesthesia department of NMCSD will be a practical step towards reducing the occurrence of PNDs among elderly surgical patients.

Focus Areas

This evidence-based project focused on evaluating the process of implementing an ERAS protocol aimed at decreasing the risk of PND subgroups POCD and POD in elderly beneficiaries, age 60 years and older, after receiving general anesthesia for noncardiac surgery. This project had three aims regarding implementing the ERAS protocol in the NMCSD anesthesia department. The first aim was to create and present the evidence-based ERAS protocol to the anesthesia department head and stakeholders for approval. The second aim was to enhance the knowledge of the anesthesia providers by providing training on the ERAS protocol, the occurrence of POCD and POD among the elderly population, and the current recommendations supported by the literature. The third aim was to evaluate the departmental utilization of the ERAS protocol by comparing the frequency of specific interventions used during the three months prior to protocol implementation and three months afterward.

Business Case Analysis

By assessing the needs identified by senior staff at NMCSD, this team developed an evidence-based ERAS guideline focused on standardizing anesthesia practice and decreasing the occurrence of POCD and POD in the elderly patient population of NMCSD. Utilizing a

multiphase approach to the care of these patients will result in decreased complications, length of stay, and costs. In turn, it will also enhance patient safety and satisfaction. The business case analysis (BCA) for this project estimates a potential cost savings of \$1,019,844.00 per 1000 cases (Appendix H). These figures were calculated from the cost of BIS electrodes, replacement monitor parts, vials of dexmedetomidine, and staff education. This estimate also considers the assumption that an anesthetic delivery titrated to achieve a BIS range between 40 and 60 would prevent 23 out of 1000 elderly major surgery patients from developing POCD and 83 patients from developing delirium (Chan et al., 2013). The cost of the 1st year of medical care after the development of POCD is \$17,275 per patient. Also, the cost of the extended hospital stay and extra care required for POD is \$8,373 per patient (Boone et al., 2020; Zywiell et al., 2015). The calculations were based on the costs published in the current literature and the current cost of supplies recorded on NMCSO invoices.

Organizing Framework

The Iowa Model for Evidence-Based Practice Change was selected as the organizational framework for this project, given it is an interdisciplinary team-oriented model with a direct, practical approach to identifying issues, researching solutions, and implementing changes. The framework consists of six steps: assess the need for change, identify the best evidence, synthesize evidence, design practice change, implement and evaluate, then integrate and maintain the changes in practice (Iowa model collaborative, 2017).

Preventing POCD and POD is of the utmost importance as our nation's elderly population rapidly grows due to the aging baby boomer generation, declining fertility rates, and rising life expectancy (U. S. Census Bureau, 2020). Recognizing there is no standard anesthetic protocol for the care of elderly patients and the increased awareness of the susceptibility of

elderly surgical patients to the complication of POCD and POD facilitated command support for this project. After conducting literature reviews of peer-reviewed articles and meta-analyses, sufficient evidence was gathered to determine the significance of POCD and POD in elderly surgical patients. Further literature reviews were conducted to develop an evidence-based ERAS protocol for the care of elderly patients receiving general anesthesia. During this project's ERAS protocol development, meetings were held with key stakeholders and subject matter experts to create an evidence-based ERAS for NMCSD. After creating the ERAS protocol with multidisciplinary input, it was implemented for utilization in the department by providing face-to-face and pre-recorded training to the anesthesia staff of NMCSD. A review of electronic medical records (EMRs) three months before implementation and three months after was conducted to evaluate change in practice. The final step was integrating the ERAS protocol into NMCSD anesthesia practice and conducting periodic updates.

Project Design

General Approach

This process improvement and evaluation project implemented an ERAS protocol and provided staff education. Pre and post-implementation data were collected to measure staff ERAS intervention utilization. That information was then analyzed with the assistance of an on-site bio-statistician.

Setting and Population

NMCSD is a 272-bed multi-specialty hospital and ambulatory complex with 18 operating rooms located in San Diego, California. More than 45,000 TriCare beneficiaries age 60 and greater are eligible for surgery at NMCSD (Schlichting, R. personal communication, October 5, 2020). Ninety-four anesthesia providers of NMCSD's anesthesia department (anesthesiologists,

CRNAs, residents, and CRNA students) were observed for this project. The NMCSD anesthesia department performs over 3,300 anesthesia procedures on elderly patients annually, with over 550 of those procedures being surgical cases requiring general anesthesia (Surgical Scheduling System).

Procedural Steps

This project plan was separated into 5 phases (Appendix E). In phase 1, evidence from literature was gathered to formulate a problem and solution synthesis. During phase 2, meetings were conducted with key stakeholders and subject matter experts to create an evidence-based ERAS protocol and gain command approval. During phase 3, the ERAS protocol was implemented in the department. EMR reviews were conducted to data-mine for information of interest, such as the utilization of the processed EEG and pharmacological agents administered throughout the eligible surgical cases (specifically, meperidine, morphine, dexmedetomidine, midazolam.) The presence of preoperative and postoperative neurocognitive assessments in the patient's chart will also be measured. In phase 4, we analyzed the data with assistance from an on-site statistician. The last phase, phase 5, encompasses disseminating project findings through military email accounts, departmental flyers, poster presentations, USU research week presentation, a submission to the TSNRP Dissemination Course, and submission to the AANA Annual Congress.

Data Analysis Plan

Outcome variables for the project were compared from the first three-month period to the second 3 month period, and as recommended by our facility statistician, a logistic regression model was utilized to observe for any correlations within the findings. Descriptive statistics were

utilized to describe the frequency distribution of nominal data, and differences between pre and post-implementation data were compared (Appendix G).

Potential Barriers

The initial potential barriers for this project were a lack of supplies such as BIS quattro strips and BIS monitors. The anesthesia department previously had three working modules. This project was awarded a \$10,000 TSNRP mini EBP grant which was utilized to purchase components to make three more modules operational. There was initial concern that if the BIS components were unable to be secured or purchased for unseen reasons, the project's team members would ask the anesthesia providers to chart a lack of available BIS supplies as the reason why BIS monitoring was not used. This would have brought to attention the importance of allocating funding towards purchasing BIS supplies.

Another potential barrier was the lack of buy-in from anesthesia providers. This project understood there was a possibility that providers would be reluctant to change their personal practice for a seemingly new concept presented by students. The project's team members gained tremendous support from the USU site research director, anesthesia chair, and a senior anesthesiologist regarded as the subject matter expert for neurological surgeries. Their influence, the evidence-based rationales in this presentation, and buy-in from other anesthesia providers helped gather inertia and sway the minds of the late majority and laggards.

Dissemination Plan

The findings of this EBP project were disseminated throughout the anesthesia department as well as the USU community. Electronic and printed flyers were created and distributed throughout the NMCS D anesthesia department. A follow-up presentation was conducted during a department meeting of the project's findings. A poster and PowerPoint presentation was

developed and presented during the 2022 USU research week. Lastly, an abstract and poster was submitted to the TSNRP Dissemination Course, a national venue to present EBP findings to military healthcare professionals.

HIPAA Concerns

There are minimal HIPAA concerns for this project. The team assigned to this project had access to patients' personally identifiable information while data mining electronic health records. However, only demographic data such as age, gender, procedure type, anesthesia type, and ERAS protocol interventions used were gathered, categorized, and presented. The presentation of data did not include individual patient statistics/information. Personally identifiable information from providers were not used. Data documentation occurred on electronic databases (Microsoft Excel) that were stored on a Common Access Card (CAC) enabled government computer maintained in a locked office.

Project Results

Information was collected from 646 electronic medical records (EMRs) made of two groups. The non-ERAS group (n=306) consisted of EMRs from three months prior to protocol introduction. The ERAS group (n=340) consisted of EMRs from three months after protocol implementation. Both groups had a mean age (SD) of 71.09 (8.582) years. Further demographic data is shown in Table 4 and Figure 1.

The ERAS group showed an increase in the utilization of 5 out of 7 interventions. Statistically significant increases were observed in preoperative assessment performance and BIS monitor use.

Intravenous meperidine and morphine were not used in either group. Preoperative cognitive assessments were performed 77 more times in the ERAS group ($p < 0.001$).

Postoperative cognitive assessments were performed six more times in the ERAS group ($p=0.386$). Dexmedetomidine was administered 21 more times in the ERAS group ($p=0.163$). Midazolam was administered 17 more times the ERAS group ($p=0.810$). Processed electroencephalography (EEG) was used 98 more times on the ERAS group ($p<0.001$) (Table 5, Figure 2).

A logistic regression model was utilized to observe possible correlations between intervention utilization and demographic data. There was a statistically significant correlation between the bleeding risk category and dexmedetomidine infusion ($p<0.001$). The use of BIS monitoring showed a statistically significant correlation with four other factors; dexmedetomidine infusion ($p<0.011$), administration of a regional block ($p<.001$), preoperative cognitive assessment ($p<0.020$), and ERAS protocol implementation ($p<.001$). Other significant correlations include dexmedetomidine bolus administration with general anesthesia ($p=0.050$; 1 sided) as well as dexmedetomidine bolus use with midazolam administration ($p=0.035$).

Table 4

Pre and Post ERAS Sample Demographic Data

Demographic Data by Frequency and Percentage Before and After Protocol					
	Non-ERAS	Non-ERAS %	ERAS	ERAS %	p-value
N=646	306	100.0%	340	100.0%	
Gender					
Male	158	51.6%	202	40.6%	$p=0.048$
Female	148	48.4%	138	59.4%	
Age					
60-64	93	30.4%	98	28.8%	$p=0.537$
65-69	55	18.0%	77	22.6%	
70-77 *	88	28.8%	91	26.8%	
78 and older*	70	22.9%	74	21.8%	
Pain risk category					
Low	144	47.1%	167	48.1%	$p=0.209$
Mod	97	31.7%	95	29.7%	

High	65	21.2%	78	22.1%	
Blood loss risk category					
Low	156	51.0%	176	51.8%	p=0.572
Mod	93	30.4%	117	34.4%	
High	57	18.6%	47	7.3%	
* (adjusted due to distribution)					

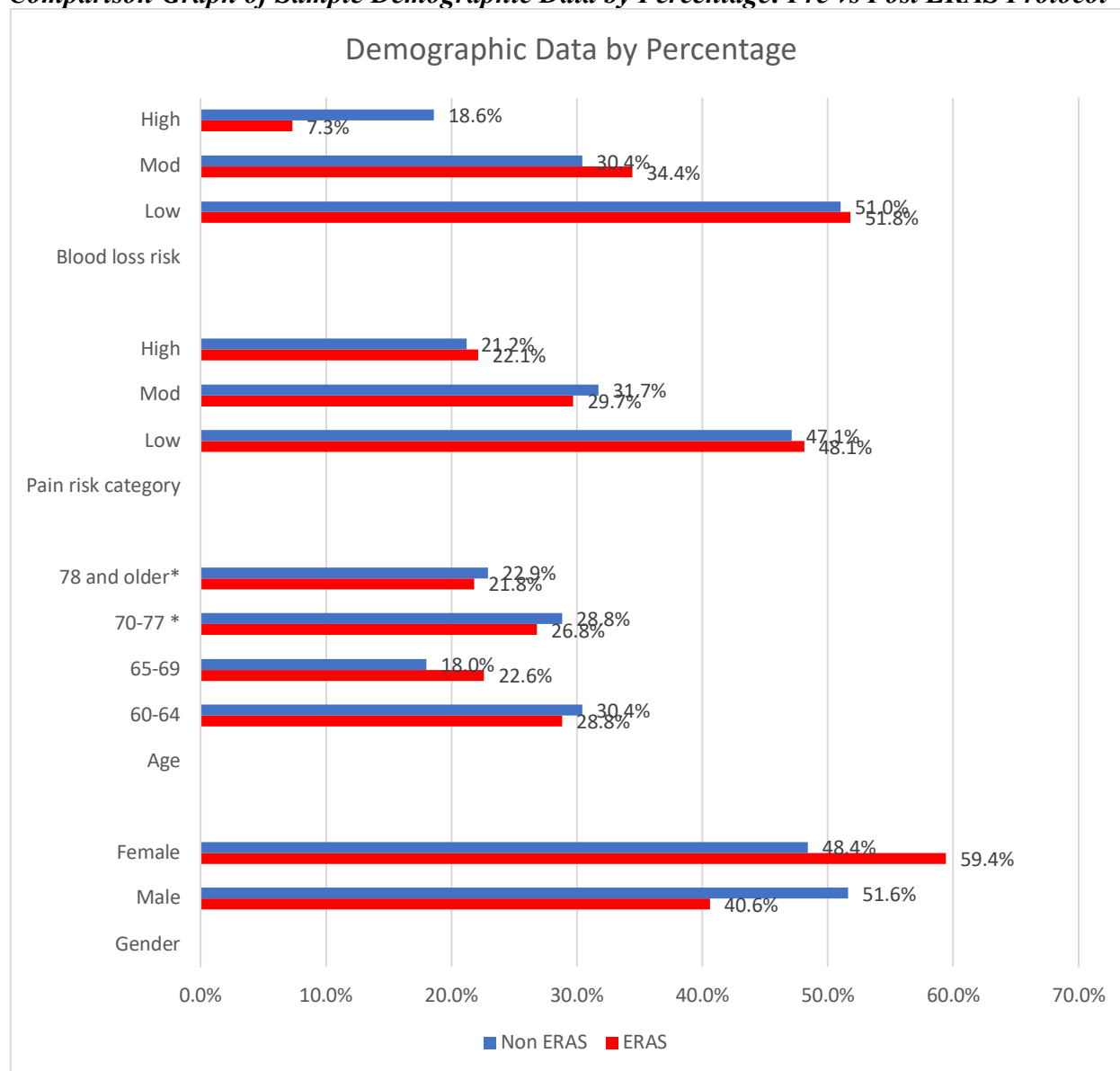
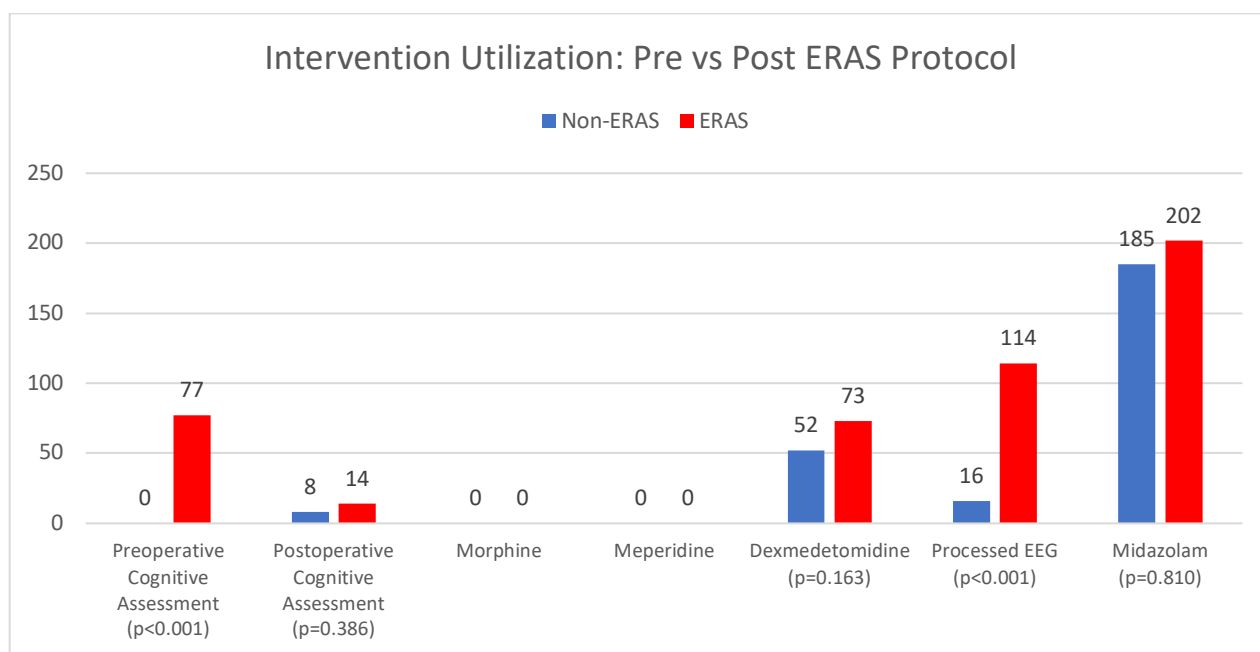
Figure 1***Comparison Graph of Sample Demographic Data by Percentage: Pre vs Post ERAS Protocol***

Table 5***Pre and Post ERAS Protocol Intervention Use***

Frequency of Interventions Used Before and After Protocol			
Data	Non-ERAS	ERAS	p-value
Preoperative Cognitive Assessment	0	77	p<0.001
Postoperative Cognitive Assessment	8	14	p=0.386
Morphine	0	0	n/a
Meperidine	0	0	n/a
Dexmedetomidine	52	73	p=0.163
Midazolam	185	202	p=0.810
Processed EEG Use	16	114	p<0.001

Figure 2***Comparison Graph of Intervention Use: Pre vs Post ERAS Protocol*****Analysis of the Results**

After staff education and protocol initiation, the utilization of five out of seven interventions increased. Two interventions, meperidine and morphine administration, were never

performed in either group. These findings show overwhelming staff support of the ERAS protocol and the evidence-based interventions adopted from the Fifth International Perioperative Neurotoxicity Working Group (Berger et al., 2018), the Perioperative Quality Initiative (POQI)-6 consensus conference (Hughes et al., 2020), the Perioperative Brain Health Initiative Expert Panel (Peden et al., 2020).

This project would also like to draw attention to two unexpected aspects of our data. First is the lack of statistical significance in the frequency of dexmedetomidine use. Dexmedetomidine is an alpha-2 receptor agonist that providers commonly administer for sedation, analgesia, and neuroprotective effects (Zhao et al., 2020). In many cases, dexmedetomidine can cause hypotension and bradycardia with administration (Zhao et al., 2020); therefore, a patient's cardiovascular stability can dictate its use by the provider. Unfortunately, we did not account for the vital signs or specific comorbidities for each patient; therefore, we cannot fully determine a reason for the lack of statistical significance.

The second unexpected result is the increase of midazolam administration in the ERAS group. Our initial protocol guidance was to administer benzodiazepines to elderly patients judiciously. This was based on our review of the 2015 American Geriatrics Society Beers Criteria Expert Panel guidelines, which stated benzodiazepines administration could synergize the effects of opioids, antidepressants, and other medications, resulting in an increased risk for falls and fractures, and other severe injuries among the elderly population. However, the 2019 American Geriatrics Society Beers Criteria Update Expert Panel stated that administration of benzodiazepines among the elderly population is acceptable for "periprocedural anesthesia." The discovery of the Beers criteria updates led us to remove midazolam administration guidance from our protocol.

Proposed Organizational Impact and Implications for Practice

This project was conducted to create multiple organizational impacts. First, this project increased facility awareness of the danger and prevalence of POD and POCD within the elderly surgical population. Next, it provided education on current guidelines that address POD and POCD in elderly patients to anesthesia providers and members of the perioperative team.

Increasing staff knowledge and providing evidence-based guidelines increases patient safety and satisfaction, decreases morbidity and mortality, prevents additional accrued costs, and decreases the incidence of perioperative neurocognitive dysfunction (Peden et al., 2020). This will also positively impact patient quality of life, health, safety, and productivity. The overall impact will be the improved anesthetic management of this growing patient population.

Despite the increasing prevalence of POD and POCD in the elderly surgical population, few healthcare systems utilize standardized protocols to monitor and minimize POD and POCD. For example, the MHS alone provides healthcare to over 2.3 million elderly beneficiaries (Tricare online) and does not utilize a standardized approach for POD and POCD prevention and monitoring. Therefore, a multi-MTF adoption of this project's ERAS protocol and education will benefit over 2.3 million elderly MHS beneficiaries and result in a projected cost savings of over 1 million dollars per 1000 cases (Boone et al., 2020).

Future Directions for Research and Practice

Future research and practice directions include disseminating these outcomes locally at NMCS D to include key stakeholders. This presentation will illustrate the benefits of educating anesthesia providers on the significance and occurrence of perioperative cognitive dysfunctions in elderly patients receiving general anesthesia. The enhanced recovery guidelines will be a permanent ERAS protocol available at NMCS D for utilization by anesthesia staff. We appointed

a champion within the anesthesia department who is well versed in the project and is committed to advocating for the project's progression. This champion will also continue updating the ERAS protocol with current literature annually. The champion will also perform periodic peer chart reviews to record protocol utilization. New staff members will have access to a presentation explaining the ERAS protocol and a copy of the ERAS protocol to assist with familiarization.

Another future direction for this project is to ensure the pre and post neurocognitive baseline exams throughout the perioperative process and possibly during the first post-surgical follow-up. An ultimate goal would be for all surgical services to understand the ERAS protocol and counsel their elderly patients about the risk of developing POD/POCD with surgery and anesthesia.

This project will be presented during the Uniformed Services University (USU) Research Week to raise awareness and support the general anesthesia brain health initiative for elderly patients. This project will also be presented as a digital poster during the 2022 TSRNP Dissemination Course. Furthermore, our team plans to submit an abstract to the American Association of Nurse Anesthetists (AANA) for publication and an opportunity to present during the annual AANA conference.

Conclusion

Elderly patients are at increased risk of developing POCD and POD. These debilitating PNDs can severely impair activities of daily living, increase the length of hospital stay, increase medical costs, and develop into further morbidity and mortality (Besch et al., 2018; Monk et al., 2008; Peden et al., 2020; Rengel et al., 2019; Schupf et al., 2005). Therefore, actions must be taken to mitigate the development of these PNDs amidst the looming growth of the elderly population. The introduction of an ERAS protocol and performance of staff education aimed at

reducing the rate of POCD and POD in elderly patients within the anesthesia department of a large MTF is associated with increased performance of preoperative cognitive assessments and postoperative cognitive assessments, as well as increased intraoperative use of dexmedetomidine and processed EEG. These guidelines can be utilized by all MHS MTFs and surgical sites that perform surgical procedures on patients older than 60 years old. POD and POCD development will remain relevant concerns for anesthesia providers confronting an aging population. A greater understanding of these conditions and preventative strategies is necessary for future practice. Further research and development of universal diagnosing criteria for POCD must be refined to increase the detection of POCD and improve the accuracy of reported prevalence. In addition, research must be conducted to track POD and POCD within MTFs and in the weeks following surgical procedures.

References

- Alam, A., Hana, Z., Jin, Z., Suen, K.C., & Ma, D. (2018). Surgery, neuroinflammation and cognitive impairment. *EBioMedicine*, 37, 547-556.
<https://doi.org/10.1016/j.ebiom.2018.10.021>
- American Association of Nurse Anesthetists. (2017). *Enhanced Recovery after Surgery Considerations for Pathway Development and Implementation*.
[https://www.aana.com/docs/default-source/practice-aana-com-web-documents-\(all\)/enhanced-recovery-after-surgery.pdf?sfvrsn=6d184ab1_12](https://www.aana.com/docs/default-source/practice-aana-com-web-documents-(all)/enhanced-recovery-after-surgery.pdf?sfvrsn=6d184ab1_12)
- American Geriatrics Society 2019 Beers Criteria Update Expert Panel. (2019). American geriatrics society 2019 updated AGS beers criteria for potentially inappropriate medication use in older adults. *The Journal of American Geriatrics Society*, 67(4), 674–694. doi: 10.1111/jgs.15767
- Barrientos, R., Hein, A. M., Frank, M. G., Watkins, L. R., & Maier, S. F. (2012). Intracisternal interleukin-1 receptor antagonist prevents postoperative cognitive decline and neuroinflammatory response in aged rats. *The Journal of Neuroscience*, 32(42), 14641-14648. <https://doi.org/10.1523/JNEUROSCI.2173-12.2012>
- Benhamou, D., & Bouquet, A. (2016). Postoperative cerebral dysfunction in the elderly: Diagnosis and prophylaxis. *Journal of Visceral Surgery*, 153, 527-532.
<https://dx.doi.org/10.1016/j.jviscsurg.2016.09.015>
- Berger, M., Schenning, K. J., Charles H. B., Deiner, S. G., Whittington, R. A., Eckenhoff, R.G., Angst, M. S., Avramescu, S., Bekker, A., Brzezinski, M., Crosby, G., Culley, D. J., Eckenhoff, M., Eriksson, L. I., Evered, L., Ibinson, J., Kline, R. P., Kofke, A., Ma, D., ... Zuo, Z. (2018). Best practices for postoperative brain health: Recommendations from the

fifth international perioperative neurotoxicity working group. *Neuroscience and Neuroanesthesiology*, 127(6), 1406-1413.

<https://doi.org/10.1213/ANE.0000000000003841>

Besch, G., Vettoretti, L., Clavuea, M., Boichut, N., Mahr, N., Bouhake, Y., Liu, N., Chazot, T., Samain, E., & Pili-Floury, S. (2018). Early post-operative cognitive dysfunction after closed-loop versus manual target controlled-infusion of propofol and remifentanyl in patients undergoing elective major non-cardiac surgery. *Medicine*, 97(40), 1-5.

<https://doi.org/10.1097/MD.00000000000012558>

Bocskai, T., Kovacs, M., Szakacs, Z., Gede, N., Hegyi, P., Varga, G., Pap, I., Toth, I., Revesz, P., Szanyi, I., Nemeth, A., Gerlinger, I., Karadi, K., & Lujber, L. (2020). Is bispectral index monitoring protective against postoperative cognitive decline? A systematic review with meta-analysis. *PLOS One*, 15(2), 1-17.

<https://doi.org/10.1371/journal.pone.0229018>

Boone, M., Sites, B., Von Recklinghausen, F., Mueller, A., Taenzer, A., & Shaefi, S. (2020). Economic burden of postoperative neurocognitive disorders among US medicare patients. *JAMA Network Open*, 3(7), 1-16. <https://doi.org/10.1001/jamanetworkopen.2020.8931>

Centers for Disease Control. (2010). *Number of all-listed procedures for discharges from short-stay hospitals, by procedure category and age: United States, 2010* [Data set]. CDC/NCHS National Hospital Discharge Survey.

www.cdc.gov/nchs/data/nhds/4procedures/2010pro4_numberprocedureage.pdf

Cole, D. J., & Kharasch, E. D. (2018). Postoperative brain function: Toward a better understanding and the american society of anesthesiologists perioperative brain health initiative. *Anesthesiology*, 129(5), 861. <https://doi.org/10.1097/ALN.0000000000002085>

- Defense Health Agency. (2019). Quadruple Aim Performance Process: Transforming Performance Improvement. <https://www.health.mil/Reference-Center/Presentations/2019/02/11/Quadruple-Aim-Performance-Process-Transforming-Performance-Improvement>
- Engelhard, K., & Werner, C. (2005). Postoperative cognitive dysfunction. *Der Anaesthetist*, 54(6), 588-594. <https://doi.org/10.1007/s00101-005-0829-y>
- Evered, L. A. & Silbert, B. S. (2018). Postoperative cognitive dysfunction and noncardiac surgery. *Geriatric Anesthesia*, 127(2), 496-505. <https://doi.org/10.1213/ane.0000000000003514>
- Fitzpatrick, S. & Owen, K. (2018). Postoperative cognitive disorders: Postoperative delirium and postoperative cognitive dysfunction. *Anesthesia Tutorial of the Week: Tutorial 385*. Retrieved from https://www.wfsahq.org/components/com_virtual_library/media/8c6f8f69fda03c9f78a3eca904980fa6-atow-385-00-01.pdf
- Gao, W., He, Y., Liu, L., Quan, Y., Wang, Y., & Zhao, B. (2018). BIS monitoring on intraoperative awareness: A meta-analysis. *Current Medical Science*, 38(2), 349-353. <https://doi.org/10.1007/s11596-018-1886-1>
- Gleason, L. J., Schmitt, E. M., Kosar, C. M., Tabloski, P., Saczynski, J. S., Robinson, T., Cooper, Z., Rogers, S. O., Jones, R. N., Marcantonio, E. R., Inouye, S. K. (2015). Effect of delirium and other major complications after elective surgery in older adults. *JAMA Surgery*, 150(12), 1134-1140 <https://dx.doi.org/10.1001/jamasurg.2015.2606>
- Hughes, C. G., Boncyk, C. S., Culley, D. J., Fleisher, L. A., Leung, J. M., McDonagh, D. L., Gan, T. J., McEvoy, M. D., Miller, T. E. (2020). American society for enhanced recovery

- and perioperative quality initiative joint consensus statement on postoperative delirium prevention. *International Anesthesia Research Society*, 130(6), 1572-1590.
- Inouye, S., Westendorp, R., & Saczynski, J. (2014). Delirium in elderly people. *The Lancet*, 382, 911-922. [https://dx.doi.org/10.1016/S0140-6736\(13\)60688-1](https://dx.doi.org/10.1016/S0140-6736(13)60688-1)
- Iowa Model Collaborative. (2017). Iowa model of evidence-based practice: Revisions and validation. *Worldviews on Evidence-Based Nursing*, 14(3), 175-182. <https://doi.org/10.1111/wvn.12223>
- Krenk, L., & Rasmussen, L. S. (2011). Post-operative delirium and postoperative cognitive dysfunction in the elderly. What are the differences? *Minerva Anestesiologica*, 77(7), 742-749.
- Krenk, L., Rasmussen, L. S., Hansen, T. B., Bogo, S., Soballe, K., & Kehlet, H. (2012). Delirium after fast-track hip and knee arthroplasty. *British Journal of Anaesthesia*, 108(4), 607-611. <https://doi.org/10.1093/bja/aer493>
- Leslie, D. L., Marcantonio, E. R., Zhang, Y., Leo-Summers, L., & Inouye, S. K. (2008). One-year health care costs associated with delirium in the elderly. *Archives of Internal Medicine*. 168(1) 27-32. <https://doi.org/10.1001/archinternmed.2007.4>
- Lonie, J. A., Kalu, U. G., & Ebmeier, K. P. (2010). A systematic review of cognitive screening for mild cognitive impairment. *Mind & Brain, The Journal of Psychiatry*, 1(1), 1-8.
- Maldonado, J. R., Wysong, A., Van Der Starre, P. J. A., Block, T., Miller, C., & Rietz, B.A. (2009). Dexmedetomidine and the reduction of postoperative delirium after cardiac surgery. *Psychosomatics*, 50(3), 206-217. <https://doi.org/10.1176/appi.psy.50.3.206>
- Ming, S., Zhang, X., Gong, Z., Xie, Y., & Xie, Y. (2020). Perioperative dexmedetomidine and postoperative delirium in non-cardiac surgery: A meta-analysis. *Annals of Palliative Medicine*, 9(2), 263-271. <https://dx.doi.org/10.21037/apm.2020.02.27>

- Moher, D., Liberati, A., Tetzlaff, J., Altman, D. G., & PRISMA Group. (2009). Preferred reporting items for systematic reviews and meta-analyses: The PRISMA statement. *Public Library of Science Medicine*, 6(7). <https://doi.org/10.1371/journal.pmed.1000097>
- Moller, J. T., Cluitmans, P., & Rasmussen, L. S., Houx, P., Rasmussen, H., Canet, J., Rabbit, P., Jolles, J., Larsen, K., Hanning, C. D., Langeron, O., Johnson, T., Lauven, P. M., Kristensen, P. A., Biedler, A., Van Beem, H., Fraidakis, O., Silverstein, J. H., Beneken, J. E., & Gravenstein, J. S. (1998). Long-term postoperative cognitive dysfunction in the elderly: ISPOD 1 study. *Lancet*, 351(9106), 857–61. [https://doi.org/10.1016/s0140-6736\(97\)07382-0](https://doi.org/10.1016/s0140-6736(97)07382-0)
- Monk, T. G., Weldon, B. C., & Garvan, C. W. (2008). Predictors of cognitive dysfunction after major noncardiac surgery. *Anesthesiology*, 1(108), 18–30. <https://doi.org/10.1097/01.anes.0000296071.19434.1e>
- Morrison, R. S., Magaziner, J., Gilbert, M., Koval, K. J., McLaughlin, M. A., Orosz, G., Strauss, E., & Siu, A. L. (2003). Relationship between pain and opioid analgesics on the development of delirium following hip fracture. *Journal of Gerontology*, 58(1), 76-81. <https://doi.org/10.1093/gerona/58.1.m76>
- Naval Medical Center San Diego. (nd). *About us*. Retrieved April 14, 2020, from <https://www.med.navy.mil/sites/nmcscd/pages/command/command-about-us.aspx>
- Needham, M. J., Webb, C. E., & Bryden, D. C. (2017). Postoperative cognitive dysfunction and dementia: What we need to know and do. *British Journal of Anaesthesia*, 119(1), 115-125. <https://doi.org/10.1093/bja/aex354>
- O' Brien, H., Mohan, H., O'Hare, C. O., Reynolds, J. V., & Kenny, R. A. (2017). Mind over matter? The hidden epidemic of cognitive dysfunction in the older surgical patient.

- Annals of Surgery*, 265(4), 677-691. <https://doi.org/10.1097/sla.0000000000001900>
- Older people projected to outnumber children for the first time in U.S. history*. United States Census Bureau. Retrieved November 19, 2020 from <https://www.census.gov/newsroom/press-releases/2018/cb18-41-population-projections.html>
- Palanca, B. J., Mashour, G. A., & Avidan, M. S. (2009). Processed electroencephalogram in depth of anesthesia monitoring. *Current Opinion in Anaesthesiology*, 22(5), 553–559. <https://doi.org/10.1097/ALN.0000000000002323>
- Paton, F., Chambers, D., Wilson, P., Eastwood, A., Craig, D. Fox, D., Jayne, D., & McGinnes, E. (2014). Effectiveness and implementation of enhanced recovery after surgery programmes: a rapid evidence synthesis. *BMJ Open*, 4(7), 1-10. <https://doi.org/10.1136/bmjopen-2014-005015>
- Peden, C.J., Miller, T.R., Diener, S.G., Eckenhoff, R.G., Fleisher, L.A., and Members of the Perioperative Brain Health Expert Panel (2021). Improving perioperative brain health: An expert consensus review of key actions for the perioperative care team. *British Journal of Anaesthesia*, 126(2), 423-432.
- Quan, C., Chen, J., Luo, Y., Zhou, L., He, X., Liao, Y., Chou, J., Guo, Q., Chen, A. F., & Wen, O. (2019). BIS-guided deep anesthesia decreases short term postoperative cognitive dysfunction and peripheral inflammation in elderly patients undergoing abdominal surgery. *Brain and Behavior*, 9(4). <https://doi-org.usu01.idm.oclc.org/10.1002/brb3.1238>
- Radtke, F. M., Franck, M., Lendner, J., Krüger, S., Wernecke, K. D., & Spies, C. D. (2013). Monitoring depth of anesthesia in a randomized trial decreases the rate of postoperative delirium but not postoperative cognitive dysfunction. *British Journal of Anaesthesia*,

- 110(S1), 98-105. <https://doi.org/10.1093/bja/aet055>
- Raats, J. W., Steunenberg, S. L., Crolla, R. M., Wijsman, J. H., Slaa, A., & Van der Laan, L. (2015). Postoperative delirium in elderly after elective and acute colorectal surgery: A prospective cohort study. *International Journal of Surgery*, 18(2015), 216-219. <https://dx.doi.org/10.1016/j.ijssu.2015.04.080>
- Recart, A., White, P. F., Wang, A., Gasanova, I., Byerly, S., & Jones, S. B. (2003). Effect of auditory evoked potential index monitoring on anesthetic drug requirements and recovery profile after laparoscopic surgery. *American Society of Anesthesiologist*, 99(4), 813-818. <https://doi.org/10.1097/00000542-200310000-00011>
- Rengel, K. F., Pandharipande, P. P., & Hughes, C. G. (2019). Special considerations for the aging brain and the perioperative neurocognitive dysfunction. *Anesthesiology Clinics*, 37(3), 521-536. <https://doi.org/10.1016/j.anclin.2019.04.010>
- Saller, T., MacLulich, A. M. J., Schafer, S. T., Crispin, A., Neitzert, R., Schule, C., VonDossow, V., & Hofmann-Kiefer, K. F. (2019). Screening for delirium after surgery: validation of the 4 A's test (4AT) in the post-anaesthesia care unit. *Anaesthesia*, 74, 1260-1266.
- Schupf, N., Tang, M. X., Albert, S. M., Costa, R., Andrews, H., Lee, J. H., & Mayeux, R. (2005). Decline in cognitive and functional skills increases mortality risk in nondemented elderly. *Neurology*, 65(8), 1218-1226. <https://doi.org/10.1212/01.wnl.0000180970.07386.cb>
- Sieber, F. E., Mears, S., Lee, H., & Gottschalk, A. (2011). Postoperative opioid consumption and its relationship to cognitive function in older adults with hip fracture. *Journal of the American Geriatrics Society*, 59(12). <https://doi-org.usu01.idm.oclc.org/10.1111/j.1532-5415.2011.03729.x>
- Smith, N. A., & Yeow, Y. Y. (2016). Use of the Montreal cognitive assessment test to

- Investigate the prevalence of mild cognitive impairment in the elderly elective surgical population. *Anaesthesia and Intensive Care*, 44(5), 581-587.
<https://doi.org/10.1177/0310057x1604400507>
- Tieges, Z., MacLulich, A., Annand, A., Brookes, C., Cassarino, M., O'Connor, M., Ryan, D., Saller, T., Arora, R., Chang, Y., Agarwal, K., Taffet, G., Quinn, T., Shenkin, S., and Galvin, R. (2020). Diagnostic accuracy of the 4AT for delirium detection in older adults: systematic review and meta-analysis. *Age and Ageing*, 20(00), 1-11.
- Vizcaychipi, M. P. (2016). Post-operative cognitive dysfunction: Preoperative risk assessment and perioperative risk minimization: A pragmatic review of the literature. *Journal of Intensive and Critical Care*, 2(1), 1. <https://doi.org/10.21767/2471-8505.100022>
- Wong, C., Holroyd-Ledue, J., Simel, D., & Straus, S. (2010). Does this patient have delirium? Value of bedside instruments. *JAMA*, 304(7), 779-786.
<https://doi.org/10.1001/jama.2010.1182>
- Woerschling, J. (2017). Postoperative cognitive dysfunction after noncardiac and non-neurologic surgery: An integrative review. *American Association of Nurse Anesthesiology*, 85(1), 17-27.
- Youngblom, E., DePalma, G., Sands, L., & Leung, J. (2014). The temporal relationship between early postoperative delirium and postoperative cognitive dysfunction in older patients: a prospective cohort study. *Canadian Journal of Anesthesia*, 61, 1084-1092.
<https://doi.org/10.1007/s12630-014-0242-6>
- Zhang, J., Liu, G., Zhang, F., Fang, H., Zhang, D., Liu, S., Chen, B., & Xiao, H. (2019). Analysis of postoperative cognitive dysfunction and influencing factors of dexmedetomidine anesthesia in elderly patients with colorectal cancer. *Oncology Letters*, 18(3), 3058–3064.

<https://doi.org/10.3892/ol.2019.10611>

Zhou, C., Zhu, Y., Liu, Z., & Ruan, L. (2016). Effect of dexmedetomidine on postoperative cognitive dysfunction in elderly patients after general anaesthesia: A meta-analysis.

Journal of International Medical Research, 44(6), 1182-1190.

<https://doi.org/10.1177/0300060516671623>

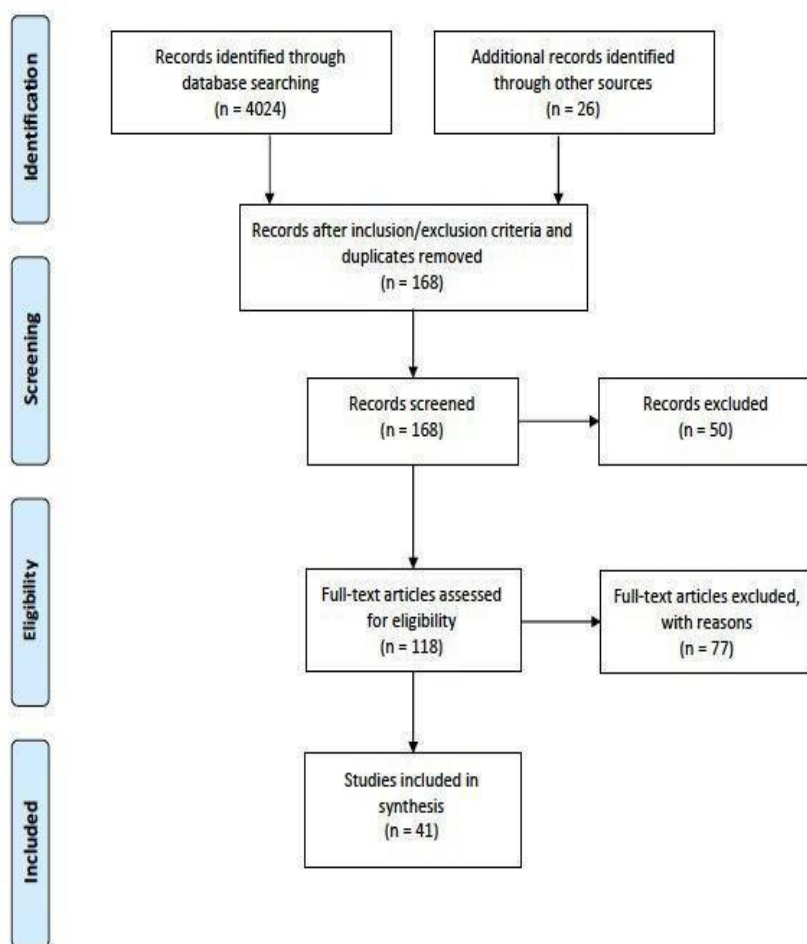
Zywiell, M. G., Hurley, R. T., Perruccio, A. V., Hancock-Howard, R., L., Coyte, P. C., Rampersaud, Y. R. (2015). Health economic implications of perioperative delirium in older patients after surgery for a fragility hip fracture. *Journal of Bone and Joint Surgery*, 97(10), 829-836. <https://dx.doi.org/10.2106/JBJS.N.00724>

Appendix A

PRISMA Diagram



PRISMA 2009 Flow Diagram



From: Moher D, Liberati A, Tetzlaff J, Altman DG, The PRISMA Group (2009). Preferred Reporting Items for Systematic Reviews and Meta-Analyses: The PRISMA Statement. PLoS Med 6(7): e1000097. doi:10.1371/journal.pmed1000097

For more information, visit www.prisma-statement.org.

Appendix B

Search History Table

NMCSD1 Search History

SEARCH TERMS	DATA BASE USED	DATES SEARCHED	# RESULTS	INCLUSION CRITERIA	EXCLUSION CRITERIA
(POCD) AND (Elderly) AND (Non-cardiac surgeries)	Google scholar	5 April 2020	1,510	full text, 10 years, english	different age 60 years plus
(POCD) AND (60 years and older)	Google Scholar	10 April 2020	2130	non-cardiac, full text	cardiac surgery
(POCD) AND (Elderly)	Power Search	10 April 2020	1,326	full text, 10years, english, journal	cardiac surgery, wrong age
POCD	Pubmed	7 April 2020	837	full text, 10 years, english, journal	cardiac surgery, wrong age
(POCD) and (60 years and older)	Pubmed	12 April 2020	116	full text, 10 years, english, journal	wrong outcomes/population
(POCD) AND (BIS monitoring)	Pubmed	15 April 2020	17	full text, 10 years, english	wrong outcomes/population
(POCD) AND (Dexmedetomidine)	Pubmed	15 April 2020	37	full text, 10 years, english	wrong outcomes/population
(POCD) AND (prevention)	Pubmed	18 April 2020	252	full text, 10 years, english	wrong outcomes/population
(POCD) AND (prevention)	Power Search	18 April 2020	141	full text, 10 years, english	wrong outcomes/population
Neurocognitive tests	PubMed	16 April 2020	1137	full text, 10 years, english	wrong outcomes/population
(MMSE) AND (POCD)	pubmed	13 April 2020	80	full text, 10 years, english	wrong outcomes/population
MoCA vs telephone MoCA	pubmed	20 April 2020	7	full text, 10 years, english	wrong outcomes/population
POCD	Elsevier	13 April 2020	81	full text, 10 years, english	wrong outcomes/population
(MoCA) + (POCD)	Pubmed	10 April 2020	22	full text, 10 years, english	wrong outcomes/population
(POD) + (prevention)	pubmed	14 April 2020	1411	full text, 10 years, english	wrong outcomes/population
(POCD) AND (BIS monitoring in elderly)	Power Search	15 October 2020	60	articles, peer reviews, lat 10 years	wrong outcomes/population
BIS monitoring reliable in elderly patient use	Power Search	16 October 2020	189	full text, 10 years	wrong outcomes/population

Evidence Levels	Quality Ratings
Level I Experimental study, randomized controlled trial (RCT) Explanatory mixed method design that includes only a level I quantitative study Systematic review of RCTs, with or without meta-analysis	<u>Quantitative Studies</u> A High quality: Consistent, generalizable results; sufficient sample size for the study design; adequate control; definitive conclusions; consistent recommendations based on comprehensive literature review that includes thorough reference to scientific evidence. B Good quality: Reasonably consistent results; sufficient sample size for the study design; some control, fairly definitive conclusions; reasonably consistent recommendations based on fairly comprehensive literature review that includes some reference to scientific evidence. C Low quality or major flaws: Little evidence with inconsistent results; insufficient sample size for the study design; conclusions cannot be drawn.
Level II Quasi-experimental study Explanatory mixed method design that includes only a level II quantitative study Systematic review of a combination of RCTs and quasi-experimental studies, or quasi-experimental studies only, with or without meta-analysis	<u>Qualitative Studies</u> No commonly agreed-on principles exist for judging the quality of qualitative studies. It is a subjective process based on the extent to which study data contributes to synthesis and how much information is known about the researchers' efforts to meet the appraisal criteria. <i>For meta-synthesis, there is preliminary agreement that quality assessments of individual studies should be made before synthesis to screen out poor-quality studies¹.</i> A/B High/Good quality is used for single studies and meta-syntheses². The report discusses efforts to enhance or evaluate the quality of the data and the overall inquiry in sufficient detail; and it describes the specific techniques used to enhance the quality of the inquiry. Evidence of some or all of the following is found in the report: • Transparency: Describes how information was documented to justify decisions, how data were reviewed by others, and how themes and categories were formulated. • Diligence: Reads and rereads data to check interpretations; seeks opportunity to find multiple sources to corroborate evidence. • Verification: The process of checking, confirming, and ensuring methodologic coherence. • Self-reflection and scrutiny: Being continuously aware of how a researcher's experiences, background, or prejudices might shape and bias analysis and interpretations. • Participant-driven inquiry: Participants shape the scope and breadth of questions; analysis and interpretation give voice to those who participated. • Insightful interpretation: Data and knowledge are linked in meaningful ways to relevant literature.
Level III Nonexperimental study Systematic review of a combination of RCTs, quasi-experimental and nonexperimental studies, or nonexperimental studies only, with or without meta-analysis Exploratory, convergent, or multiphasic mixed methods studies Explanatory mixed method design that includes only a level III quantitative study Qualitative study Meta-synthesis	C Low quality studies contribute little to the overall review of findings and have few, if any, of the features listed for high/good quality.

Evidence Levels	Quality Ratings
Level IV Opinion of respected authorities and/or nationally recognized expert committees or consensus panels based on scientific evidence Includes: • Clinical practice guidelines • Consensus panels/position statements	A High quality: Material officially sponsored by a professional, public, or private organization or a government agency; documentation of a systematic literature search strategy; consistent results with sufficient numbers of well-designed studies; criteria-based evaluation of overall scientific strength and quality of included studies and definitive conclusions; national expertise clearly evident; developed or revised within the past five years B Good quality: Material officially sponsored by a professional, public, or private organization or a government agency; reasonably thorough and appropriate systematic literature search strategy; reasonably consistent results, sufficient numbers of well-designed studies; evaluation of strengths and limitations of included studies with fairly definitive conclusions; national expertise clearly evident; developed or revised within the past five years C Low quality or major flaws: Material not sponsored by an official organization or agency; undefined, poorly defined, or limited literature search strategy; no evaluation of strengths and limitations of included studies, insufficient evidence with inconsistent results, conclusions cannot be drawn; not revised within the past five years
Level V Based on experiential and nonresearch evidence Includes: • Integrative reviews • Literature reviews • Quality improvement, program, or financial evaluation • Case reports • Opinion of nationally recognized expert(s) based on experiential evidence	Organizational Experience (quality improvement, program or financial evaluation) A High quality: Clear aims and objectives; consistent results across multiple settings; formal quality improvement, financial, or program evaluation methods used; definitive conclusions; consistent recommendations with thorough reference to scientific evidence B Good quality: Clear aims and objectives; consistent results in a single setting; formal quality improvement, financial, or program evaluation methods used; reasonably consistent recommendations with some reference to scientific evidence C Low quality or major flaws: Unclear or missing aims and objectives; inconsistent results; poorly defined quality improvement, financial, or program evaluation methods; recommendations cannot be made Integrative Review, Literature Review, Expert Opinion, Case Report, Community Standard, Clinician Experience, Consumer Preference A High quality: Expertise is clearly evident; draws definitive conclusions; provides scientific rationale; thought leader(s) in the field B Good quality: Expertise appears to be credible; draws fairly definitive conclusions; provides logical argument for opinions C Low quality or major flaws: Expertise is not discernable or is dubious; conclusions cannot be drawn

1 https://www.york.ac.uk/crd/SysRev/ISSI/WebHelp/6_4_ASSESSMENT_OF_QUALITATIVE_RESEARCH.htm

2 Adapted from Polit & Beck (2017).

Appendix D Evidence Table

1st Author Name (Publication Yr)	Study Purpose/Aims	Research Questions/Hypothesis	Study Design	Total Sample Size	Sampling Plan	Independent Variables	Dependent Variables	Statistical Analyses	Results	Strengths	Weaknesses	Level of evidence
O'Brien et al. (2017)	The aim is to highlight the vulnerability of aging brain to surgery and anesthesia, examine postoperative cognitive outcomes, and recommend interventions.	none specified	A literature review utilizing Pubmed/Medline.	75 articles	The search terms used included POCD, postoperative cognitive decline, postoperative cognitive impairment, cardiac and non-cardiac surgery, preoperative cognitive impairment, MCI, POD, dementia, long-term cognitive impairment, and elderly and older patient.	none specified	none specified	none specified	Closer preoperative collaboration between surgeons, geriatricians, and anesthesiologists will enable identification of complex at-risk older patients.	1) table broke down each article separately with relevant information	1) weak presentation of information 2) PRISMA diagram of article selection process was not shown. 3) Didn't present general breakdown of articles chosen, i.e. RCT vs Quasi vs descriptive.	Vb
Chan et al. (2013)	Test the effects of BIS monitoring on POCD in elderly patients undergoing major noncardiac surgery.	To determine whether BIS-guided anesthesia decreases the incidence of POCD and postoperative delirium in elderly patients undergoing major surgery.	This was a prospective, randomized, double-blinded, and parallel group study.	1657 patients were eligible; 736 were excluded; 921 were randomized into 2 groups. There were 221 people in the nonsurgical control group.	Patients were enrolled between Jan 2007 and Dec 2009. Recruited patients were ≥ 60 y/o, scheduled for elective major surgery that was expected to last for ≥ 2 hours and expected hospital stay of 4 days. Exclusion criteria: Not able to participate in interviews, Literacy, language difficulties.	Nominal: Use of BIS-Guided anesthesia care to maintain BIS value within 40-60.	Nominal: Presence of POCD at 1 week, and 3 months post-op as measured by verbal fluency test	POCD between groups was compared using the Fisher exact test. Median recovery times were calculated using Kaplan-Meier survival analysis. Fisher exact test and/or chi square test were used to analyze secondary endpoints.	The use of BIS-guided anesthetic care to maintain a value between 40-60 during scheduled major surgery in patients ≥ 60 y/o can reduce the risk of developing POCD at 3 months after surgery.	1. Randomized 2. A non-surgical control was used to analyze the effects of repeated testing.	1. Test used were chosen because of sensitivity and cultural adoption specific for the local population.	IA
Evered, et al. (2011)	The aim was to determine the association of type of surgical procedure and associated anesthesia on the incidence of POCD after general anesthesia.	hypothesis: if the magnitude of the operation or the dose and complexity of the anesthetic are significant factors for the occurrence of POCD.	Quantitative Quasi-experimental design: 3 separate trials (1. sedation with coronary angiography (CA), 2. Major noncardiac surgery under general anesthesia, 3. CABP under general) compared to a nonoperative control group.	644 recruited total for all 3 procedure groups. 636 underwent all neuro tests. 34 subjects in control group. 2001 to 2010 study period.	Inclusion: age >50 yr for CA, age >55 yrs for hip and CABG surgeries, fluency in English, geographical accessibility for baseline testing. Exclusion: history of stroke or TIA, treatment with sedatives, clinical hx of dementia or MMSE score <26 . Control group: age >55 yrs, had larger joint osteoarthritis and had no surgery planned for 12 months	Nominal: 3 experimental surgery groups and control group. 8 neurocognitive tests implemented.	Ordinal: POCD occurrence at 7 days post op and 3 months post op.	Group comparisons using unpaired t test for continuous variables, Spearman correlation coefficient or Kruskal-Wallis test for ranked data, and chi square or Fisher exact test for dichotomous variable.	At 7 days post-op, the incidence of POCD was 17% for the hip surgery patients and 43% for the CABG surgery patients. Controls at 7 days had 6% deterioration in testing from baseline was significantly lower than both patient groups. At 3 months, the incidence of POCD over all groups combined was 17%.	1. Testing methodology: regulation in investigators and meds used. 2. to minimize confounders identical and consistent staff in implementing all 3 groups.	1. RCI method relies on an appropriate control group and differing baseline means for 2 of 8 tests. 2. Sampling power analysis was not discussed.	IIA
Berger, et al. (2018)	The objective was to discuss and develop consensus solutions to improve patient management and outcomes and to discuss what older adults should be told about postoperative brain health risks.	None specified	Narrative review article. Article covers opinion of 30 experts who met at the Fifth International Perioperative Neurotoxicity Workshop in 2016.	30 experts	4 key issues discussed: preprocedure consent, preoperative cognitive assessment, intraoperative management, and postoperative follow-up. Panel discussed EBP supporting and conflicting key issues; followed by a consensus statement.	none specified	none specified	none specified	1) preprocedure consent 2)preoperative cognitive assessment 3) intraoperative management: monitor age-adjusted end-tidal MAC fraction and perform EEG-based anesthetic management in older adults. 4) More studies are needed to evaluate the efficacy, feasibility, and cost-effectiveness	1. Panel discussed support for recommendation and also conflicts with research. 2. discussed gaps in research/evidence	1. Informal, in person discussion and consensus at 2016 meeting.	IVa

Lei et al. (2020)	The aim of this meta-analysis was to explore whether there is an association between DEX and physiological saline with incidence of POCD	none specified	Meta-Analysis of RCT articles, 2 review authors, PubMed, EMBASE, and Web of Science databases using MeSH terms.	165 potential articles, narrowed to 11 relevant studies; accounted for 1400 patients: 751 DEX and 689 received saline.	Inclusion: (1) study contains 2 groups: control and case group, (2) adult participants (3) comparisons (4) primary outcome, incidence of POCD. Exclusion criteria: (1) only have case group but no control group; (2) reviews, letters, abstracts, or editorials; and (3) insufficient data.	none specified	none specified	A fixed-effect model was used for statistical analysis. Analyses were conducted using Review Manager. The quality of the included studies was evaluated by the Newcastle-Ottawa Scale.	The results showed that lower incidence of POCD associated with DEX treatment on the first or seventh postoperative day. On the first postoperative day in DEX group were lower than that in the physiological saline group. This meta-analysis suggested that DEX use could reduce the risk of POCD and improve long-term cognitive dysfunction and anti-inflammation.	1. reported publication bias. 2. all the studies within the 95% CI	1. Sample size was relatively small. 2. Long term associations could not be reported (trials ended at 3 months).	IB
Smith et al. (2016)	The aim was to estimate the prevalence of mild cognitive impairment among elderly patients presenting for elective surgery using the Montreal Cognitive Assessment test.	none specified	Quasi-experiment Quantitative study= pretest and posttest design. 2 groups: enrolled at different locations, 1 group enrolled day of surgery and 2 group enrolled 6 weeks prior to elective surgery.	113 in DOSA group and 102 for PAC group.	Inclusion and exclusion criteria: non specified	Nominal: Surgical patients being screened preoperatively either DOSA or 6 weeks prior utilizing a Montreal Cognitive Assessment Test.	Ordinal: Montreal performance and scoring. If results should mild cognitive impairment.	The Shapiro-Wilk test statistic was used to determine normality of the data. ANOVAs were then used to compare the domain means against each other. A Mann-Whitney U test was used to investigate the influence of location on total MoCA score.	The prevalence of MCI in each group was 60% for DOSA and 52% for PAC. No significant difference between the groups. The overall combined prevalence of MCI was 56%. The median test score for the DOSA group was 24 and 25 for PAC.	1) There were no confounding variables 2) article explained significant results.	1) Power analysis of sample size was not presented 2) there was no randomization in the sample groups.	IIB
Recart et al. (2003)	Purpose: to test if AAI-guided administration will alter the use of the volatile anesthetic, opioid analgesic, and sympatholytic drugs compared to standard clinical monitoring practices.	hypothesis: that AAI-guided administration of the maintenance anesthetics and analgesics would improve their titration and thereby provide a faster recovery from general anesthesia.	RCT= Quantitative study= pretest and posttest design. 2 groups: AEP monitored group, Control group (standard clinical signs without AEP monitoring)	70 patients= 35 AEP, 35 control	Inclusion: Surgical pt undergoing elective lap general surgery procedures. Exclusion: history of central nervous system disease, chronic use of psychoactive medication, and any significant CV, renal, hepatic, or endocrinologic disorders.	Nominal: Pt's undergoing surgery with AEP monitoring or by standard clinical signs only	Ordinal: The AAI values and hemodynamic variables, and end-tidal desflurane concentrations, were recorded at 3- to 5-min intervals.	Analysis of variance followed by multiple Wilcoxon matched-pairs tests, and Student t test for multiple comparisons. Categorical data were analyzed using the chi-square test with Fisher exact test where appropriate.	The average intraoperative AAI value in the AEP monitored group was significantly higher than in the control group. Use of the AEP monitor reduced the desflurane requirement by 26% compared to the control group and received less intraoperative fentanyl and more rapidly achieved fast-track eligibility.	1. Randomized control study 2. power analysis of sample size 3. Demographics discussed	1. small sample size	IB
Bocskai et al. (2020)	Our aim was to compile evidence on the effects of BIS on POD and POCD in a systematic review with meta-analysis using two comparisons: general anaesthesia with and without BIS monitoring.	none specified	systematic review and Meta-Analysis, 6 databases searched, articles included RCT's, discussed anesthesia with and without BIS	14 studies found, 8 eligible for meta-analysis, 2138 patients	Inclusion: Anaesthesia with and without BIS monitoring or low (<50) and high (>50) BIS levels and which measured the risk of POD and POCD. PICO search. MEDLINE (via PubMed), EMBASE, Cochrane. Exclusion: none specified.	none specified	none specified	Performed statistical analysis if at least two RCTs per group were available. Random effect model with the DerSimonian-Laird estimation. I2 and chi2 tests were used to quantify statistical heterogeneity and obtain P-values.	Findings suggest a protective effect of BIS compared to not using BIS regarding the incidence of POD at 1 day and POCD at 12 weeks.	1. utilized RCT articles only 2. PRISMA flow included 3. rigorous selection and RoB assessment	1. unable to perform publication bias 2. study protocols and date reporting are incomplete 3. statistical heterogeneity occurred in some analyses	IB

Zhou et al. (2016)	Purpose: to examine the efficacy of dexmedetomidine for the prevention of POCD in elderly patients. To inform future clinical decision making.	none specified	systematic review and Meta-Analysis, 5 databases searched, PubMed, EMBASE, the Cochrane Library, China Academic Journals full-text database and Google Scholar.	564 articles initially, narrowed to 13 RCT's	Inclusion: RCT's of patients undergoing surgery under GA. Exclusion: studies that lacked specific exclusion data, studies with incomplete information or data, and articles for which we could not obtain the full text.	none specified	none specified	Heterogeneity test and χ^2 test. A fixed effects model was used to conduct the meta-analysis if no heterogeneity. If significant heterogeneity was found they sought the source.	Compared with controls, dexmedetomidine: 1) significantly reduced the incidence of POCD and improved MMSE score on the first postoperative day and 2) reduced the incidence of POCD after the first postoperative day.	1. utilized RCT articles only 2. Excluded articles without MMSE measure on postop day 1 3. RevMan used for statistical analysis	1. Small sample size 2. doses and methods of administration of dex varied	IB
Glumac et al. (2019)	The purpose of this review is to examine and discuss the recent literature concerning POCD after cardiac surgery, with an emphasis on controversies that follow the definition of POCD.	none specified	Narrative review article. 2 reviewers, Searched the MEDLINE, Scopus, PsycINFO and CENTRAL databases for the best evidence.	92 articles	Inclusion: English, published up to Oct 2018. Exclusion: not discussed	none specified	none specified	none specified	Defining POCD is a very controversial matter and that the inflammatory response plays an important role in the mutually overlapping processes included in POCD development. Thus, developing the definition of POCD represents an absolute priority in POCD investigations, and the inflammatory response to cardiac surgery merits further research.	1. clear aims and objectives 2. reported evidence from grade 1 and 2 articles.	None noted	Va
Carr et al. (2018)	This brief review discusses evidence suggesting an association between neuroinflammation and POCD and whether the use of DEX, will decrease the incidence of POCD.	none specified	Systematic review of POCD, Dexmedetomidine, and neuroinflammation	67 articles	Inclusion: POCD, Dex, Neuroinflammation, meta-analysis, systematic reviews Exclusion: not specified	none specified	none specified	none specified	There is evidence to support the anti-inflammatory and immunomodulatory effects of dexmedetomidine in animal models. Human trials have yielded incomplete results concerning its use for the management of POCD. DEX may reduce acute POD, but further studies are needed prior to recommending the use of dexmedetomidine for the direct reduction of POCD.	1. Summarized article findings and made recommendations for improvements for future research 2. expertise appears to be credible	1. Search technique, articles found, exclusions and other relevant information not included. 2. Only a narrative of expert opinions based off evidence.	Vb
Lonie et al. (2009)	Purpose: investigated which measures distinguish between patients with amnesic mild cognitive impairment (aMCI) who convert to dementia and those who do not, and which combination of measures best predicts the fate of aMCI patients.	none specified	Quantitative, Non-experimental, Longitudinal prospective cohort study, 4 years follow up	44 patients, grouped by dementia or normal cognitive ability	Inclusion: 60 years or older, NHS referrals for memory complaints, with or without clinical diagnosis of dementia	IV: Nominal: Neuropsychological battery of tests performed on all patients	DV: Ordinal: performance and scores on neuropsychological tests, number of patients who convert from mild cognitive impairment to dementia over 4 years time.	Independent t-tests were conducted to compare the baseline performances of aMCI converters and aMCI non-converters on the demographic indices of age, NART FSIQ, and years of follow-up, and the neuropsychological measures: ACE total score, PAL, HVLTR delayed recall and discrimination index.	Forty one percent of aMCI participants received a clinical diagnosis of dementia (most often AD) at some point prior to study endpoint (i.e. on average 4.33 years after entry into the study), giving an average annual conversion rate of 11.4%. The remaining 26/44 (59%) participants had not received a clinical diagnosis of dementia. Of the participants who had not received a clinical diagnosis of dementia, 8/26 (31%) were stable, 10/26 (38%) progressive, and 8/26 (31%) reverted to normal	1. no attrition occurred over long time period	1. limits generalization of study findings beyond groups characterized similarly. 2. Small sample size 3. Power analysis for sample size was not discussed	IB

Alam et al. (2018)	Aim: This narrative review summarizes our current understanding of the mechanisms underlying POD and POCD and therapeutic approaches to manage these conditions.	none specified	Systematic and narrative review; using PubMed, MEDLINE and EMBASE, Lancet, Critical Care and Annals of Surgery. (2017).	not reported	Inclusion: clinical and pre-clinical papers to have been written in the last 5 years (1st January 2013 – 1st September 2018). Exclusion: none specified	none specified	none specified	none specified	Results: The study summarized their current understanding of the mechanisms underlying POD and POCD in addition to current novel therapeutic approaches to manage these conditions and promising future pathways that require further investigation.	1. Expertise appear to be credible; draws definitive conclusions from research and text books	1. No statistical analysis of article evidence to show validity or reliability 2. no PRISMA diagram 3. Exclusion criteria not reported	Va
By the American Geriatrics Society 2015 Beers Criteria Update Expert Panel (2015)	The specific aim was to have a 13-member interdisciplinary panel of experts in geriatric care and pharmacotherapy update the 2012 AGS Beers Criteria.	none specified	Systematic review completed by 13 member interdisciplinary panel of experts in geriatric care and pharmacotherapy updated the 2012 AGS Beers criteria using modified Delphi method to systematic review and grading. Aug 2011-July 2014.	1,188 unduplicated citations for the full panel reviewed. Reviewed abstracts, and evidence tables were developed for 342 studies, including 60 systematic reviews and meta-analyses, 49 RCT, and 233 observational and other types of publications	Explicit criteria for medication articles: can identify high-risk drugs using a list of PIMs that have been identified through expert panel review as having an unfavorable balance of risks and benefits by themselves and considering alternative treatments available.	none specified	none specified	none specified	53 medications or classes encompass the final updated Criteria, which are divided into three categories 1: potentially inappropriate medications and classes to avoid in older adults, 2: potentially inappropriate medications and classes to avoid in older adults with certain diseases and syndromes that the drugs listed can exacerbate, and 3: medications to be used with caution in older adults.	1. use of evidenced based approach 2. Delphi grading method	1. Reviewer bias	IVa
Boonie et al. (2020)	To quantify the economic burden associated with a PND diagnosis in 1 year following surgical treatment among older patients in the U.S.	none specified	A retrospective cohort study used claims data from the Bundled Payments for Care Improvement Advanced Model from 4285 hospitals. January 2013 and December 2016.	A total of 2380473 patients who underwent surgical procedures were included. 44974 patients were diagnosed with PND.	All Medicare patients aged 65 years or older who underwent an inpatient hospital admission associated with a surgical procedure. Data were analyzed from October 2019 and May 2020.	Nominal: Patients 65 years or older	Ordinal: diagnosed or experienced neurocognitive dysfunction, mild cognitive change or dementia. With or without PND occurrence.	Categorical data are presented as frequencies and proportions and assessed with a χ test. Continuous data were reported as means and SDs. Normality of continuous variables was assessed with a Shapiro-Wilk test.	A total of 2380447 Medicare patients underwent surgical procedures. 44974 patients were diagnosed with a PND.	1. clear aims and objectives 2) There were no confounding variable	1. Limitations of administrative data to identify PND. 2. used a linear model and did not have optimized for some variable.	IIia
Rengel et al. (2019)	The aim is to highlight special considerations for the aging brain and perioperative neurocognitive dysfunction.	none specified	Narrative review article. 2 reviewers.	none specified	none specified	none specified	none specified	none specified	Description of epidemiology, pathophysiology, treatment, risk factors, and management strategy	1. utilized evidence based support for review	1. did not specify how many articles searched or databases. Did not explain data collection process.	Va

Gao et al. (2019)	The aim of the article was to research the effect of BIS monitoring on the incidence of intraoperative	none specified	A meta-analysis. Searched PubMed, Medline and Cochrane Library. Key words "intraoperative awareness" and "general anesthesia" and "bispectral index" or "BIS". Ranged 2004-2012.	107 articles identified. Excluded non RCTs, not english and not meeting criteria. 5 articles remained encompassing 34181 patients.	Inclusion criteria: RCT, articles english, Ranged 2004-2012 and studies with large study group. In addition, animal studies and reviews were excluded	none specified	none specified	The heterogeneity was estimated by using the I ² statistic. Fixed effect model was used to determine heterogeneity. $P < 0.1$ and $I^2 \leq 50\%$, the random effect model was selected."	Meta-analysis showed that BIS monitoring had no appreciable advantage in the reduction of the intraoperative awareness incidence in IA but showed a remarkable superiority in TIVA. BIS monitoring group showed a lower incidence of intraoperative awareness in patients with TIVA when compared with non-BIS monitoring group.	1. use of evidenced based approach and utilized RCT articles 2. grading method 3. PRISMA included	1. They did not yet analyzed the relationship between the dosage or combination of drugs under the same anesthesia and the BIS monitoring. 2. there are differences between different individuals.	ib
Radtke et al. (2013)	Assess whether BIS-guided anaesthesia vs routine care reduces the incidence of postoperative delirium in elderly patients.	none specified	RCT= Quantative study= open and blind groups. 2 groups: Bis monitor was open and second group the monitor was blinded	Surgery greater than 60 min and pt >60 yo were included between March 2009 and May 2010. A total of 1277 patients of a consecutive sample were randomized (638 open, 639 blinded).	Patients were eligible for the study if ≥ 60 yr undergoing elective surgery expected to last at least 60 min. Patients who had cognitive impairment characterized by MMSE of 24.	Nominal: Patients 60 years or plus undergoing surgery and BIS monitor used during anesthetic care was open or blinded to the anesthesia provider.	Ordinal: Occurrence of delirium and the anesthesia depth	Fisher's exact test and two groups of equal proportions. A two-tailed P-value of .005 was considered statistically significant	Delirium incidence was lower in patients guided with BIS. POD was detected in 95 patients (16.7%) in the intervention group compared with 124 patients (21.4%) in the control group. BIS monitoring did not alter the incidence of POCD. BIS monitoring is associated with a lower incidence of POD.	1. Randomized control study 2. power analysis of sample size discussed 3. Demographics discussed	1. The blinded group was unblinded during the procedure at some point.	ib
Krenk et al. (2012)	The aim of this study was to evaluate the incidence of PD after fast-track THA or TKA with anticipated length of stay of 3 days.	none specified	Prospective multicenter study. It was approved by the regional ethics committee.	225 non-demented patients with a mean age of 70 yr undergoing either THA or TKA in a fast-track set-up. Anaesthesia and postoperative pain management were standardized with limited opioid use.	Inclusion criteria were age ≥ 60 yr and ASA physical health class I-IV. Excluded if had been anaesthetized within the past 30 days, had dementia (MMSE ≤ 23), Parkinson's or other neurological disease.	nominal: Patient undergoing elective THA and TKA surgery and standardized anesthetic plan	Ordinal: occurrence of delirium	Continuous data are reported as mean or median with range or IQR and the incidence of PD is reported with 95% confidence interval.	22 patients received GA, and the rest had spinal anaesthesia. No patients developed PD. A fast-track set-up with multimodal opioid-sparing analgesia was associated with lack of PD after elective THA and TKA in elderly patients.	1. clear aims and objectives 2) There were no confounding variable	1. The limitation with the CAM screening procedure is often the frequency of screening 2. small study group	iib
Quan et al. (2019)	This study investigated the association between depth of anesthesia and POCD in elderly patients undergoing abdominal surgery.	none specified	Randomized parallel control clinical trail. Dates Feb 2014 to Feb 2016.	120 patients aged 60 years or older who had a planned abdominal surgery underwent TIVA for anesthetic plan were included. 105 patients completed the study.	All participants completed 9 battery neuropsych tests at 7 days and 3 months after surgery. Randomization in 2 groups: deep group and light group. Exclusion criteria: patients with a preexisting neurological diseases; MMSE < 23 before surgery; Chinese not being first language.	Nominal: Deep group (BIS target 30-45) vs light group (BIS target 45-60).	Ordinal: The occurrence of POCD at 7 days postop and 3 months postop.	independent t tests for continuous variables, the Mann-Whitney U test for ranked data, and chi-square or Fisher exact test for dichotomous data. Correlation analyses were performed using Spearman's rank correlation.	The incidence of POCD at 7 days after surgery in the deep anesthesia group was 19.2% and the light anesthesia group 39.6%. The depth of anesthesia had no effect on POCD at 3 months after surgery (10.3% vs 14.6%). Deep anesthesia under TIVA decreased short-term POCD compared with light anesthesia.	1. clear aims and objectives 2) random assignment to groups. 3) There were no confounding variable 4) flow diagram of drop outs	1. Long term recovery index due to mortality rate. 2. No measure of sleep/circadian dysregulation and mood.	ib

Ming et al. (2019)	Aim is to compare the effects of perioperative DEX with placebo on the rate of postoperative delirium in adult patients who underwent non-cardiac surgeries.	none specified	Meta-analysis was performed on RCT's: MEDLINE, the Cochrane Central Register of Controlled Trials, and Embase.	10 trials with 2,286 total participants. Search terms used in Embase were as follows: "dexmedetomidine" AND ("delirium" OR "subacute delirium" OR "mixed origin delirium")	RCT's were included age >18 y/o, non cardiac surgery, assessed POD outcomes, compared postoperative complications of DEX with placebo or other sedation. Exclusion: Trials pre-op delirium or multifactorial intervention.	none specified	none specified	The heterogeneity of calculated using Cochran's Q test and I^2 index. Egger's test to assess publication bias in the 10 articles included in this meta-analysis.	From 10 trials with 2,286 total participants, 363 had POD during the follow-up periods. When the DEX infusion rate was higher than 0.2 µg/kg/h, the relative risk of POD reduced significantly by 34%, compared with other sedation methods. Infusion lower than 0.2 µg/kg/h reduced by 62%. Compared to the placebo perioperative DEX sedation resulted in lower rates of POD.	1. use of evidenced based approach and utilized RCT articles 2. grading method 3. PRISMA included	1. small number of trials and the limited ability to perform a meta-regression to understand the effects in different patient subgroups 2. Only focus was delirium	la
An et al. (2011)	Aim to investigate whether the depth of total intravenous anesthesia affects postoperative cognitive dysfunction	none specified	RCT: Patients undergoing microvascular decompression were randomly assigned to deeper anesthesia or lighter anesthesia group.	96 patients total. 50 in deeper group and 46 in lighter group. 80 patients completed the post evaluation.	Inclusion: 28-67 years old with facial spasm hx. Exclusion: a history of neurologic or mental disease, comorbidities, a history of surgery, fewer than 6 years of school, inability to complete neuropsychologic testing, vision dysfunction, and auditory dysfunction.	nominal: Patient undergoing microvascular decompression surgery and assigned to either deep or light anesthesia group.	ordinal: Occurrence of POCD after surgery.	Continuous data were analyzed by the Student t-test or Mann-Whitney U test for between-group differences and categorical data were analyzed by w2 test.	POCD occurred in 4 patients (10%) in the deeper anesthesia group and in 11 patients (27.5%) in the lighter anesthesia group. Deeper total intravenous anesthesia can decrease the incidence of POCD in the early postoperative period.	1. clear aims and objectives 2) random assignment to groups. 3) There were no confounding variable 4) flow diagram of drop outs	1. Long-term cognitive function was not addressed. 2. Used only objective neuro psych tests. 3. unable to identify the mechanism of early POCD.	lb
Morrison et al. (2003)	The aim of this study was to examine the relationship among pain, analgesics, and other factors on delirium in hip fracture patients.	none specified	Prospective cohort study: patients admitted with intertrochanteric or femoral neck fracture without evidence of delirium.	541 patients enrolled with hip fracture and without delirium. July 1997 to August 1998. 541 subjects completed the study.	Inclusion: hip fracture and without delirium. Exclusion: not specified	nominal: patient with hip fracture and without delirium upon admission	ordinal: types of medications given for pain control and occurrence of delirium during hospitalization	Logistic regression was used to identify risk factors for delirium.	87 of 541 patients (16%) became delirious. Patients who received less than 10 mg of parenteral morphine sulfate equivalents per day or received meperidine were more likely to develop delirium than patients who received other opioid analgesia. In cognitively intact patients, severe pain significantly increased the risk of delirium.	1. clear aims and objectives 2) There were no confounding variable	1. No statistical analysis of article evidence to show validity or reliability 2. no PRISMA diagram 3. Exclusion criteria not reported	lllb
Sieber et al. (2011)	The aim is to determine the relationship between opioid consumption and cognitive impairment after hip fracture.	none specified	Prospective cohort study.	236 patients aged 65 and older undergoing hip fracture repair. April 2005-July 2009. Tested for delirium using CAM and assessed pain score via numerical scale.	66 had dementia, 213 received opioids postoperatively. Inclusion: 65 years old and greater and hip surgery. Exclusion: none specified	nominal: patient with hip fracture and without delirium upon admission	ordinal: pain medications given and occurrence of delirium	Group comparisons were analyzed using the Fisher exact test or the chi-square test for frequency data. The Mann-Whitney U-test for ordinal data, and analysis of variance for continuous data.	Of the 236 participants, 66 (28%) had dementia, and 213 (90%) received opioids postoperatively, including 55 (83%) with dementia and 158 (93%) without. There was no association between the use of any postoperative opioid and incident delirium in participants with and without dementia.	1. clear aims and objectives 2) There were no confounding variable	1. No statistical analysis of article evidence to show validity or reliability 2. no PRISMA diagram 3. Exclusion criteria not reported	lllb

Department of Anesthesiology
Enhanced Recovery for Elderly Patients Pathway

ANESTHESIA PREOP TEAM

Establish baseline neurocognitive assessment:

Anesthesia providers conducting a pre-anesthesia interview for patients who are ASA II or greater will utilize the Orientation Memory Concentration Test (OMCT) to obtain a baseline neurocognitive assessment for patients 60 years of age and older who are scheduled to undergo general anesthesia. Educate patients on risk of postoperative delirium (POD) and postoperative cognitive dysfunction (POCD).

Encourage glucose containing PO hydration with approved clears until 2 hours prior to arrival.

PREOP HOLD AREA

Preop team will conduct an OMCT on all patients 60 years and older on the DOS who did not have one completed prior to DOS. Preop staff will contact Anesthesia Staff assigned to patient for scores of 9-28; (floor walker as back-up.) Anesthesia staff will conduct a further cognitive evaluation for these patients and discuss with surgeon increased risk of POD and POCD.

PREOP HOLD AREA

During discussion of anesthesia risks, educate all patients 60 years and older and escort of the risks of POD and POCD and potential for prolonged duration after surgery.

Minimize or avoid the use of benzodiazepines (lorazepam and midazolam) for anxiolysis

IN OR

Favor regional anesthesia as primary anesthetic plan (surgery type dependent) in order to reduce exposure to opioids and volatile agents

Use age-adjusted MAC values for volatile anesthetics

Minimize or avoid the use of opioids (particularly meperidine)

Administer intraoperative Dexmedetomidine (0.2-0.7 mcg/kg/hr) infusion.

Utilize processed EEG guided anesthesia titration and maintain a goal of 40-60 level for anesthesia depth

Fluid goal= normovolemia

PACU

Minimize or avoid the use of narcotics in PACU (particularly meperidine and morphine).

Minimize or avoid medications associated with post-op cognitive impairment: benzodiazepines, opioids in combination with benzodiazepines and gabapentinoids, anticholinergics, diphenhydramine, metoclopramide, and tramadol.

The Anesthesia PACU staff will monitor POD occurrence utilizing the OMCT before the patient transfers to the APU or inpatient ward.

WARD

Postoperative pain control utilizing multimodal pain technique, use of recovery regional anesthesia if indicated and opioid sparing techniques.

Encourage early ambulation

Maintain sensory input (provide glasses and hearing aids)

Provide cognitive stimulation and reorientation (family members and friends)

Avoid dehydration

Enhanced Recovery for Elderly Patients

1. **Issue:** Enhanced recovery (ERPs) pathways for many types of surgery and patients have been developed using evidence based multimodal therapies to decrease surgical stress, reduce postoperative ileus, and shorten length of stay. The main components of ERAS are avoidance of perioperative fasting, zero-sum fluid balance, and non-narcotic pain control. Studies have demonstrated that the benefits, safety, and cost-effectiveness of these protocols seen across multiple surgical disciplines.

2. **Evidence:** The following goals were considered while developing this pathway:
 - Establish baseline neurocognitive function through by utilizing a validated tool such as the 4AT, Orientation Memory Concentration Test or MoCA (Berger et al., 2018; Katzman et al., 1983; Lonie et al., 2010; Needham et al., 2017; Saller et al., 2019; Tieges et al., 2020)
 - Ensure elderly patients 60 years and older are aware of POD and POCD risks and emphasize on anesthesia consent (Berger et al., 2018)
 - Pre-operative administration of oral carbohydrate leads to a significantly reduced hospital stay by attenuating the neuroendocrine stress response, catabolism and insulin resistance and improves well-being. This will assist the patient in remaining euvolemic with less requirement for intravenous fluids (Kotekar et al., 2018).
 - Utilize processed EEG guided anesthesia to maintain an anesthetic depth between 40-60 to reduce the utilization of opioids, volatile agents and intravenous anesthetics (Bocskai et al., 2020; Chan et al., 2013; Palanca et al., 2009; Gao et al., 2018; Quan et al., 2019; An et al., 2011)
 - Administer intraoperative dexmedetomidine to reduce the occurrence of postoperative delirium and postoperative cognitive dysfunction (Alam et al., 2018; Ming et al., 2020; Zhou et al., 2016)
 - Minimize or avoid mediations associated with causing cognitive impairment: benzodiazepines, opioids, anticholinergics, diphenhydramine, metoclopramide, and medications that may cause serotonin syndrome (tramadol, and dextromethorphan) (American Geriatrics Society 2019 Beers Criteria Update Expert Panel, 2019).
 - Minimization or avoidance of opioid use (particularly meperidine) can be accomplished using multimodal analgesia, including neuraxial anesthesia, regional anesthesia, and total intravenous anesthesia (American Geriatrics Society 2019 Beers Criteria Update Expert Panel, 2019).
 - Avoid use of lorazepam, midazolam, morphine and meperidine due to association with delirium. Alternative agents: propofol, dexmedetomidine, and fentanyl are recommended. (Morrison et al., 2003; Sieber et al., 2011).
 - Non-pharmacological interventions include early mobilization, maintain sensory input (glasses and hearing aids), cognitive stimulation and reorientation and avoid dehydration in elderly patients (O'Brien et al., 2017).
 - Postoperative pain control is essential: utilize multimodal technique, regional anesthesia if indicated and opioid sparing methods. (Rengel et al., 2019; Krend et al., 2012).
 - IV fluid restriction is not necessary and excessive fluids can be harmful to recovery. Therefore, normovolemia is ideal (Lassen et al., 2009).
 - Measures to avoid hypothermia and hypoxemia also decrease surgical stress and the resulting systemic complications (Kehlet et al., 1997).

3. **NMCSD Management Guidelines:**
Pre-operative Preparation
 - In pre-admission testing, all medications will be reviewed. Patients will be asked to stop the following medications:
 - Aspirin unless the patient has a stent or severe coronary artery disease.
 - NSAIDs should be stopped greater than 5 days prior to surgery



Department of Anesthesiology

- ACE inhibitors (i.e. Lisinopril) or angiotensin receptor blockers should not be taken on the day of surgery.
- Diuretics should not be taken on the day of surgery unless given for heart failure.
- Modifications to oral hypoglycemic and insulin regimens will be specified.
- Assess postoperative nausea and vomiting (PONV) risk. For patients at high risk, suggest totally intravenous anesthetic (TIVA) anesthetic, regional anesthesia if appropriate or use of a propofol infusion.
- Encourage pre-operative clear fluids by mouth (preferably carbohydrate containing fluids) up to 2 hours before surgery. The following are acceptable clear liquids:
 - Water, apple juice, Pedialyte, Gatorade or other sports drinks, Sprite or 7-up, black coffee (NOCREAMER), tea
- Anesthesia preop team to complete an anesthesia pre-evaluation on all patients 60 years and older in PAC and discuss pathway with patient
- Establish baseline neurocognitive assessment utilizing a validated screening tool (ex: OMCT, 4AT, or MoCA) for all patients 60 years and older.
- Discuss pathway and anesthetic plan with patient
- Educate patients on risk of POD and POCD.
- Encourage patient to have escort available initially postoperatively to help reorient patient and for cognitive stimulation.

Pre-operative hold area

- An intravenous line will be started.
- During anesthesia consent process, discuss and educate all patients 60 years and older and escort of risk of POD and POCD and potential for prolonged duration after surgery.
- Conduct a baseline neurocognitive assessment if not already completed prior to DOS.
- Minimize or avoid the use of benzodiazepines for anxiolysis.

Intra-operative

- Favor regional anesthesia as primary anesthetic plan (surgery type dependent) in order to reduce exposure to opioids and volatile agents
- Use age-adjusted MAC values for volatile anesthetics
- Minimize or avoid the use of opioids (particularly meperidine)
- Utilize dexmedetomidine (0.2-0.7 mcg/kg/hr) infusion if patient can safely tolerate administration.
- Utilize processed EEG (BIS) guided anesthesia titration and maintain a goal of 40-60 level for anesthesia depth
- Fluid goal= normovolemia

Postoperative Management

- PACU:
 - Fluid management
 - IVF at 75 ml/hr for 6 hrs then 10 ml/hr while PCA is running (kvo)
 - If HR>110 bpm, SBP<90 mmHg, or UOP <0.25 ml/kg/hr, then administer bolus of LR 250 ml over 15 minutes. The bolus can be repeated after 30 min in the PACU if the patient's tachycardia, hypotension or oliguria was fluid responsive
 - Medications to minimize or avoid with patients 60 years and older due to an association with causing cognitive impairment:
 - Benzodiazepines
 - Opioids (particularly meperidine)
 - Anticholinergics
 - Diphenhydramine



Department of Anesthesiology

- Metoclopramide
- Medications that may cause serotonin syndrome (tramadol and dextromethorphan)
- Ward:
 - Non-pharmacological interventions:
 - Early mobilization
 - Maintain sensory input (glasses and hearing aids)
 - Cognitive stimulation and reorientation
 - Avoid dehydration

The care of patients is dependent on individual circumstances and no policy or procedure can detail or describe each circumstance. Thus, this policy is not a statement of the standard of care and should not be interpreted as such. It is meant to be a guideline only and should never be a substitute for the exercise of judgement.



Department of Anesthesiology

References:

- An, J., Fang, Q., Huan, C., Quian, X., Fan, T., Lin, Y., & Guo, Q. (2011). Deeper total intravenous anesthesia reduced the incidence of early postoperative cognitive dysfunction after microvascular decompression for facial spasm. *Journal of Neurosurgical Anesthesiology*, 23(1), 12-17.
<https://doi.org/10.1097/ana.0b013e3181f59db4>
- Alam, A., Hana, Z., Jin, Z., Suen, K.C., & Ma, D. (2018). Surgery, neuroinflammation and cognitive impairment. *EBioMedicine*, 37, 547-556. <https://doi.org/10.1016/j.ebiom.2018.10.021>
- American Geriatrics Society 2019 Beers Criteria Update Expert Panel. (2019). American geriatrics society 2019 updated beers criteria for potentially inappropriate medication use in older adults. *The Journal of American Geriatrics Society*, 63(11), 2227-2246. <https://doi.org/10.1111/jgs.13702>
- Bocskai, T., Kovacs, M., Szakacs, Z., Gede, N., Hegyi, P., Varga, G., Pap, I., Toth, I., Revesz, P., Szanyi, I., Nemeth, A., Gerlinger, I., Karadi, K., & Lujber, L. (2020). Is bispectral index monitoring protective against postoperative cognitive decline? A systematic review with meta-analysis. *PLOS One*, 15(2), 1-17.
<https://doi.org/10.1371/journal.pone.022901>
- Berger, M., Schenning, K. J., Charles H. B., Deiner, S. G., Whittington, R. A., Eckenhoff, R.G., Angst, M. S., Avramescu, S., Bekker, A., Brzezinski, M., Crosby, G., Culley, D. J., Eckenhoff, M., Eriksson, L. I., Evered, L., Ibinson, J., Kline, R. P., Kofke, A., Ma, D., ... Zuo, Z. (2018). Best practices for postoperative brain health: Recommendations from the fifth international perioperative neurotoxicity working group. *Neuroscience and Neuroanesthesiology*, 127(6), 1406-1413.
<https://doi.org/10.1213/ANE.0000000000003841>
- Chan, M. T., Cheng, B. C., Lee, T. M., & Gin, T. (2013). BIS-guided anesthesia decreases postoperative delirium and cognitive decline. *Journal of Neurosurgical Anesthesiology*, 25(1), 33-42.
<https://doi.org/10.1097/ana.0b013e3182712fba>
- Gao, W., He, Y., Liu, L., Quan, Y., Wang, Y., & Zhao, B. (2018). BIS monitoring on intraoperative awareness: A meta-analysis. *Current Medical Science*, 38(2), 349-353. <https://doi.org/10.1007/s11596-018-1886-1>
- Katzman, R., Brown, T., & Guld, P. (1983). Validation of a short orientation-memory concentration test of cognitive impairment. *American Journal of Psychiatry*, 140, 734-739.
- Kehlet, H. (1997). Multimodal approach to control postoperative pathophysiology and rehabilitation. *British Journal of Anaesthesia*, 78(5), 606-17.
- Kotekar, N., Shenkar, A., & Nagaraj, R. (2018). Postoperative cognitive dysfunction-current preventive strategies. *Clinical Interventions in Aging*, 13, 2267-2273. <https://dx.doi.org/10.2147%2FCIA.S133896>
- Krenk, L., & Rasmussen, L. S. (2011). Post-operative delirium and postoperative cognitive dysfunction in the elderly. What are the differences? *Minerva Anestesiologica*, 77(7), 742-749.
- Lassen, et al. Consensus review of optimal perioperative care in colorectal surgery. Enhanced Recovery After Surgery (ERAS) Group Recommendations. *Arch Surg*. 144:10 2009.
- Lonie, J. A., Kalu, U. G., & Ebmeier, K. P. (2010). A systematic review of cognitive screening for mild cognitive impairment. *Mind & Brain, The Journal of Psychiatry*, 1(1), 1-8.
- Ming, S., Zhang, X., Gong, Z., Xie, Y., & Xie, Y. (2020). Perioperative dexmedetomidine and postoperative delirium in non-cardiac surgery: A meta-analysis. *Annals of Palliative Medicine*, 9(2), 263-271.
<https://dx.doi.org/10.21037/apm.2020.02.27>
- Morrison, R. S., Magaziner, J., Gilbert, M., Koval, K. J., McLaughlin, M. A., Orosz, G., Strauss, E., & Siu, A. L. (2003). Relationship between pain and opioid analgesics on the development of delirium following hip fracture. *Journal of Gerontology*, 58(1), 76-81. <https://doi.org/10.1093/gerona/58.1.m76>
- Needham, M. J., Webb, C. E., & Bryden, D. C. (2017). Postoperative cognitive dysfunction and dementia: What we need to know and do. *British Journal of Anaesthesia*, 119(1), 115-125.
<https://doi.org/10.1093/bja/aex354>



Department of Anesthesiology

- O' Brien, H., Mohan, H., O'Hare, C. O., Reynolds, J. V., & Kenny, R. A. (2017). Mind over matter? The hidden epidemic of cognitive dysfunction in the older surgical patient. *Annals of Surgery*, 265(4), 677-691. <https://doi.org/10.1097/sla.0000000000001900>
- Palanca, B. J., Mashour, G. A., & Avidan, M. S. (2009). Processed electroencephalogram in depth of anesthesia monitoring. *Current Opinion in Anaesthesiology*, 22(5), 553–559. <https://doi.org/10.1097/ALN.0000000000002323>
- Quan, C., Chen, J., Luo, Y., Zhou, L., He, X., Liao, Y., Chou, J., Guo, Q., Chen, A. F., & Wen, O. (2019). BIS-guided deep anesthesia decreases short term postoperative cognitive dysfunction and peripheral inflammation in elderly patients undergoing abdominal surgery. *Brain and Behavior*, 9(4). <https://doi-org.usu01.idm.oclc.org/10.1002/brb3.1238>
- Rengel, K. F., Pandharipande, P. P., & Hughes, C. G. (2019). Special considerations for the aging brain and the perioperative neurocognitive dysfunction. *Anesthesiology Clinics*, 37(3), 521-536. <https://doi.org/10.1016/j.anclin.2019.04.010>
- Saller, T., MacLulich, A. M. J., Schafer, S. T., Crispin, A., Neitzert, R., Schule, C., VonDossow, V., & Hofmann-Kiefer, K. F. (2019). Screening for delirium after surgery: validation of the 4 A's test (4AT) in the post-anaesthesia care unit. *Anaesthesia*, 74, 1260-1266.
- Sieber, F. E., Mears, S., Lee, H., & Gottschalk, A. (2011). Postoperative opioid consumption and its relationship to cognitive function in older adults with hip fracture. *Journal of the American Geriatrics Society*, 59(12). <https://doi-org.usu01.idm.oclc.org/10.1111/j.1532-5415.2011.03729.x>
- Tieges, Z., MacLulich, A., Annand, A., Brookes, C., Cassarino, M., O'Connor, M., Ryan, D., Saller, T., Arora, R., Chang, Y., Agarwal, K., Taffet, G., Quinn, T., Shenkin, S., and Galvin, R. (2020). Diagnostic accuracy of the 4AT for delirium detection in older adults: systematic review and meta-analysis. *Age and Ageing*, 20(00), 1-11.
- Zhou, C., Zhu, Y., Liu, Z., & Ruan, L. (2016). Effect of dexmedetomidine on postoperative cognitive dysfunction in elderly patients after general anaesthesia: A meta-analysis. *Journal of International Medical Research*, 44(6), 1182-1190. <https://doi.org/10.1177/0300060516671623>

SHORT ORIENTATION- MEMORY- CONCENTRATION TEST

Patient Name: _____

Rater Name: _____

Date: _____

Instruction

Score 1 error for each incorrect response, to maximum for each item.

No.	Question	Maximum error	Score	x	Weight
1.	What year is it now?	1	_____	x 4	= _____
2.	What month is it now?	1	_____	x 3	= _____
	Repeat this phrase John Brown, 42 Market Street, Chicago				
3.	About what time is it? (within one hour)	1	_____	x 3	= _____
4.	Count backwards 20 to 1	2	_____	x 2	= _____
5.	Say the months in reverse order December, November, October, September, August, July, June, May, April, March, February, January	2	_____	x 2	= _____
6.	Repeat the phrase just given	5	_____	x 2	= _____
<i>Total error score</i>					= _____/28

Reference

Katzman R, Brown T, Fuld P, Peck A, Schechter R, Schimmel H. "Validation of a short Orientation-Memory-Concentration Test of cognitive impairment."
Am J Psychiatry. 1983;140;734-739.

Comment

Scoring:

0 - 8: Normal-minimum impairment

9 - 19: Minimal to Moderate impairment

20 - 28: Severe impairment

A score from 0 - 8 is within normal limits. A score of 9 or greater patient is at risk for delirium and cognitive impairment may be present.

Appendix G

Data Analysis Plan and Table

Interventions recorded on electronic health record (EHR) before and after ERAS protocol implementation								
	Variable Name	Variable description and type of measure	Data Source	Possible Range of Values	Level of Measurement	Time frame for collection	Statistical Test	Decision Rule
Event	IV:Implementation of Eras Protocol	Anesthesia providers administering general anesthesia to elderly (age 60 and above) patients. Process measure	Time Electronic Health Record (EHR) was reviewed	1=After Protocol 0=Before Protocol	Nominal		None	
	DV: Was a preoperative cognitive assessment performed?	Denotes the presence of a preoperative cognitive assessment before surgery. -Outcome measure	EHR	1= Yes 0= No	Nominal	3 months before protocol implementation and 3 months after protocol implementation	Chi-Squared test Fischer's-exact	
	DV: Was a postoperative cognitive assessment performed?	Denotes the presence of a postoperative cognitive assessment before surgery. -Outcome measure	EHR	1= Yes 0= No	Nominal	3 months before protocol implementation and 3 months after protocol implementation	Chi-Squared test Fischer's-exact	
	DV: Did the providers use processed EEG?	Accounts for processed EEG use during surgery. -Outcome measure	EHR	1= Yes 0= No	Nominal	3 months before protocol implementation and 3 months after protocol implementation	Chi-Squared test Fischer's-exact	
	DV: Did the providers use meperidine?	Accounts for meperidine use during surgery. -Outcome measure	EHR	1= Yes 0= No	Nominal	3 months before protocol implementation and 3 months after protocol implementation	Chi-Squared test Fischer's-exact	
	DV: Did the providers use morphine?	Accounts for morphine use during surgery. -Outcome measure	EHR	1= Yes 0= No	Nominal	3 months before protocol implementation and 3 months after protocol implementation	Chi-Squared test Fischer's-exact	
	DV: Did the providers use dexmedetomidine?	Accounts for dexmedetomidine use during surgery. -Outcome measure	EHR	1= Yes 0= No	Nominal	3 months before protocol implementation and 3 months after protocol implementation	Chi-Squared test Fischer's-exact	
	DV: Did the providers use midazolam?	Accounts for midazolam use during surgery. -Outcome measure	EHR	1= Yes 0= No	Nominal	3 months before protocol implementation and 3 months after protocol implementation	Chi-Squared test Fischer's-exact	

ID	ERAS	MO	Age	SEX	SURG_TYP2	Blood loss RSK_CA T	Postop Pain RSK_CA T	AN_TYPE	AN_PROV	PREASS	POSTASS	MEP	MRPH	PRECDRP	PRECBOL	MID	BIS
020864BW	0	1	64	M	Amputation, foot at ankle	Hi	Mod	Gen	EB	0	0	0	0	0	0	1	0
020467GP	0	1	67	F	Angiogram	Hi	Low	Gen	MT	0	0	0	0	0	0	0	0
020573SP	0	1	73	F	Arthroplasty, CMC	Hi	Mod	Gen/Reg	NH	0	0	0	0	0	1	1	0
021587FK	0	1	87	F	Arthroplasty, hip	Hi	High	Gen	SB	0	0	0	0	0	0	0	0
021081EE	0	1	81	F	Arthroplasty, hip, hemi	Hi	High	Mac/Reg	JI/TU	0	0	0	0	0	0	0	0
021272CE	0	1	72	F	Arthroplasty, hip, hemi	Hi	High	Gen	BW	0	0	0	0	0	0	0	0
020261VC	0	1	61	F	Arthroplasty, hip, total	Hi	High	Mac/Reg	BW	0	0	0	0	0	0	1	0
022466CA	0	1	66	F	Arthroplasty, hip, total L	Hi	High	Mac/Reg	AN/BW	0	0	0	0	0	0	1	0
022477WS	0	1	77	F	Arthroplasty, hip, total L	Hi	High	Mac/Reg	BW	0	0	0	0	0	0	1	0
022362YJ	0	1	62	M	Arthroplasty, hip, total R	Hi	High	Mac/Reg	BM	0	0	0	0	0	0	1	0
020267BL	0	1	67	F	Arthroplasty, knee, total	Hi	High	Mac/Reg	BW	0	0	0	0	0	0	1	0
020366PRE	0	1	66	F	Arthroplasty, knee, total	Hi	High	Gen/Reg	AL	0	0	0	0	0	0	1	0
020373RJ	0	1	73	M	Arthroplasty, knee, total	Hi	High	Mac/Reg	AL/AS	0	0	0	0	0	0	0	0
021764BR	0	1	64	F	Arthroplasty, knee, total	Hi	High	Mac/Reg	MT	0	0	0	0	0	0	1	0
022476HJ	0	1	76	M	Arthroplasty, knee, total L	Hi	High	Gen	BW	0	0	0	0	0	0	0	0
020882WL	0	1	82	M	Arthroplasty, knee, unicompartmental	Hi	High	Gen/Reg	AL/JH	0	0	0	0	0	0	0	0
022371VP	0	1	71	M	Arthroscopy, ankle, limited debride	Lo	Low	Gen/Reg	AP/AS	0	0	0	0	0	0	1	0
020483RM	0	1	83	F	Arthroscopy, repair, rotator,subscapu	Lo	Low	Gen	AL/BM	0	0	0	0	0	0	0	0
021660CP	0	1	60	M	Arthroscopy, shoulder	Lo	Low	Gen/Reg	AL/AS	0	0	0	0	0	0	1	0
021278AB	0	1	78	F	AVF creation, graft	Inter	Low	Gen	DD	0	0	0	0	0	0	0	0
022585TW	0	1	85	M	AVF creation, graft	Inter	Low	Gen	ISMAWAN	0	0	0	0	0	0	0	0
022669FA	0	1	69	F	AVF creation, graft	Inter	Low	Gen	BERNADETTE	0	0	0	0	0	0	1	0
021161OJ	0	1	61	F	Biopsy, axillary node	Lo	Mod	Gen/Reg	AL/JS	0	0	0	0	0	0	1	0
021173NM	0	1	73	F	Biopsy, breast, needle localization	Lo	Mod	Gen	JS	0	0	0	0	0	0	0	0
021264WJ	0	1	64	F	Biopsy, breast, needle localization	Lo	Mod	Gen	CS	0	0	0	0	0	0	1	0
021761SM	0	1	61	F	Biopsy, breast, needle localization	Lo	Mod	Gen	DE	0	0	0	0	0	0	1	0
022586WE	0	1	86	M	Bronchoscopy	Lo	Low	Gen	MT	0	0	0	0	0	0	0	0
020274TZ	0	1	74	F	Cholangiopancreatography, endosco	Lo	Low	Gen	AL	0	0	0	0	0	0	0	0
020568DF	0	1	68	M	Cholangiopancreatography, endosco	Lo	Low	Gen	MB	0	0	0	0	0	0	1	0
021094VM	0	1	94	F	Cholangiopancreatography, endosco	Lo	Low	Gen	JS	0	0	0	0	0	0	0	1
020280MT	0	1	80	M	Closure. local flap	Lo	Mod	Gen	NH	0	0	0	0	0	0	1	0
020568GE	0	1	68	F	Colonoscopy	Lo	Low	Gen	KS	0	0	0	0	0	0	1	0
022476SR	0	1	76	F	Colpocleisis, Le Fort type	Inter	Low	Gen	SH	0	0	0	0	0	0	0	0
020465MR	0	1	65	M	Cystoscopic brachytherapy, prostate	Inter	Low	Gen	DC/OR	0	0	0	0	0	0	0	0
021876KD	0	1	76	F	Cystoscopy	Lo	Low	Gen	DD	0	0	0	0	0	0	0	0
022666HS	0	1	66	F	Cystoscopy, ureter, pylegram	Lo	Low	Gen	AS	0	0	0	0	0	0	1	0
020282KE	0	1	82	F	Debridement, wound	Lo	Low	Gen	JH	0	0	0	0	0	1	0	0
020778JC	0	1	78	F	Debridement, wound	Lo	Low	Gen	JH	0	0	0	0	0	1	0	1
021162SL	0	1	62	F	Dilation, esophageal	Lo	Low	Gen	JR	0	0	0	0	0	0	1	0
022563ML	0	1	63	F	Dissection, axillary lymph node	Lo	Mod	Gen	AB	0	0	0	0	0	0	0	0
021771KL	0	1	71	F	Enucleation	Lo	Mod	Gen	BW	0	0	0	0	1	0	1	0
020765SS	0	1	65	F	Esophagogastroduodenoscopy (EGE	Lo	Low	Gen	JH	0	0	0	0	0	1	1	1
020279SD	0	1	79	M	Examination, rectum	Lo	Low	Gen	SB	0	0	0	0	0	0	0	0
022266WS	0	1	66	F	Excision/ replacement, penile prosth	Lo	Mod	Gen	HP	0	0	0	0	0	0	1	0
020271RL	0	1	71	F	Fusion, Foot	Inter	High	Gen	MP	0	0	0	0	0	0	1	0
020866PM	0	1	66	F	Gastrostomy/Jejunostomy tube place	Lo	Mod	Gen	BW	0	0	0	0	0	0	0	0

021772RS	0	1	72	M	Graft, skin, split thickness	Lo	Mod	Gen	DL	0	0	0	0	1	0	1	0
022669PA	0	1	69	F	Graft/ fat injection	Inter	Mod	Gen	WU	0	0	0	0	0	0	0	0
020364FA	0	1	64	F	Hysteroscopy	Lo	Mod	Gen	SH	0	0	0	0	0	0	1	0
021162SM	0	1	62	F	Hysteroscopy, surgical; w/ biopsy, w/	Lo	Mod	Mac/Reg	MB	0	0	0	0	0	0	1	0
021963DW	0	1	63	M	Incision and drainage	Lo	Low	Gen	AN	0	0	0	0	0	1	1	0
020275PD	0	1	75	M	Incision and drainage, LE	Lo	Low	Gen	SB/SS	0	0	0	0	0	1	0	0
020872DA	0	1	72	M	Insertion, penis prosthesis, inflatable	Inter	Mod	Gen	DG	0	0	0	0	1	1	0	0
020768SA	0	1	68	M	Laparotomy, exploratory	Inter	High	Gen/Reg	SW	0	0	0	0	0	1	1	0
021974RS	0	1	74	M	Ligation, Saphenous vein	Lo	Low	Gen	LS	0	0	0	0	0	0	0	0
022375GM	0	1	75	F	MOHS, RPR	Lo	Low	Gen	BW	0	0	0	0	0	0	1	0
021860DC	0	1	60	F	Nephrolithotomy, percutaneous	Inter	Low	Gen	DD	0	0	0	0	1	0	0	0
021762MI	0	1	62	F	Paracentesis, eye, anterior chamber	Lo	Low	Gen	AP	0	0	0	0	0	0	0	0
020266NK	0	1	66	F	Placement, wound Vac	Lo	Low	Gen	KS	0	0	0	0	0	0	0	0
021873MJ	0	1	73	M	Pyelogram, retrograde	Lo	Low	Gen	DD	0	0	0	0	0	0	0	0
020560BG	0	1	60	M	Reduction, open internal fixation, dist	Inter	High	Gen/Reg	AS/BM/DC	0	0	0	0	0	0	1	0
021977FR	0	1	77	M	Release, carpal tunnel	Lo	Low	Gen	JL	0	0	0	0	0	1	0	0
022261MC	0	1	61	F	Release, tarsal tunnel	Lo	Low	Gen	SH	0	0	0	0	0	0	0	0
021675DP	0	1	75	F	Repair, fistula	Lo	Low	Gen	BW	0	0	0	0	0	0	0	0
021664CJ	0	1	64	F	Repair, hernia, abdominal wall, lapar	Lo	Mod	Gen	MB	0	0	0	0	0	0	1	0
022461WV	0	1	61	F	Repair, hernia, incisional w/ mesh, rot	Lo	Mod	Gen	HP	0	0	0	0	0	0	1	0
020462DG	0	1	62	M	Repair, hernia, incisional, w/mesh	Lo	Mod	Gen	SHAPIRA	0	0	0	0	0	0	1	0
020874LR	0	1	74	M	Repair, hernia, inguinal	Lo	Mod	Gen	BW	0	0	0	0	0	0	1	1
020474CA	0	1	74	M	Repair, hernia, inguinal, laparoscopic	Lo	Mod	Gen	EN	0	0	0	0	0	0	1	0
020560GR	0	1	60	M	Repair, hernia, inguinal, w/ mesh	Lo	Mod	Gen	DE	0	0	0	0	0	0	1	0
021366HV	0	1	66	M	Repair, hernia, inguinal, w/ mesh	Lo	Mod	Gen	SG	0	0	0	0	0	0	1	0
022579SJ	0	1	79	M	Repair, hernia, inguinal, w/ mesh R	Lo	Mod	Gen	DD	0	0	0	0	0	0	0	0
020375GW	0	1	75	M	Repair, intertrochanteric fracture	Inter	High	Gen	SG	0	0	0	0	0	0	0	0
020771AE	0	1	71	M	Resection, appendix, laparoscopic	Inter	Mod	Gen	JH	0	0	0	0	0	1	1	0
021765AH	0	1	65	F	Resection, appendix, laparoscopic	Inter	Mod	Gen	AP	0	0	0	0	0	0	1	0
022088PC	0	1	88	F	Resection, appendix, laparoscopic	Inter	Mod	Gen	JH	0	0	0	0	0	0	1	0
022461CR	0	1	61	F	Resection, breast (bilateral); skin graf	Inter	Mod	Gen	MB	0	0	0	0	0	0	1	0
020564OF	0	1	64	F	Resection, breast, partial	Inter	Mod	Mac/Reg	AB/AS	0	0	0	0	0	0	1	0
021263OC	0	1	63	F	Resection, breast, partial	Inter	Mod	Gen	CS	0	0	0	0	0	0	1	0
020985PR	0	1	85	F	Resection, breast, total	Inter	Mod	Gen/Reg	JU/KS	0	0	0	0	0	0	0	1
021673LE	0	1	73	F	Resection, breast, total	Inter	Mod	Gen	RO/TU	0	0	0	0	1	0	1	1
022673GC	0	1	73	F	Resection, disc, (bilateral) (L4-L5), mi	Inter	Mod	Gen	DD	0	0	0	0	0	0	1	0
022287TD	0	1	87	M	Resection, disc, micro (Left) (L5-S1)	Inter	Mod	Gen	MT/SW	0	0	0	0	0	0	0	0
022362KJ	0	1	62	M	Resection, epididymis; scrotum exploi	Lo	Mod	Gen	SB	0	0	0	0	0	0	1	0
020178SL	0	1	78	M	Resection, gall bladder, laparoscopic	Inter	Low	Gen	SS	0	0	0	0	0	0	0	0
020468DF	0	1	68	M	Resection, gall bladder, laparoscopic	Inter	Low	Gen	BW/SHAPIRA	0	0	0	0	0	0	1	1
020674VJ	0	1	74	M	Resection, gall bladder, laparoscopic	Inter	Low	Gen	CP	0	0	0	0	0	0	0	0
020972KD	0	1	72	F	Resection, gall bladder, laparoscopic	Inter	Low	Gen	DD	0	0	0	0	0	0	0	0
021687CB	0	1	87	F	Resection, gall bladder, laparoscopic	Inter	Low	Gen/Reg	BW/JS	0	0	0	0	0	0	0	0
021961KT	0	1	61	M	Resection, gall bladder, laparoscopic	Inter	Low	Gen	BW	0	0	0	0	1	0	1	0
021675GJ	0	1	75	F	Resection, kidney, radical, robotic	Hi	Mod	Gen	DD	0	0	0	0	1	0	0	0
021169LA	0	1	69	F	Resection, lump, breast, needle local	Lo	Mod	Gen	DD	0	0	0	0	0	0	0	0
021861OD	0	1	61	F	Resection, lump, breast, needle local	Lo	Mod	Gen	MB	0	0	0	0	0	0	1	0
021971HB	0	1	71	M	Resection, lung lobe	Hi	High	Gen	JS	0	0	0	0	0	0	1	1
020361LL	0	1	61	F	Resection, pannus	Inter	Mod	Gen	JA	0	0	0	0	0	1	0	0
022569TR	0	1	69	M	Resection, prostate, transurethral	Inter	Low	Gen	MT	0	0	0	0	0	0	1	0
020962HJ	0	1	62	M	Resection, tongue, total	Inter	Mod	Gen	SB	0	0	0	0	0	1	1	0

021062FD	0	1	62	M	Tenodesis, biceps	Inter	High	Gen	AL/BW	0	0	0	0	0	0	1	0
020378JC	0	1	78	F	Thromboendarterectomy, carotid	Inter	Low	Gen	SB	0	0	0	0	0	0	1	0
020471CP	0	1	71	M	Thromboendarterectomy, carotid	Inter	Low	Gen	MT	0	0	0	0	0	0	1	0
021276MH	0	1	76	M	Thromboendarterectomy, carotid	Inter	Low	Gen	AB	0	0	0	0	0	0	0	0
022681LR	0	1	81	F	Ultrasound, endobronchial	Lo	Low	Gen	RO	0	0	0	0	0	0	0	1
021268LC	0	1	68	F	Ureteroscopy w/ lithotripsy	Lo	Low	Gen	HH	0	0	0	0	0	0	1	0
021272DM	0	1	72	M	Ureteroscopy w/ lithotripsy	Lo	Low	Gen	CT	0	0	0	0	0	0	0	0
021670SJ	0	1	70	M	Ureteroscopy w/ lithotripsy	Lo	Low	Gen	EB	0	0	0	0	0	0	1	0
022669RA	0	1	69	M	Ureteroscopy w/ lithotripsy L	Lo	Low	Gen	AS	0	0	0	0	0	0	1	0
020391SCP	0	1	91	F	Vestibuloplasty	Lo	High	Gen	DE	0	0	0	0	0	0	1	0
021291SCP	0	1	91	F	Vestibuloplasty; complex	Lo	High	Gen	IL	0	0	0	0	0	0	0	0
030161GK	0	2	61	M	w/ stent placement	Lo	Mod	Gen	AB/SB	0	0	0	0	0	0	1	0
031264BW	0	2	64	M	Amputation, below knee	Inter	Low	Gen/Reg	AS/HH/JU/RW	0	0	0	0	0	0	1	0
032490KT	0	2	90	M	Amputation, digit, foot	Inter	Mod	Gen	LA/TU	0	0	0	0	0	0	0	0
032674KD	0	2	74	M	Arthroplasty, digit, hand	Hi	Mod	Gen	AE	0	0	0	0	0	0	1	0
030184MR	0	2	84	F	Arthroplasty, hip, total	Hi	High	Mac/Reg	JJ/TS	0	1	0	0	0	0	1	0
030261OR	0	2	61	M	Arthroplasty, hip, total	Hi	High	Mac/Reg	DD/MP	0	0	0	0	0	0	1	0
032272RV	0	2	72	F	Arthroplasty, hip, total	Hi	High	Mac/Reg	AB/AL/BW/DM	0	1	0	0	0	0	1	0
033184WH	0	2	84	M	Arthroplasty, hip, total	Hi	High	Mac/Reg	JN/MT/RW/SW	0	0	0	0	0	0	1	0
030460GS	0	2	60	M	Arthroplasty, knee, partial	Hi	High	Mac/Reg	DC/OO	0	0	0	0	1	0	0	0
030161CR	0	2	61	F	Arthroplasty, knee, total	Hi	High	Mac/Reg	JJ/TS	0	0	0	0	0	0	0	0
030462MS	0	2	62	M	Arthroplasty, knee, total	Hi	High	Mac/Reg	DC/OO	0	0	0	0	1	0	0	0
032465LL	0	2	65	M	Arthroplasty, knee, total	Hi	High	Mac/Reg	DD/ES	0	0	0	0	0	0	1	0
032978WC	0	2	78	F	Arthroplasty, knee, total	Hi	High	Mac/Reg	KS	0	0	0	0	0	0	1	0
033164CT	0	2	64	F	Arthroplasty, knee, total	Hi	High	Mac/Reg	JN/SW	0	0	0	0	0	0	1	0
031079AP	0	2	79	M	Arthroplasty, shoulder L	Hi	High	Gen	AN/EB	0	0	0	0	1	0	1	0
031967PC	0	2	67	F	Arthroplasty, shoulder, total	Hi	High	Gen/Reg	AB/AS/DE/EA	0	0	0	0	0	0	1	0
030260ME	0	2	60	F	Arthroscopy, ankle	Lo	Low	Gen	DC/JN	0	0	0	0	0	0	1	0
030374RS	0	2	74	M	drainage, abdomen	Lo	Low	Gen	DD/JJ	0	0	0	0	0	0	0	0
031973PL	0	2	73	F	Arthroscopy, repair rotator cuff	Lo	Low	Gen/Reg	AB/AS/EA/NH	0	0	0	0	0	0	1	0
030579TR	0	2	79	M	Aspiration, bladder	Lo	Low	Gen	JJ/MC	0	0	0	0	0	0	0	0
031978BJ	0	2	78	F	AVF creation	Lo	Low	Gen	DD/GC	0	0	0	0	0	0	0	0
031980AR	0	2	80	M	AVF creation	Lo	Low	Mac/Reg	AL/DD/EA/GC/K	0	0	0	0	1	0	0	0
031877WJ	0	2	77	F	AVF, revision	Lo	Low	Gen	AB/AL/BW/LA/S	0	0	0	0	0	0	0	0
031982PW	0	2	82	M	AVF, revision	Lo	Low	Gen	KJ/MB/MP	0	1	0	0	0	0	0	0
032282PW	0	2	82	M	AVF, revision	Lo	Low	Gen	DE/NH/TD	0	0	0	0	0	0	0	0
030574GV	0	2	74	F	Biopsy, breast, needle localization	Lo	Mod	Gen	HH/OO	0	0	0	0	0	0	1	0
031674GC	0	2	74	M	Biopsy, inguinal lymph node	Lo	Mod	Gen	BW/JN	0	0	0	0	0	0	0	0
032377MC	0	2	77	M	Biopsy, thoracoscopy	Lo	Mod	Gen	ES/SB	0	0	0	0	0	1	1	0
031860PL	0	2	60	M	Bronchoscopy w/ biopsy	Lo	Low	Gen	ES/SB	0	0	0	0	0	0	1	0
033162MG	0	2	62	F	Colpocleisis	Inter	Low	Gen	JS/SB	0	0	0	0	0	0	1	0
030864FA	0	2	64	F	Colporrhaphy, Cystoscopy w/ biopsy	Inter	Low	Gen	MR/NH	0	0	0	0	0	0	1	0
031562WD	0	2	62	M	insertion	Inter	Mod	Gen	AL/LA	0	0	0	0	0	0	1	0
030964AA	0	2	64	M	Cystoscopy w/ biopsy	Lo	Low	Gen	JU/RH	0	0	0	0	0	1	1	0
031788NJ	0	2	88	M	exploratory laparotomy	Inter	Low	Gen/Reg	DD/GC/HP	0	0	0	0	0	0	0	0
030485NK	0	2	85	M	Cystoscopy, rigid	Lo	Low	Gen	AP/SP	0	0	0	0	0	0	1	0
030164FH	0	2	64	F	exploration of female genitals	Lo	Low	Gen	AB/SB	0	0	0	0	0	0	1	0
030978MR	0	2	78	F	catheterization	Lo	Low	Gen	JU/RH	0	0	0	0	0	1	0	0
031161JK	0	2	61	M	catheterization	Lo	Low	Gen	JB	0	0	0	0	0	0	1	0
032976NP	0	2	76	F	Decompression, ulnar nerve	Lo	Low	Gen	LS	0	0	0	0	0	0	0	0
031266WB	0	2	66	M	Endarterectomy, carotid	Hi	Low	Gen	AB/IJ	0	0	0	0	0	0	1	0

031187OM	0	2	87	M	(EGD)	Lo	Low	Gen	AB/MB	0	0	0	0	0	0	0	0
031188BJ	0	2	88	M	(EGD) w/ biopsy	Lo	Low	Gen	AB/MB	0	0	0	0	0	0	0	0
032676RA	0	2	76	F	(EGD) w/ dilation	Lo	Low	Gen	EN/ES/LS	0	0	0	0	0	0	0	0
030462BF	0	2	62	F	Excision, breast implant	Inter	Mod	Gen	AB/RH	0	0	0	0	0	0	1	0
031071PM	0	2	71	F	Excision, lesion, skin	Lo	Low	Gen	ES/NH/RK	0	0	0	0	0	0	1	0
030999SJ	0	2	99	M	Excision, urinary sphincter device	Lo	Low	Gen	JU/RH	0	1	0	0	0	1	0	1
032275DF	0	2	75	M	Extraction, cataract w/ IOL insertion	Lo	Low	Gen	HP/JU	0	0	0	0	1	0	1	0
031762HD	0	2	62	M	Extraction, dental	Lo	Low	Gen	ML	0	0	0	0	0	0	0	0
031663SS	0	2	63	F	Hysteroscopy	Lo	Mod	Gen	CT	0	0	0	0	0	1	1	0
030768AP	0	2	68	M	Incision and drainage	Lo	Low	Gen	AL/JU/MC	0	0	0	0	0	0	0	0
031068AP	0	2	68	M	Incision and drainage LFA	Lo	Low	Gen	RH	0	0	0	0	0	0	0	0
031573JG	0	2	73	M	Incision and drainage, hand	Lo	Low	Gen	EA/MT/SB	0	0	0	0	0	0	1	0
031575PD	0	2	75	M	Incision and drainage, knee	Lo	Low	Gen	ES/KJ/MP	0	0	0	0	0	0	0	0
030174RS	0	2	74	M	Incision and drainage, LE	Lo	Low	Gen	JS	0	0	0	0	0	0	0	0
030772PD	0	2	72	M	Incision and drainage, LE	Lo	Low	Gen	AS/SB	0	0	0	0	0	0	1	0
032176SV	0	2	76	F	Insertion, intramedullary nail- femur	Inter	Mod	Gen	ES/MB/RW	0	1	0	0	0	0	0	0
030264MC	0	2	64	M	Insertion, penis prosthesis	Inter	Mod	Gen	TU	0	0	0	0	0	0	1	0
030161VW	0	2	61	F	Laparotomy, exploratory	Inter	High	Gen	MP	0	0	0	0	0	0	1	0
030573SD	0	2	73	F	Reduction, open internal fixation, ank	Inter	Mod	Gen/Reg	CT/JI/JU/RW	0	0	0	0	0	0	0	0
030960RB	0	2	60	F	tibia	Inter	Mod	Gen	AB/DG/JD	0	0	0	0	0	0	1	0
031560CK	0	2	60	F	wrist	Inter	High	Gen	MP	0	0	0	0	0	0	1	0
030361BT	0	2	61	M	Repair, hernia, inguinal	Lo	Mod	Gen	MB	0	0	0	0	0	0	1	0
031772GM	0	2	72	M	Repair, hernia, inguinal	Lo	Mod	Gen	DG/NH	0	0	0	0	0	0	1	0
031566JT	0	2	66	M	Resection, appendix, laparoscopic	Inter	Mod	Gen	SS	0	0	0	0	0	0	0	0
030469LA	0	2	69	F	node	Inter	High	Gen	DM/TU	0	0	0	0	0	0	0	0
030964HB	0	2	64	F	node L	Inter	High	Gen	DC/TD	0	0	0	0	0	1	1	0
032361TD	0	2	61	M	Resection, colon R	Hi	High	Gen	AL/CT/TD/TS	0	0	0	0	0	0	1	0
032668BD	0	2	68	F	Resection, disc, anterior cervical	Inter	Mod	Gen	DE	0	0	0	0	1	0	1	0
033160BD	0	2	60	M	Resection, disc, lumbar	Inter	Mod	Gen	JN/SD	0	0	0	0	0	0	1	0
031264TC	0	2	64	M	Resection, disc, lumbar, micro	Inter	Mod	Gen	ES/NH	0	0	0	0	0	0	1	0
030362HM	0	2	62	F	Resection, facet joint, lumbar	Inter	Mod	Gen	BW/ES	0	0	0	0	1	0	1	0
031560CR	0	2	60	F	Resection, gall bladder	Inter	Low	Gen/Reg	DL/EA	0	0	0	0	1	0	1	0
032469NP	0	2	69	F	Resection, gall bladder, laparoscopic	Inter	Low	Gen	KS/RO	0	0	0	0	0	0	0	0
032471BJ	0	2	71	M	Resection, gall bladder, laparoscopic	Inter	Low	Gen	ES/IL	0	0	0	0	0	0	0	0
032761HR	0	2	61	F	Resection, gall bladder, laparoscopic	Inter	Low	Gen	DG/KJ/MP	0	0	0	0	0	0	1	0
031675MM	0	2	75	M	Resection, lamina, lumbar	Inter	High	Gen	JU/SD	0	1	0	0	0	0	0	0
030461MW	0	2	61	M	Resection, large intestine	Hi	High	Gen	DD/ES	0	0	0	0	1	0	1	0
033172BK	0	2	72	M	Resection, lung, robot-assisted	Hi	Low	Gen	EA/SB	0	0	0	0	0	1	1	0
030460CK	0	2	60	M	Resection, parotid	Lo	Mod	Gen	AP/DL/GC	0	0	0	0	0	0	1	0
032682WD	0	2	82	M	Resection, prostate, lymph node	Inter	High	Gen	AS/DD/JJ	0	1	0	0	0	0	0	0
030566KG	0	2	66	M	Resection, prostate, transurethral	Inter	Low	Mac/Reg	JJ/MC	0	1	0	0	0	0	1	0
030568WF	0	2	68	M	Resection, prostate, transurethral	Inter	Low	Gen	MP/NH	0	0	0	0	0	0	1	0
030885NK	0	2	85	M	insertion of urethral stent	Inter	Low	Gen	GC/GN/HH/KJ	0	0	0	0	0	0	0	0
031779DD	0	2	79	M	Resection, thyroid lobe R	Lo	Mod	Gen	JS/SB	0	0	0	0	0	0	1	0
031260MC	0	2	60	F	laparoscopic	Hi	Mod	Gen	CP/GC	0	0	0	0	0	0	1	0
030363JJ	0	2	63	F	Septorhinoplasty	Lo	Low	Gen	DC/DM	0	0	0	0	0	1	1	0
031168GE	0	2	68	F	Ureteroscopy	Lo	Low	Gen	DC/JD	0	0	0	0	0	0	1	0
031574MR	0	2	74	M	Ureteroscopy	Lo	Low	Gen	MR/OO	0	0	0	0	0	0	0	0
031661DC	0	2	61	F	Ureteroscopy	Lo	Low	Gen	JJ/MT	0	0	0	0	0	0	1	0
032360DC	0	2	60	F	Ureteroscopy	Lo	Low	Gen	JJ/MT	0	0	0	0	0	0	1	0
040387AY	0	3	87	F	Arthroplasty, hip, total	Hi	High	Mac/Reg	DL/ES	0	0	0	0	0	1	0	0

041973BL	0	3	73	F	Arthroplasty, hip, total	Hi	High	Mac/Reg	AS/DG/EK/JF/M:0	0	0	0	0	0	1	0
042168CN	0	3	68	M	Arthroplasty, hip, total	Hi	High	Mac/Reg	DC/DM/SB	0	0	0	0	0	1	0
041961LG	0	3	61	M	Arthroplasty, knee, partial	Hi	High	Gen/Reg	BW/KS	0	0	0	0	0	0	1
040565AD	0	3	65	F	Arthroplasty, knee, total	Hi	High	Gen	BM/IL	0	0	0	0	0	1	0
041271RR	0	3	71	F	Arthroplasty, knee, total	Hi	High	Mac/Reg	AL	0	0	0	0	1	1	0
042872CT	0	3	72	M	Arthroplasty, knee, total	Hi	High	Mac/Reg	ML/NH	0	0	0	0	0	1	0
041465RP	0	3	65	F	Arthroplasty, shoulder, total	Hi	High	Gen	CR/DC/EA/KP/JI	0	0	0	0	0	0	0
041568RE	0	3	68	M	cuff	Lo	Low	Gen/Reg	DC/LA/SS/TD	0	0	0	0	0	1	0
041970GR	0	3	70	F	AVF creation	Lo	Low	Mac/Reg	AB/EK/HP/JF/JI	0	0	0	1	0	0	0
042262DH	0	3	62	M	AVF creation	Lo	Low	Gen	JI/TK	0	0	0	0	0	1	0
040271LS	0	3	71	M	AVF, revision	Lo	Low	Mac/Reg	BW/JF/MT/SB/Y.	0	0	0	0	0	1	0
041971CR	0	3	71	M	AVF, revision	Lo	Low	Mac/Reg	AB/AS/JF/JI/NH	0	0	0	1	0	0	0
040264HD	0	3	64	M	Biopsy, bladder	Lo	Low	Gen	EB/SS	0	0	0	0	0	1	0
042973PK	0	3	73	F	Biopsy, bladder	Lo	Low	Mac/Reg	DD/TK	0	0	0	1* intratheca	0	0	0
040291BN	0	3	91	F	ultrasound	Lo	Low	Gen	JS/JU/SB	0	0	0	0	0	1	0
040967RE	0	3	67	F	ultrasound	Lo	Low	Gen	LC	0	0	0	0	0	1	0
042783DA	0	3	83	M	ultrasound	Lo	Low	Gen	AS/SB	0	0	0	0	0	0	0
041563RJ	0	3	63	M	Closure, ileostomy	Inter	Mod	Gen	MB/OO	0	0	0	0	0	1	0
043060VA	0	3	60	M	Closure, ileostomy	Inter	Mod	Gen/Reg	AL/BW/HP/JF/MI	0	0	0	1	0	1	0
041283OD	0	3	83	M	Colonoscopy, upper endoscopy	Lo	Low	Gen	SB	0	0	0	0	0	1	0
040184BG	0	3	84	M	Laparoscopy, diagnostic	Hi	Mod	Gen	NH/YA	0	0	0	0	0	0	0
042364CM	0	3	64	F	Craniotomy	Inter	Mod	Gen	BW/KJ	0	0	0	1	0	1	0
041972HE	0	3	72	M	Cystoscopic cystostomy	Lo	Low	Gen	DL/RW	0	0	0	0	0	0	0
040990AR	0	3	90	M	Cystoscopic excision of lesion	Lo	Low	Gen	AB	0	0	0	0	0	0	0
040177KI	0	3	77	M	Cystoscopy w/ biopsy	Lo	Low	Gen	BM/TD	0	0	0	0	0	1	0
043064AA	0	3	64	M	Cystoscopy w/ biopsy	Lo	Low	Gen	JR	0	0	0	0	0	0	0
040585NK	0	3	85	M	Cystoscopy w/ stent placement	Lo	Low	Gen	AP/SP	0	0	0	0	0	0	0
041274CS	0	3	74	F	Cystoscopy, rigid	Lo	Low	Gen	BM/LC	0	0	0	0	0	1	0
042986BB	0	3	86	F	Cystoscopy, ureter catheterization	Lo	Low	Gen	DD/KT	0	0	0	0	0	0	0
043061JK	0	3	61	M	catheterization	Lo	Low	Gen	AB/DL	0	0	0	0	0	1	0
042871KS	0	3	71	F	Dacryocystorhinostomy	Lo	Low	Gen	BW/OO/SH	0	0	0	0	0	0	0
043077MH	0	3	77	M	Decompression, median nerve	Lo	Low	Gen	HH/OO	0	0	0	0	0	0	0
042070AF	0	3	70	M	Dilation, esophageal	Lo	Low	Gen	DE	0	0	0	0	0	0	0
040282PS	0	3	82	M	Dissection, neck, ear excision	Inter	Mod	Gen	AB/SB	0	0	0	1	0	1	0
040869CE	0	3	69	F	Endarterectomy, carotid	Hi	Low	Gen	CR/JS	0	0	0	0	0	1	0
042265PS	0	3	65	M	Endarterectomy, carotid	Hi	Low	Gen	JI/RH/RW/TK/YA	0	0	0	0	0	1	0
042978JC	0	3	78	F	Endarterectomy, carotid	Hi	Low	Gen	AB/SB	0	0	0	0	0	0	0
042367FL	0	3	67	M	(EGD)	Lo	Low	Gen	SB/TD	0	0	0	0	0	1	0
040568DF	0	3	68	M	(EGD) w/ ERCP	Lo	Low	Gen	HH/NH/YA	0	0	0	0	0	0	0
042062MI	0	3	62	F	Evisceration, eye	Lo	Mod	Gen	SP/SW	0	0	0	0	1	0	0
041382PS	0	3	82	M	Excision, cartilage donor site, ear	Lo	Mod	Gen	MC	0	0	0	0	0	1	0
042761MS	0	3	61	M	Excision, lesion LE	Lo	Low	Gen	JS/KS	0	0	0	0	0	1	0
042871ML	0	3	71	M	Extraction, cataract w/ IOL insertion	Lo	Low	Gen	OO/SH	0	0	0	0	0	0	0
042363CG	0	3	63	M	implants	Lo	Low	Gen	SB/SS	0	0	0	0	0	1	0
040263DW	0	3	63	M	Fusion, ankle	Lo	High	Gen/Reg	DE/JF/MT	0	0	0	0	0	1	0
041266RM	0	3	66	F	Fusion, Foot	Inter	High	Gen/Reg	AB/DL/JF/NH	0	0	0	0	0	1	0
042071LS	0	3	71	M	Incision and drainage UE	Lo	Low	Mac/Reg	BW/JF/MT/SB/Y.	0	0	0	0	0	1	0
041371PM2	0	3	72	F	Incision and drainage, face	Lo	Low	Gen	EK/ES/NH	0	0	0	0	0	1	0
040269AP	0	3	69	M	Incision and drainage, hand	Lo	Low	Gen	RH	0	0	0	0	0	0	0
041465GT	0	3	65	F	Incision and drainage, hand	Lo	Low	Gen	AB	0	0	0	0	0	1	0
040983CR	0	3	83	F	Incision and drainage, LE	Lo	Low	Mac/Reg	AS/DE/DL	0	0	0	0	0	1	0

041283CR	0	3	83	F	Incision and drainage, LE	Lo	Low	Mac/Reg	AS/DL/JF/YA	0	0	0	0	0	0	0	0
041683KE	0	3	83	F	Incision and drainage, LE	Lo	Low	Gen	AB	0	0	0	0	0	0	0	0
041963RD	0	3	63	M	Insertion, penis prosthesis	Inter	Mod	Gen	MB	0	0	0	0	0	0	1	0
040174SL	0	3	74	F	Laparotomy, exploratory	Inter	High	Gen/Reg	KJ/SB/TK	0	0	0	0	0	0	1	0
041874KJ	0	3	74	F	Laparotomy, exploratory	Inter	High	Gen	AB/LS/RW/SB/Y	0	0	0	0	0	0	0	0
041664OJ	0	3	64	M	Laryngoscopy	Lo	Low	Gen	CT/JR	0	0	0	0	0	0	1	0
042062SG	0	3	62	F	Mastopexy	Inter	Mod	Gen/Reg	AL/AS/EB/JF/SF	0	0	0	0	0	0	1	0
043062CD	0	3	62	F	Nephrostomy	Inter	Low	Gen	AE/ES	0	0	0	0	0	0	1	0
042779TA	0	3	79	M	Reduction, open internal fixation, ank	Inter	Mod	Gen/Reg	AL/BW/DE/JF/SI	0	0	0	0	1	1	1	0
042085KM	0	3	85	F	femur	Inter	High	Gen	MC/SB/SW	0	0	0	0	0	0	0	0
042165CA	0	3	65	F	femur	Inter	High	Gen	JS/RW	0	0	0	0	0	0	1	0
041977SP	0	3	77	F	ulna	Inter	High	Gen	JB	0	0	0	0	0	0	0	0
040769EB	0	3	69	M	Repair, graft, endovascular	Hi	Mod	Gen	HP/KPJ	0	0	0	0	1	0	1	0
040780SW	0	3	80	M	Repair, hernia, inguinal	Lo	Mod	Gen	DD/JD	0	0	0	0	0	0	1	0
041268CW	0	3	68	M	Repair, hernia, inguinal	Lo	Mod	Gen	AE/SB	0	0	0	0	0	0	0	0
041274HC	0	3	74	M	Repair, hernia, inguinal	Lo	Mod	Gen	DG	0	0	0	0	0	0	1	0
042365OL	0	3	65	M	Repair, hernia, inguinal	Lo	Mod	Gen	JB	0	0	0	0	0	0	1	0
041362PL	0	3	62	M	Repair, hernia, inguinal, laparoscopic	Lo	Mod	Gen	AL	0	0	0	0	0	0	1	0
041383WL	0	3	83	M	Repair, hernia, inguinal, laparoscopic	Lo	Mod	Gen	AL/MP	0	0	0	0	0	0	0	0
041661GD	0	3	61	M	Repair, hernia, inguinal, laparoscopic	Lo	Mod	Gen/Reg	JF/SS	0	0	0	0	0	0	1	0
040870HW	0	3	70	M	Repair, hernia, umbilical	Lo	Mod	Gen	MP/SB	0	0	0	0	0	0	1	0
042862ZF	0	3	62	M	Repair, hernia, umbilical	Lo	Mod	Gen	DD/ED/TD	0	0	0	0	0	0	1	0
041371PM	0	3	71	F	Repair, lip; creation, free flap, UE	Inter	High	Gen	ES/SB	0	0	0	0	0	1	1	0
040665AM	0	3	65	M	Repair, lip; dissection, neck	Inter	Low	Gen	AP/RW/SB/TK/Y	0	0	0	0	0	1	1	0
040973LJ	0	3	73	F	Repair, nerve, UE	Lo	Mod	Mac/Reg	AL/AS/EB/KS/SI	0	0	0	0	0	0	1	0
043065RJ	0	3	65	M	endovascular abdominal aorta	Hi	Mod	Gen/Reg	DD/MP/MS/RW/Σ	0	0	0	0	0	0	1	0
041561AT	0	3	61	F	Resection, breast	Inter	Mod	Gen/Reg	AP/HH/JF/YA	0	0	0	0	0	0	1	0
042263FB	0	3	63	F	lymph node biopsy	Inter	High	Gen/Reg	AS/DL/JF/MC/M	0	0	0	0	0	1	1	0
042966EC	0	3	66	F	biopsy, breast reconstruction	Inter	High	Gen/Reg	AE/AS/HH/KJ/M	0	0	0	0	0	1	1	0
042894NB	0	3	94	M	Resection, colon R	Hi	High	Gen	SB/TK	0	0	0	0	0	0	0	0
043074NK	0	3	74	M	Resection, colon, sigmoid	Hi	High	Gen/Reg	AH/EW	0	0	0	0	0	0	1	0
041485RS	0	3	85	F	Resection, disc, lumbar	Inter	Mod	Gen	CR/MC	0	0	0	0	0	0	0	0
042284RS	0	3	84	F	Resection, disc, lumbar	Inter	Mod	Gen	DD/YA	0	0	0	0	1	0	0	0
042270GC	0	3	70	M	Resection, disc, lumbar, micro	Inter	Mod	Gen	BM/RH/RW/YA	0	0	0	0	0	0	1	0
042085FE	0	3	85	M	laparoscopic w/ cholangiogram	Inter	Low	Gen	DD/KPJ	0	0	0	0	0	0	0	1
040881MB	0	3	81	F	laparoscopic w/ ERCP	Inter	Low	Gen	BW/SB	0	0	0	0	0	0	1	1
040985GM	0	3	85	F	laparoscopic w/ ERCP	Inter	Low	Gen	RA	0	0	0	0	0	0	0	0
042961ZD	0	3	61	M	Resection, hemorrhoids	Lo	High	Mac/Reg	KS/SS	0	0	0	0	0	0	1	0
040987PA	0	3	87	M	Resection, large intestine	Hi	High	Gen/Reg	AL/AS/EW/MP/F	0	0	0	0	0	0	0	0
042880LR	0	3	80	F	Resection, lung lobe	Hi	High	Gen	CR/JS	0	0	0	0	0	0	0	0
040661QG	0	3	61	M	mediastinal	Inter	High	Gen	CR/MC	0	0	0	0	0	0	1	0
042878MA	0	3	78	F	Resection, parathyroid	Lo	Mod	Gen	EB/MS	0	0	0	0	1	0	0	0
042088HL	0	3	88	M	Resection, prostate, transurethral	Inter	Low	Mac/Reg	CT/MG	0	0	0	0	0	0	0	0
040779DD	0	3	79	M	dissection	Lo	Mod	Gen	AS/MB/SB	0	0	0	0	0	0	0	0
042673SH	0	3	73	F	node(s), vaginal, total, cystoscopy,	Inter	Mod	Gen	WU	0	0	0	0	0	0	0	1
040563SS	0	3	63	F	laparoscopic	Hi	Mod	Gen	JR/MP	0	0	0	0	1	0	1	0
041271KM	0	3	71	F	laparoscopic, robotic	Hi	Mod	Gen	MB/SP	0	0	0	0	0	0	1	0
041273GM	0	3	73	F	laparoscopic, robotic, Cystoscopy	Hi	Mod	Gen	MB/SP	0	0	0	0	0	0	1	0
042860MA	0	3	60	F	cystoscopy, rigid	Inter	Mod	Gen	KS	0	0	0	0	0	0	1	0
040774VJ	0	3	74	M	Restoration, oral cavity	Lo	Mod	Gen	JS/YA	0	0	0	0	0	0	1	1
041567BJ	0	3	67	M	conducting ear implant	Lo	Low	Gen	BW/SB	0	0	0	0	0	0	1	0

043062BK	0	3	62	F	Septorhinoplasty	Lo	Low	Gen	MS/NH	0	0	0	0	0	0	1	1
042874NK	0	3	74	M	Sigmoidoscopy	Lo	Low	Gen	JF/SB/SG	0	0	0	0	0	0	1	0
041375VL	0	3	75	M	Tracheostomy	Lo	Low	Gen	AH/AS/MC/TD	0	0	0	0	0	0	1	0
040661CD	0	3	61	F	Ureteroscopy	Lo	Low	Gen	RH/SB	0	0	0	0	0	0	1	0
041269RA	0	3	69	M	Ureteroscopy	Lo	Low	Gen	DC/LC	0	0	0	0	0	0	1	0
052664OC	1	4	64	M	Amputation, below knee	Inter	Mod	Gen	DG	0	0	0	0	0	0	0	1
050374HM	1	4	74	F	Arthroplasty, hip	Hi	High	Mac/Reg	EW	0	0	0	0	0	0	1	0
052868FM	1	4	68	F	Arthroplasty, knee, total	Hi	High	Mac/Reg	NH	1	0	0	0	0	0	1	0
051960MA	1	4	60	M	Arthroplasty, knee, total L	Hi	High	Gen	KS	1	0	0	0	0	0	1	0
051182TA	1	4	82	F	Arthroplasty, shoulder, total	Hi	High	Gen	SB	0	0	0	0	0	0	0	0
052981RN	1	4	81	F	Arthroscopy, knee	Hi	Low	Gen	NH	0	0	0	0	0	0	0	0
052784WG	1	4	84	M	Arthrotomy, knee	Hi	Low	Gen	AL	0	0	0	0	0	0	0	1
052762SG	1	4	62	M	AVF creation	Lo	Low	Mac/Reg	SB	1	0	0	0	1	1	1	0
051065CD	1	4	65	M	Biopsy, bladder	Lo	Low	Gen	RA	1	0	0	0	0	0	0	0
052571MK	1	4	71	F	Blepharoplasty	Lo	Low	Gen	MP	0	0	0	0	0	0	0	0
051177KS	1	4	77	F	Bronchoscopy	Lo	Low	Gen	BW	1	0	0	0	0	0	0	0
052063WC	1	4	63	F	Bronchoscopy	Lo	Low	Gen	CS	0	0	0	0	0	0	1	0
052185FK	1	4	85	M	Bronchoscopy	Lo	Low	Gen	JI	0	0	0	0	0	0	0	0
050671CS	1	4	71	F	Cataract	Lo	Low	Gen	AE/SW	0	0	0	0	0	0	1	1
051877HH	1	4	77	M	Change, wound vac	Lo	Low	Gen	DC	1	0	0	0	0	1	0	0
050471PJ	1	4	71	M	Cholangiopancreatography, endosco	Lo	Low	Gen	CT	0	0	0	0	0	0	0	0
051071PJ	1	4	71	M	Cholangiopancreatography, endosco	Lo	Low	Gen	BW	0	0	0	0	0	0	0	0
051168DF	1	4	68	M	Cholangiopancreatography, endosco	Lo	Low	Gen	BW	0	0	0	0	0	0	1	0
052668DF	1	4	68	M	Cholangiopancreatography, endosco	Lo	Low	Gen	BW	0	0	0	0	0	0	0	0
052894VM	1	4	94	F	Cholangiopancreatography, endosco	Lo	Low	Gen	AB	0	0	0	0	0	0	0	1
052467TV	1	4	67	F	Colonoscopy	Lo	Low	Gen	HP	0	0	0	0	0	0	1	1
051764SC	1	4	64	M	Cystoscopic cystostomy, flexible	Lo	Low	Gen	NH	1	0	0	0	0	1	0	0
051364LJ	1	4	64	M	Cystoscopic, brachytherapy, prostate	Lo	Low	Gen	SB	0	0	0	0	0	0	1	0
052075LR	1	4	75	M	Cystoscopy w/ fulguration	Lo	Low	Gen	DC	1	1	0	0	0	0	0	1
050562SC	1	4	62	M	Cystoscopy, rigid	Lo	Low	Gen	LS	0	0	0	0	0	0	0	0
050572DS	1	4	72	F	Cystoscopy, robot assisted	Lo	Low	Gen	DG	0	1	0	0	0	0	0	0
050363DW	1	4	63	M	Debridement, ankle	Lo	Low	Gen	MT	0	0	0	0	0	0	1	0
051463DW	1	4	63	M	Debridement, ankle	Lo	Low	Gen	JI	0	0	0	0	0	0	1	0
051968LP	1	4	68	F	Decompression, ulnar nerve	Lo	Low	Gen	EB	0	0	0	0	0	0	0	1
050189GV	1	4	89	M	(EGD)	Lo	Low	Gen	SB	0	0	0	0	0	0	0	0
050285CT	1	4	85	M	(EGD)	Lo	Low	Gen	TS	0	0	0	0	0	0	0	0
051178LD	1	4	78	M	(EGD)	Lo	Low	Gen	JB	0	0	0	0	0	0	0	0
052071PJ	1	4	71	M	(EGD)	Lo	Low	Gen	SB	0	0	0	0	0	0	0	0
052177RW	1	4	77	M	(EGD)	Lo	Low	Gen	DD	0	0	0	0	0	0	0	1
052865SS	1	4	65	F	(EGD)	Lo	Low	Gen	AB	0	0	0	0	0	0	1	1
052885BF	1	4	85	M	(EGD)	Lo	Low	Gen	AB	0	0	0	0	0	0	0	0
052464PC	1	4	64	F	Esophagogastroduodenoscopy (EGI	Lo	Low	Gen	HP	0	0	0	0	0	1	1	1
052876CG	1	4	76	M	Esophagogastroduodenoscopy (EGI	Lo	Low	Gen	DC	0	0	0	0	0	0	0	1
050463FD	1	4	63	M	Examination, rectum	Lo	Low	Gen	JI	0	0	0	0	0	0	1	0
050761ZD	1	4	61	M	Examination, rectum	Lo	Low	Mac/Reg	MB/SB	0	0	0	0	0	0	1	0
051165FR	1	4	65	M	Excision, lesion back	Lo	Low	Gen	DC	1	1	0	0	0	0	1	0
051275DJ	1	4	75	M	Excision, lesion skin torso	Lo	Low	Gen	JB	0	0	0	0	0	0	0	0
052672TM	1	4	72	M	Excision, lesion, head/ neck	Lo	Low	Gen	SB	0	0	0	0	0	0	1	1
050360LD	1	4	60	M	Extraction, dental	Lo	Low	Gen	LC	0	0	0	0	0	0	1	0
052485PH	1	4	85	F	Extraction, dental	Lo	Low	Gen	AL	0	0	0	0	1	0	0	1
051874SR	1	4	74	M	Fusion, anterior lumbar interbody	Hi	High	Gen	JR	1	0	0	0	0	0	1	1

051974SR	1	4	74	M	Fusion, anterior lumbar interbody	Hi	High	Gen	TS	1	0	0	0	1	0	1	1
051262RJ	1	4	62	F	Fusion, anterior/posterior lumbar inter	Hi	High	Gen	BW	0	0	0	0	0	0	0	1
052581HA	1	4	81	M	Fusion, anterior/posterior lumbar inter	Hi	High	Gen	SW	1	0	0	0	0	0	1	1
051379RP	1	4	79	F	Graft, coronary bypass	Hi	High	Gen	DD	1	0	0	0	1	0	1	1
052477HH	1	4	77	M	Graft, skin	Lo	Mod	Gen	DC	0	0	0	0	0	0	0	1
051974CW	1	4	74	M	Graft, skin; Free flap creation	Lo	Mod	Gen	SB	1	1	0	0	0	1	1	0
050769FM	1	4	69	F	Hysteroscopy	Lo	Mod	Gen	EB	1	0	0	0	0	0	1	0
051066AH	1	4	66	F	Hysteroscopy	Lo	Mod	Gen	RO	0	0	0	0	0	0	1	0
051770SA	1	4	70	F	Hysteroscopy	Lo	Mod	Gen	BM	0	0	0	0	0	0	1	0
051775WC	1	4	75	F	Hysteroscopy	Lo	Mod	Gen	BM	1	0	0	0	0	0	1	0
051263DW	1	4	63	M	Incision and drainage LE	Lo	Low	Gen	HH	0	0	0	0	0	0	0	0
052663BR	1	4	63	M	Incision and drainage, hand	Lo	Low	Gen	AP	0	0	0	0	0	0	1	0
052792RF	1	4	92	M	Insertion, intramedullary nail- femur	Inter	Mod	Gen	AL	1	0	0	0	0	0	0	1
050486BD	1	4	86	F	Laparotomy, exploratory	Inter	High	Gen	AN	0	0	0	0	0	0	0	0
050678LD	1	4	78	M	Laparotomy, exploratory	Inter	High	Gen	AP	0	1	0	0	0	0	0	0
051774MM	1	4	74	F	Laparotomy, exploratory	Inter	High	Gen	AE	0	0	0	0	0	0	0	0
052065FA	1	4	65	F	Laparotomy, exploratory	Inter	High	Gen	NH	0	0	0	0	0	0	0	0
052760GD	1	4	60	M	Laparotomy, exploratory	Inter	High	Gen	SB	0	0	0	0	0	0	1	1
052872MR	1	4	72	M	Laparotomy, exploratory	Inter	High	Gen	JS	0	0	0	0	0	0	1	1
052078DB	1	4	78	M	Laryngoscopy, direct	Lo	Low	Gen	AE	0	0	0	0	0	0	0	0
051067PE	1	4	67	F	Manipulation, knee	Inter	Mod	Mac/Reg	SB	1	0	0	0	0	1	1	0
051364VT	1	4	64	F	Nephrostomy	Inter	Low	Gen	AP	1	0	0	0	0	0	1	0
050668RW	1	4	68	M	Osteotomy, digit, foot	Lo	Mod	Gen	AN	0	0	0	0	0	0	1	0
050677KR	1	4	77	M	Phlebectomy, LE	Lo	Low	Gen	MC	0	0	0	0	0	0	0	0
052569LF	1	4	69	M	Reduction, open internal fixation, ank	Inter	Mod	Gen	LC	1	0	0	0	0	1	1	1
051291OD	1	4	91	M	femur	Inter	High	Gen	JS	0	0	0	0	0	0	0	0
050563TK	1	4	63	M	Repair, hernia, inguinal	Lo	Mod	Gen	SB	0	0	0	0	0	0	1	0
051164BM	1	4	64	M	Repair, hernia, inguinal	Lo	Mod	Gen/Reg	SH	0	0	0	0	0	0	1	0
052685DN	1	4	85	M	Repair, hernia, inguinal	Lo	Mod	Gen	NH	1	0	0	0	0	0	0	1
051477BB	1	4	77	M	Repair, hernia, inguinal, laparoscopic	Lo	Mod	Gen	CT	0	0	0	0	0	0	0	0
051086BC	1	4	86	M	Repair, hernia, laparoscopic	Lo	Mod	Gen	Movinsky	0	0	0	0	0	1	0	0
050462CM	1	4	62	M	Repair, hernia, umbilical	Lo	Mod	Gen/Reg	SB	0	0	0	0	0	0	1	0
050774GR	1	4	74	M	Repair, hernia, umbilical	Lo	Mod	Gen	WU	0	0	0	0	0	0	0	1
050366RR	1	4	66	F	Repair, tendon LE	Lo	Low	Gen	MP	0	0	0	0	0	0	0	0
052786DN	1	4	86	M	Resection, appendix, laparoscopic	Inter	Mod	Gen	BW	0	0	0	0	0	0	0	0
051772SG	1	4	72	M	Resection, bone tumor, skull	Inter	Mod	Gen	JI	0	0	0	0	0	0	1	0
050677GJ	1	4	77	F	Resection, breast L	Inter	Mod	Gen/Reg	DL/RA	0	0	0	0	0	0	1	0
050663CA	1	4	63	F	Resection, breast, partial	Inter	Mod	Gen	CS	0	0	0	0	0	0	1	0
052562EJ	1	4	62	F	Resection, breast, partial	Inter	Mod	Gen/Reg	HH	1	0	0	0	0	1	1	1
050562HS	1	4	62	F	Resection, colon, sigmoid	Hi	High	Gen	MTL	0	0	0	0	1	0	1	1
052166BD	1	4	66	M	Resection, colon, sigmoid	Hi	High	Gen/Reg	BW	0	0	0	0	0	0	1	1
050571PJ	1	4	71	M	Resection, gall bladder, laparoscopic	Inter	Low	Gen	HH	0	0	0	0	0	0	1	0
050669AA	1	4	69	F	Resection, gall bladder, laparoscopic	Inter	Low	Gen	HP	0	0	0	0	0	0	1	0
061881MB	1	4	81	F	Resection, gall bladder, laparoscopic	Inter	Low	Gen	BW	0	0	0	0	0	0	0	1
051063HP	1	4	63	M	laparoscopic w/ cholangiogram	Inter	Low	Gen	BW	0	0	0	0	0	0	0	0
050860AS	1	4	60	M	Resection, gall bladder, laparoscopic	Inter	Low	Gen	RH	0	0	0	0	0	0	0	0
052164GA	1	4	64	F	Resection, lamina, cervical	Inter	High	Gen	AS	0	0	0	0	0	0	1	0
052376RM	1	4	76	F	Resection, large intestine	Hi	High	Gen	RH	0	0	0	0	0	1	1	1
051264WC	1	4	64	F	Resection, lung lobe	Hi	High	Gen	JI	1	0	0	0	0	0	1	0
051279JG	1	4	79	M	Resection, lung wedge	Hi	Mod	Gen	JI	0	0	0	0	0	0	0	0
051769SJ	1	4	69	F	Resection, maxilla bone	Hi	Low	Gen	AP	0	0	0	0	1	0	1	0

051061MS	1	4	61	F	Resection, ovary and fallopian tube	Inter	High	Gen	AP	0	0	0	0	0	0	1	1
050578SL	1	4	78	M	Resection, parotid	Lo	Mod	Gen	NH	0	0	0	0	0	0	1	0
050775SD	1	4	75	M	Resection, prostate, transurethral	Inter	Low	Gen	MC	0	0	0	0	1	0	1	1
051163HT	1	4	63	M	Resection, prostate, transurethral	Inter	Low	Gen	HP	0	0	0	0	0	0	1	0
052161EL	1	4	61	M	Resection, prostate, transurethral, en	Inter	Low	Gen	BW	1	0	0	0	0	0	1	0
051475WA	1	4	75	M	Resection, prostate, transurethral, ro	Inter	Low	Gen	DD	1	1	0	0	1	0	0	0
051961FN	1	4	61	F	Resection, stomach, laparoscopic	Inter	Mod	Gen	AE	0	0	0	0	0	0	1	0
052660BP	1	4	60	F	Resection, thyroid lobe	Lo	Mod	Gen	WU	0	0	0	0	0	0	1	1
051775FR	1	4	75	M	Resection, tongue, total	Inter	Mod	Gen	JR	1	0	0	0	0	0	0	0
050360SF	1	4	60	F	Resection, uterus, laparoscopic	Lo	Mod	Gen	EB	0	0	0	0	0	0	1	0
051779SJ	1	4	79	M	Suspension, urinary sling	Inter	Mod	Gen	NH	1	0	0	0	1	0	0	0
052361CS	1	4	61	M	Thoracoscopy	Inter	Mod	Gen	RH	0	0	0	0	0	0	1	1
051062SC	1	4	62	M	Ureteroscopy	Lo	Low	Gen	RA/RO	0	0	0	0	0	0	0	0
052077RJ	1	4	77	M	Urethroplasty, cystoscopic	Lo	Low	Gen	DE	1	0	0	0	0	1	0	1
052572HE	1	4	72	M	Urethroplasty, cystoscopic	Lo	Low	Gen	JS	1	0	0	0	0	0	1	1
060764LC	1	5	64	M	Ablation, prostate, transurethral	Inter	Low	Gen	BW/MP	0	0	0	0	0	1	1	0
062963WC	1	5	63	M	Ablation, prostate, transurethral	Inter	Mod	Mac/Reg	IF/JF	0	0	0	0	1	0	0	0
060370MD	1	5	70	M	Amputation, digit, foot	Inter	Mod	Mac/Reg	RH	0	0	0	0	1	0	1	0
060982PW	1	5	82	M	Amputation, digit, foot	Inter	Mod	Gen	JS/MP	0	0	0	0	0	0	0	0
060788GD	1	5	88	F	Arthroplasty, hip, total	Hi	High	Mac/Reg	AL/CR/ES/JS	1	0	0	0	0	0	1	0
061164OC	1	5	64	M	Arthroplasty, hip, total	Hi	High	Gen	AL/HH	0	0	0	0	0	0	1	1
062275CF	1	5	75	F	Arthroplasty, hip, total	Hi	High	Mac/Reg	EB	0	0	0	0	0	0	1	0
062378RD	1	5	78	M	Arthroplasty, hip, total	Hi	High	Gen/Reg	AE/AL/JS/SP	0	0	0	0	0	0	1	1
062869WS	1	5	69	M	Arthroplasty, hip, total	Hi	High	Mac/Reg	EB/NH/SP	1	1	0	0	0	0	1	0
061488BA	1	5	88	M	Arthroplasty, knee, total	Hi	High	Mac/Reg	JS/TKRA	1	0	0	0	0	0	0	0
061682BC	1	5	82	M	Arthroplasty, knee, total	Hi	High	Mac/Reg	GC/JR	1	0	0	0	0	0	0	0
062167RP	1	5	67	F	Arthroplasty, knee, total	Hi	High	Gen	BW/TK	0	1	0	0	0	1	0	0
062192LB	1	5	92	F	Arthroplasty, knee, total	Hi	High	Mac/Reg	BW/IL/TKRA	0	0	0	0	0	0	0	0
062269BJ	1	5	69	M	Arthroplasty, knee, total	Hi	High	Mac/Reg	EB/NH	0	0	0	0	0	0	1	0
063060HB	1	5	60	M	Arthroplasty, knee, total	Hi	High	Mac/Reg	CT/JD	0	0	0	0	0	0	1	0
063071HD	1	5	71	F	Arthroplasty, knee, total	Hi	High	Mac/Reg	CT/JD	0	0	0	0	0	0	0	0
060362DH	1	5	62	M	AVF creation	Lo	Low	Gen	JS/MP	0	0	0	0	0	0	1	0
061064KJ	1	5	64	F	AVF creation	Lo	Low	Gen	GC/SB/TKRA	0	0	0	0	1	1	0	1
062462MR	1	5	62	F	AVF creation	Lo	Low	Mac/Reg	HP/JI/SP	0	0	0	0	1	0	1	0
062465CW	1	5	65	F	AVF creation	Lo	Low	Mac/Reg	JI	0	0	0	0	0	0	1	0
060378KE	1	5	78	F	Biopsy, bladder	Lo	Low	Gen	JS/MP	1	0	0	0	0	0	0	0
062962SA	1	5	62	F	Blepharoplasty, face-lift	Lo	Low	Gen	CT	0	0	0	0	0	0	1	0
061762GD	1	5	62	F	Bronchoscopy w/ biopsy	Lo	Low	Gen	AN	0	0	0	0	0	0	0	0
062577KS	1	5	77	F	Bronchoscopy w/ biopsy	Lo	Low	Gen	HP	1	0	0	0	0	0	1	0
061866TT	1	5	66	M	ultrasound	Lo	Low	Gen	MB/RW	0	0	0	0	0	0	1	0
062561ML	1	5	61	F	Bronchoscopy w/ lavage	Lo	Low	Gen	HP	0	0	0	0	0	0	1	0
061469FA	1	5	69	M	Capsulotomy, eye R	Lo	Low	Gen	EB	0	0	0	0	0	0	1	0
0605105WE	1	5	105	M	Cholangiopancreatography, endosco	Lo	Low	Gen	CR/EK/RH	0	0	0	0	0	1	1	1
061983AL	1	5	83	M	Cholangiopancreatography, endosco	Lo	Low	Gen	ES/RH/SP	0	0	0	0	0	0	1	1
062368DF	1	5	68	M	Cholangiopancreatography, endosco	Lo	Low	Gen	KJ/SB	0	0	0	0	0	0	0	1
061174MJ	1	5	74	M	Cystoscopy, flexible	Lo	Low	Gen	SH	0	0	0	0	0	0	1	0
061482RT	1	5	82	M	Cystoscopy, flexible	Lo	Low	Gen	MC	1	0	0	0	0	0	1	0
060163PL	1	5	63	F	Cystoscopy, rigid	Lo	Low	Gen	MP	0	0	0	0	0	0	1	0
062163CE	1	5	63	F	Cystoscopy, rigid	Lo	Low	Gen	MR	1	0	0	0	0	1	1	0
062564PL	1	5	64	F	Cystoscopy, rigid	Lo	Low	Gen	RA	0	0	0	0	0	0	0	0
062169GK	1	5	69	F	Cystoscopy, ureter catheterization	Lo	Low	Gen	KJ/SB	0	0	0	0	0	0	1	0

062361MW	1	5	61	M	Cystoscopy, ureter catheterization	Lo	Low	Gen	RO	0	0	0	0	0	0	0	0
061783KE	1	5	83	F	Debridement, wound, ankle	Lo	Low	Gen	AN	0	0	0	0	0	0	0	0
061784AC	1	5	84	M	Endarterectomy, carotid	Hi	Low	Gen	KJ/SB	1	0	0	0	0	0	1	1
061663DW	1	5	63	M	Excision, hardware LE	Lo	Low	Gen	AA	0	0	0	0	0	0	1	0
062375ID	1	5	75	M	Excision, hardware LE	Lo	Low	Gen/Reg	AE/AL/JS/SP	0	1	0	0	0	1	1	1
061166AG	1	5	66	M	Excision, lesion UE	Lo	Low	Mac/Reg	CR/HH	0	0	0	0	1	1	1	0
061575SA	1	5	75	M	Excision, lesion, abdominal cavity	Lo	Low	Gen/Reg	AS/CR/JS/KS/SI	1	0	0	0	0	0	1	0
061565SJ	1	5	65	M	Excision, lesion, back L	Lo	Low	Gen	WU	1	0	0	0	0	0	0	0
060490AR	1	5	90	M	Excision, lesion, cystoscopy	Lo	Low	Gen	BW/MP	1	0	0	0	0	0	0	0
061868MD	1	5	68	M	Excision, lesion, cystoscopy	Lo	Low	Gen	JL	0	0	0	0	0	1	1	0
061577WJ	1	5	77	M	Fusion, ankle	Lo	High	Gen/Reg	CR/DS/JS/SP	0	0	0	0	0	0	1	0
060366JJ	1	5	66	M	Fusion, spinal, a+p	Inter	High	Gen	JS/TK	1	0	0	0	0	0	0	0
061577VR	1	5	77	M	Fusion, spinal, lumbar, a+p	Inter	High	Gen	RA/SB	0	0	0	0	0	0	0	0
061683CR	1	5	83	F	Graft, skin, application of	Lo	Mod	Gen	KS	1	0	0	0	0	0	0	0
061468TV	1	5	68	F	Hysteroscopy, vaginal	Lo	Mod	Gen	CG/HP	1	0	0	0	0	0	1	0
060774SL	1	5	74	F	Incision and drainage, chest	Lo	Low	Gen	MB	0	0	0	0	0	0	0	0
062574SL	1	5	74	F	Incision and drainage, chest	Lo	Low	Gen	DD	0	0	0	0	0	0	0	0
060764BR	1	5	64	M	Incision and drainage, hip	Lo	Low	Gen	JF/RH	0	0	0	0	0	0	1	1
060960MA	1	5	60	M	Incision and drainage, knee	Lo	Low	Gen	AN/JD	0	0	0	0	0	0	1	0
061782PW	1	5	82	M	Incision and drainage, LE	Lo	Low	Gen	JR/KJ	0	0	0	0	0	0	0	0
061761SR	1	5	61	M	Insertion, gastrostomy tube	Lo	Low	Gen	BW/JN/SW	0	0	0	0	1	1	1	0
061281EE	1	5	81	M	Laparotomy, exploratory	Inter	High	Gen	ES/NH/RW	0	0	0	0	0	0	0	0
061571KM	1	5	71	F	Laparotomy, exploratory	Inter	High	Gen	AL/ES/SP	0	0	0	0	0	0	1	0
061871KM	1	5	71	F	Laparotomy, exploratory	Inter	High	Gen	BW/CG/GC	0	0	0	0	0	0	0	1
061978BP	1	5	78	M	Laparotomy, exploratory	Inter	High	Gen	ES/RH/SP	0	0	0	0	0	0	1	1
062071KM	1	5	71	F	Laparotomy, exploratory	Inter	High	Gen	GC/MB	0	0	0	0	0	0	1	1
062178BP	1	5	78	M	Laparotomy, exploratory	Inter	High	Gen	JR/KJ	0	0	0	0	0	0	0	0
061067BE	1	5	67	M	Ligation, LE vein	Lo	Low	Gen	GC/SB	1	0	0	0	0	0	1	0
061072CT	1	5	72	M	Meatotomy, urinary	Lo	Low	Gen	JD/SS	0	0	0	0	0	0	0	0
061772TM	1	5	72	M	MOHS defect face	Lo	Low	Gen	BW	0	0	0	0	0	0	1	0
061067JN	1	5	67	F	Nephrostomy	Inter	Low	Gen	DD/JF/MB/MP	0	0	0	0	0	0	0	0
060869PJ	1	5	69	F	Osteotomy, digit, foot	Lo	Mod	Gen/Reg	KS/SP	0	0	0	0	0	0	1	0
060860CC	1	5	60	F	Pyeloplasty, robot assisted	Inter	Mod	Gen	JD/TU	1	0	0	0	1	0	0	1
060962BF	1	5	62	F	Reconstruction, nipple	Lo	Low	Gen/Reg	AL/CR/LC/SP	1	0	0	0	0	0	1	0
061671LM	1	5	71	F	Reduction, open internal fixation, ank	Inter	Mod	Gen	CR/GC/JR	0	0	0	0	0	1	1	0
062571LM	1	5	71	F	Reduction, open internal fixation, ank	Inter	Mod	Gen	EB	1	0	0	0	0	1	1	1
061466PP	1	5	66	F	Reduction, open internal fixation, ank	Inter	Mod	Gen/Reg	AL/AN/SP	1	0	0	0	0	1	1	0
061483PR	1	5	83	M	hip	Inter	High	Gen/Reg	AP/JD/JN/TKRA	0	0	0	0	0	0	0	1
060383TR	1	5	83	M	Repair, AVF, UE	Lo	Low	Mac/Reg	CR/ES/JS/SP	0	0	0	0	1	0	0	0
062262LR	1	5	62	M	Repair, hernia L	Lo	Mod	Gen	SH	0	0	0	0	0	0	1	0
060782OD	1	5	82	M	Repair, hernia, inguinal	Lo	Mod	Gen	MB/MC/TK	0	0	0	0	0	1	0	0
062463ER	1	5	63	M	Repair, hernia, laparoscopic	Lo	Mod	Gen	AN	1	0	0	0	0	0	1	0
060182BA	1	5	82	M	Repair, hernia, ventral	Lo	Mod	Gen	GC/JI	1	0	0	0	0	0	1	0
062464HE	1	5	64	M	, intestine mobilization	Lo	Mod	Gen	AN/NH	1	0	0	0	0	0	0	0
062469CR	1	5	69	M	Repair, shoulder rotator cuff L	Inter	High	Gen/Reg	EA/NH	0	0	0	0	0	0	0	1
061564CL	1	5	64	F	Resection, appendix, laparoscopic	Inter	Mod	Gen	AL/ES/SP	0	0	0	0	0	0	1	0
060374MS	1	5	74	F	biopsy	Inter	High	Gen/Reg	ES/JH/NH	1	0	0	0	0	0	1	0
060374HH	1	5	74	F	Resection, breast, partial	Inter	Mod	Gen	ES/JS	0	0	0	0	0	0	1	0
062266KD	1	5	66	F	Resection, breast, partial L	Inter	Mod	Gen	SH	0	0	0	0	0	0	1	0
062269CJ	1	5	69	F	lymph node biopsy	Inter	High	Gen	DD/NH	0	0	0	0	0	0	0	1
062262MR	1	5	62	F	Resection, disc, anterior cervical	Inter	Mod	Gen	JN/SB	0	0	0	0	0	0	1	1

060166AP	1	5	66	M	Resection, disc, lumbar, micro	Inter	Mod	Gen	SB/TK	0	0	0	0	0	0	1	0
060266HL	1	5	66	F	Resection, gall bladder, laparoscopic	Inter	Low	Gen	SB	0	0	0	0	0	0	0	0
062162SJ	1	5	62	M	Resection, gall bladder, laparoscopic	Inter	Low	Gen	AL/CG/SP	0	0	0	0	0	0	0	0
060873LE	1	5	73	M	laparoscopic w/ cholangiogram	Inter	Low	Gen	AN/SB/TK	0	0	0	0	0	1	1	0
061175LJ	1	5	75	M	laparoscopic w/ cholangiogram	Inter	Low	Gen	DD/JF	0	0	0	0	1	0	0	1
061565WM	1	5	65	F	laparoscopic w/ cholangiogram	Inter	Low	Gen	CR/JS/TS	0	0	0	0	0	0	1	0
061663WD	1	5	63	F	laparoscopic w/ cholangiogram	Inter	Low	Gen	EB	1	0	0	0	0	0	1	0
060975LR	1	5	75	M	Resection, kidney, laparoscopic	Hi	Mod	Gen	KJ/SB	0	0	0	0	0	0	1	1
062966WS	1	5	66	M	Resection, lamina, cervical	Inter	High	Gen	BW/EA/JS	0	0	0	0	0	0	1	1
062969RM	1	5	69	F	Resection, large intestine	Hi	High	Gen	IL	0	0	0	0	0	0	0	0
063078SG	1	5	78	M	bronchoscopic, robot assisted	Hi	Low	Gen	JS	0	0	0	0	1	0	0	1
063078SG	1	5	78	M	assisted	Hi	Low	Gen	JD/JS	0	0	0	0	1	0	0	1
062462BM	1	5	62	M	laparoscopic	Lo	Low	Gen	BW/JR/SB	0	0	0	0	0	0	1	0
061569WC	1	5	69	F	Resection, mass, soft tissue, hip R	Inter	Mod	Gen	DC	1	0	0	0	0	0	1	0
061760SJ	1	5	60	M	Resection, prostate, robot assisted	Inter	High	Gen	MC/TK	1	0	0	0	0	0	1	0
060462EL	1	5	62	M	Resection, prostate, transurethral	Inter	Low	Gen	BW/MP	1	0	0	0	0	0	1	0
060875GA	1	5	75	M	Resection, prostate, transurethral	Inter	Low	Gen	JD/TU	1	0	0	0	0	0	0	1
061072MR	1	5	72	M	Resection, prostate, transurethral	Inter	Low	Gen	SS	0	0	0	0	0	0	1	0
061076UC	1	5	76	M	Resection, prostate, transurethral	Inter	Low	Gen	SS	1	0	0	0	0	0	1	0
062299 RH	1	5	99	M	Resection, prostate, transurethral	Inter	Low	Gen	HH	0	0	0	0	0	0	1	0
061570AF	1	5	70	M	Resection, salivary gland	Lo	Mod	Gen	AE	0	0	0	0	1	0	1	0
062891SP	1	5	91	F	Resection, tissue, oral cavity	Lo	Mod	Gen	JS	0	1	0	0	0	0	0	1
062880MJ	1	5	80	F	Resection, uterus, abdominal, total	Hi	High	Gen/Reg	BM/CR/EB/NH/R	0	1	0	0	0	1	1	1
060771SA	1	5	71	F	assisted	Inter	Mod	Gen	EB/JN	1	1	0	0	0	0	1	1
061071KM	1	5	71	F	laparotomy	Inter	High	Gen	MP	0	0	0	0	0	0	1	1
060164FG	1	5	64	M	Septorhinoplasty	Lo	Low	Gen	JH	1	0	0	0	0	0	1	0
062260GE	1	5	60	M	Spermatocectomy L	Lo	Mod	Gen	MB/RA	1	0	0	0	0	0	1	0
062169SA	1	5	69	M	Suspension, urinary sling	Inter	Mod	Gen	LC	1	0	0	0	0	0	1	0
060786OP	1	5	86	F	Ureteroscopy	Lo	Low	Gen	BW/TK	0	0	0	0	0	0	0	0
061168PL	1	5	68	F	Ureteroscopy	Lo	Low	Gen	DG	0	0	0	0	0	0	0	0
062562CD	1	5	62	F	Ureteroscopy	Lo	Low	Gen	KG	0	0	0	0	0	0	1	0
062582WE	1	5	82	F	Ureteroscopy	Lo	Low	Gen	KG	0	1	0	0	0	0	1	0
062961MW	1	5	61	M	Ureteroscopy	Lo	Low	Gen	RO	0	0	0	0	0	0	0	0
062962MS	1	5	62	M	Ureteroscopy	Lo	Low	Gen	GC/TS	0	0	0	0	0	0	1	0
060369AJ	1	5	69	F	Vitrectomy	Lo	Low	Gen	NH	1	0	0	0	0	1	0	1
060879HM	1	5	79	F	Vitrectomy	Lo	Low	Gen	EB	0	0	0	0	0	0	1	0
071662BE	1	6	62	M	Ablation, prostate, transurethral	Inter	Low	Gen	LS	0	0	0	0	0	0	1	0
070282PW	1	6	82	M	Amputation, below knee	Inter	Mod	Gen	LS	0	0	0	0	0	0	0	0
070473JR	1	6	73	M	Amputation, digit	Inter	Mod	Gen	DG	0	0	0	0	0	0	1	0
070786BR	1	6	86	M	Arthroplasty, hip, total	Hi	High	Mac/Reg	BM	0	0	0	0	0	0	0	0
071175RC	1	6	75	F	Arthroplasty, hip, total	Hi	High	Gen/Reg	TS	0	0	0	0	0	0	0	1
070779KR	1	6	79	M	Arthroplasty, knee, total	Hi	High	Mac/Reg	BM	0	0	0	0	0	0	1	0
072181KR	1	6	81	M	Arthroplasty, knee, total	Hi	High	Mac/Reg	HP	0	0	0	0	0	0	1	0
072862BP	1	6	62	M	Arthroplasty, knee, total	Hi	High	Mac/Reg	EB	0	0	0	0	0	0	0	0
071480SL	1	6	80	M	Arthroplasty, shoulder	Hi	High	Gen	AS	0	0	0	0	0	0	1	1
072265SJ	1	6	65	M	Arthroplasty/ repair, shoulder, rotator	Lo	High	Gen/Reg	AL	0	0	0	0	0	0	1	0
072265BM	1	6	65	M	Arthroscopy, ACL repair	Lo	Mod	Gen/Reg	AL	0	0	0	0	0	0	1	0
070861GJ	1	6	61	F	Arthrotomy, digit, hand	Lo	Low	Gen	DC	1	0	0	0	0	0	1	1
070876MC	1	6	76	F	AVF creation	Lo	Low	Gen	DD	0	0	0	0	0	0	1	1
070881CP	1	6	81	M	AVF creation	Lo	Low	Gen	DD	0	0	0	0	1	1	1	0
071369CS	1	6	69	F	Biopsy, inguinal lymph node	Lo	Mod	Gen	JR	0	0	0	0	0	0	0	1

071497SJ	1	6	97	F	Biopsy, ovary, laparoscopic	Inter	Mod	Gen	NH	0	0	0	0	0	1	0	0
071566BB	1	6	67	M	Bronchoscopy	Lo	Low	Gen	SW	0	0	0	0	0	0	0	1
072963BS	1	6	63	M	Bronchoscopy	Lo	Low	Gen	JL	0	0	0	0	0	1	1	0
073078JJ	1	6	78	M	Bronchoscopy	Lo	Low	Gen	LS	0	0	0	0	0	0	0	0
071971BA	1	6	71	M	Change, wound vac	Lo	Low	Gen	JS	0	0	0	0	0	0	0	1
072369SL	1	6	69	F	Cholangiopancreatography, endosco	Lo	Low	Gen	SB	0	0	0	0	0	0	1	0
073069GK	1	6	69	F	Cholangiopancreatography, endosco	Lo	Low	Gen	IL	0	0	0	0	0	0	0	0
071366BD	1	6	66	M	Closure, ileostomy	Inter	Mod	Gen	DD	0	0	0	0	0	0	1	1
072772DS	1	6	72	F	Colonoscopic exploration, female	Lo	Low	Gen	IL	0	0	0	0	0	0	0	0
070676BG	1	6	76	M	Curettage, bone cyst LE	Lo	Low	Gen	MC	0	0	0	0	0	0	1	1
072281GR	1	6	81	M	Cystoscopy	Lo	Low	Gen	MC	0	0	0	0	0	0	1	0
072768WF	1	6	68	M	Cystoscopy	Lo	Low	Gen	MP	0	0	0	0	0	0	1	0
072780LP	1	6	80	M	Cystoscopy	Lo	Low	Gen	MP	0	0	0	0	0	0	0	0
070684BG	1	6	84	M	Cystoscopy rectum, sigmoidoscopy	Lo	Low	Gen	IL	0	0	0	0	0	0	0	1
070966SJ	1	6	66	M	Cystoscopy rigid	Lo	Low	Gen	MR	0	0	0	0	0	1	1	0
071465HB	1	6	65	M	Cystoscopy, brachytherapy, prostate	Inter	Low	Gen	SB	0	0	0	0	0	0	1	1
071362KC	1	6	62	M	Cystoscopy, catheterization	Lo	Low	Gen	SB	0	0	0	0	0	0	1	0
072870AF	1	6	70	M	Dissection, neck	Inter	Mod	Gen	JR	1	0	0	0	0	0	0	0
073072TM	1	6	72	M	Dissection, neck	Inter	Mod	Gen	DD	0	0	0	0	0	0	0	0
070875HC	1	6	75	F	Endoscopy, nasal w/ maxillary creatio	Lo	Low	Gen	MC	1	0	0	0	0	0	0	1
072478PP	1	6	78	F	(EGD)	Lo	Low	Gen	LS	1	1	0	0	0	0	1	1
072669DF	1	6	69	M	Esophagogastroduodenoscopy (EGE	Lo	Low	Gen	HH	0	0	0	0	0	0	1	1
071570GR	1	6	70	F	Excision, AV shunt	Inter	Low	Mac/Reg	AS	0	0	0	0	1	0	1	0
073068KM	1	6	68	F	Excision, hardware LE	Lo	Low	Gen	AS	0	0	0	0	0	0	0	0
072764RN	1	6	64	M	Excision, lesion axilla	Lo	Low	Gen	DD	1	0	0	0	0	0	1	0
070169BS	1	6	69	F	Exploration, vessel LE	Lo	Low	Gen	SB	1	0	0	0	0	0	1	0
070169BS	1	6	69	F	Exploration, vessel LE	Lo	Low	Gen	SB	0	0	0	0	0	0	1	0
071667GJ	1	6	67	M	Extraction, dental	Lo	Low	Gen	MC	0	0	0	0	0	0	1	0
071575KD	1	6	75	F	Face lift	Lo	Mod	Gen	MC	0	0	0	0	0	0	1	1
071963LT	1	6	63	M	Fusion, ankle	Lo	High	Gen	HP	0	0	0	0	0	1	1	0
071965BM	1	6	65	M	Fusion, ankle	Lo	High	Gen/Reg	HP	0	0	0	0	0	1	1	0
070267WS	1	6	67	M	Fusion, anterior/posterior lumbar inter	Hi	High	Gen	BW	0	0	0	0	0	0	1	1
071361IK	1	6	61	M	Fusion, anterior/posterior lumbar inter	Hi	High	Gen	BW	0	0	0	0	0	0	1	1
070276MP	1	6	76	F	Hysteroscopy	Lo	Mod	Gen	CT	1	0	0	0	0	0	0	1
070662MJ	1	6	62	M	Incision, prostate, transurethral	Inter	Low	Gen	IL	1	0	0	0	0	0	1	1
072962MI	1	6	62	F	Insertion, orbit implant	Lo	High	Gen	CS	0	0	0	0	0	1	1	0
071962PJ	1	6	62	M	Insertion, penis prosthesis	Inter	Mod	Gen	SW	0	0	0	0	0	1	1	0
071173MP	1	6	73	M	Laparotomy, exploratory	Inter	High	Gen	SW	0	0	0	0	0	0	1	1
071276DD	1	6	76	F	Laparotomy, exploratory	Inter	High	Gen	SB	0	0	0	0	0	0	1	1
071497SJ	1	6	97	F	Laparotomy, exploratory	Inter	High	Gen	LS	0	0	0	0	1	0	0	1
071666MD	1	6	66	F	Laparotomy, exploratory	Inter	High	Gen	JS	0	0	0	0	0	1	1	1
071966BD	1	6	66	M	Laparotomy, exploratory	Inter	High	Gen	CG	0	0	0	0	0	0	0	0
072163AW	1	6	63	F	Laparotomy, exploratory	Inter	High	Gen	LC	0	0	0	0	0	0	1	0
072686KP	1	6	86	M	Laparotomy, exploratory	Inter	High	Gen	SW	0	0	0	0	0	0	1	1
071560TS	1	6	60	F	Laryngoscopy, direct	Lo	Low	Gen	JS	0	0	0	0	0	0	1	1
072974PN	1	6	74	M	Laryngoscopy, direct	Lo	Low	Gen	AS	0	0	0	0	0	0	1	0
072890VB	1	6	90	M	Nephrolithotomy, percutaneous	Inter	Low	Gen	MB	0	0	0	0	0	0	0	0
072960GJ	1	6	60	M	Ossiculoplasty	Lo	Mod	Gen	JR	0	0	0	0	0	0	1	1
071474ML	1	6	74	M	Photocoagulation, eye	Lo	Low	Gen	MR	0	0	0	0	0	1	1	1
073098LW	1	6	98	M	Repair, hernia, inguinal	Lo	Mod	Gen	JS	0	0	0	0	0	0	0	1
071375PA	1	6	75	M	assisted	Lo	Mod	Gen	NH	0	0	0	0	0	0	1	1

070760MJ	1	6	60	M	Repair, hernia, ventral	Lo	Mod	Gen	MC	0	0	0	0	0	0	1	1
071567JB	1	6	67	M	Repair, hernia, ventral	Lo	Mod	Gen	WU	0	0	0	0	1	0	0	1
070160MR	1	6	60	F	Repair, hernia, ventral, laparoscopic	Lo	Mod	Gen	JS	0	0	0	0	0	0	1	1
071060MR	1	6	60	F	Repair, hernia, ventral, laparoscopic	Lo	Mod	Gen	JS	0	0	0	0	0	0	1	1
071272BC	1	6	72	F	Repair, hernia, ventral, robotic	Lo	Mod	Gen	DD	1	0	0	0	0	1	1	0
072068SH	1	6	68	M	Repair, muscle, UE	Lo	Mod	Gen	RH	0	0	0	0	0	1	0	0
072675CS	1	6	75	M	Repair, nerve, head	Lo	Mod	Gen	HP	0	0	0	0	0	0	0	0
070162RP	1	6	62	M	Repair, strabismus	Lo	Mod	Gen	IL	0	0	0	0	0	0	0	1
070164SP	1	6	64	M	Resection, appendix, laparoscopic	Inter	Mod	Gen	SW	1	0	0	0	0	0	1	0
070789MR	1	6	89	M	Resection, appendix, laparoscopic	Inter	Mod	Gen	AE	0	0	0	0	1	0	0	1
070867LJ	1	6	67	M	Resection, bone, hand	Lo	Mod	Mac/Reg	DC	0	0	0	0	0	1	1	0
070169BR	1	6	69	M	biopsy	Inter	High	Gen	AE	0	0	0	0	0	0	1	1
070875DB	1	6	75	F	biopsy	Inter	High	Gen	MB	1	0	0	0	0	0	1	0
071570RL	1	6	70	F	Resection, breast, partial	Inter	Mod	Gen	WU	0	0	0	0	1	0	0	1
071578IE	1	6	78	F	Resection, breast, partial	Inter	Mod	Gen	WU	0	0	0	0	1	0	0	1
072770SA	1	6	70	F	Resection, breast, partial	Inter	Mod	Gen/Reg	DD	0	0	0	0	0	0	1	1
072778IE	1	6	78	F	Resection, breast, partial	Inter	Mod	Gen/Reg	DD	0	0	0	0	0	0	1	0
072979WC	1	6	79	F	Resection, breast, partial	Inter	Mod	Gen	JL	0	0	0	0	0	1	0	0
073071EP	1	6	71	F	Resection, breast, partial	Inter	Mod	Gen	WU	1	0	0	0	1	0	0	1
072068RM	1	6	68	F	Resection, colon, sigmoid	Hi	High	Gen	IL	0	0	0	0	0	0	0	0
072962VR	1	6	62	F	Resection, disc, lumbar, micro	Inter	Mod	Gen	DC	0	0	0	0	1	0	0	1
070960MM	1	6	60	F	Resection, gall bladder, laparoscopic	Inter	Low	Gen	DC	0	0	0	0	1	0	1	1
071072MW	1	6	72	F	Resection, gall bladder, laparoscopic	Inter	Low	Gen	JS	0	0	0	0	0	0	0	1
071569KM	1	6	69	F	Resection, gall bladder, laparoscopic	Inter	Low	Gen	AP	0	0	0	0	0	0	1	0
072769SL	1	6	69	F	Resection, gall bladder, laparoscopic	Inter	Low	Gen	IL	0	0	0	0	0	0	0	0
070172MW	1	6	72	F	Resection, gall bladder, laparoscopic	Inter	Low	Gen	JS	0	0	0	0	0	0	0	1
071569KJ	1	6	69	M	Resection, gall bladder, laparoscopic	Inter	Low	Gen	AP	0	0	0	0	0	0	1	0
071966OD	1	6	66	F	Resection, gall bladder, laparoscopic	Inter	Low	Gen	JS	0	0	0	0	0	1	1	0
070760HJ	1	6	60	F	Resection, lamina, lumbar	Inter	High	Gen	DD	0	0	0	0	0	0	1	1
071260HJ	1	6	60	F	Resection, lamina, lumbar	Inter	High	Gen	AP	0	0	0	0	0	0	0	0
072975GC	1	6	75	M	Resection, lung lobe, robotic	Hi	Low	Gen	NH	0	0	0	0	1	0	1	0
071677BW	1	6	77	M	Resection, lung wedge	Hi	Mod	Gen	DD	0	0	0	0	0	0	0	1
072163MR	1	6	63	M	Resection, parathyroid	Lo	Mod	Gen	SG	0	0	0	0	0	0	1	0
070965CD	1	6	66	M	Resection, prostate, robot assisted	Inter	High	Gen	SW	0	0	0	0	1	0	1	1
072860KA	1	6	60	M	Resection, stomach, partial robot	Inter	Mod	Gen	DD	0	0	0	0	1	0	1	0
071971AO	1	6	71	M	Resection, thyroid lobe	Lo	Mod	Gen	MP	0	0	0	0	0	0	0	1
071964MG	1	6	64	F	Resection, uterus, partial, cystoscopy	Inter	Mod	Gen	AL	1	0	0	0	0	0	1	0
072968MS	1	6	68	F	Thoracotomy	Hi	High	Gen	NH	0	0	0	0	1	0	1	0
071264SC	1	6	64	M	Urethroplasty, cystoscopic	Lo	Low	Gen	AL	0	0	0	0	0	1	1	1
										77	22	0	0	60	71	387	130

BUSINESS CASE with VALUE BASED CARE ASSESSMENT

Proposed Title for Project/Initiative/Opportunity to Improve *Proposed Title*

“Enhanced recovery for elderly surgical patients receiving general anesthesia”

Introduction of an evidence based enhanced recovery after surgery (ERAS) protocol aimed at reducing the rate of postoperative delirium (POD) and postoperative cognitive disorder (POCD) in non-cardiac surgical patients age 60 and older.

Opportunity Statement *(Description of proposed project/initiative/opportunity to improve) Opportunity statement*

Investing in the implementation of an evidence based enhanced recovery after surgery (ERAS) protocol aimed at reducing the rate of postoperative delirium (POD) and postoperative cognitive disorder (POCD) in non-cardiac surgical patients age 60 and older can minimize the occurrence of extended PACU/ICU stays, hospital readmissions, and requirements for long-term care facility enrollments.

Business Opportunity/Objectives *(Prioritize listing – macro and micro objectives) Business Opportunity*

1. Decrease POD and POCD rates at Naval Medical Center San Diego (NMCSD) (macro)
2. Implementation of evidence based ERAS protocol and training of anesthesia providers on new protocol (micro)
3. Increased patient safety and satisfaction (micro)
4. Cost savings (micro)

Potential Impact of the Initiative/Project *(Identify outcome metrics & benchmarks/and how objectives align with Quadruple Aim, Value Based Care, and HRO goals) Potential Impact*

1. This EBP project aligns with the MHS aim, “Co-Create optimal outcomes for health, well-being, and readiness” by resulting in:
 - Decreased rate of POD in PACU/ICU as measured by CAM ICU and CAM PACU scores.
 - Decreased number of days admitted due to POD/POCD.
 - Decreased change between preoperative (baseline) and postoperative cognitive assessments (Montreal Cognitive Assessment).
 - Decreased rate of readmission due to POD or POCD.
 - Decreased risk of mortality and morbidity associated with POD and POCD.
7. This EBP project aligns with the MHS aim, “Empower and care for our people.” This project will empower the anesthesia providers by providing a tool and training to help optimize care for a specific population.
2. This project can also be adopted by other MHS facilities to treat the 2.322 million retirees and dependents age 65 and older that receive care through the MHS.

Alternatives (courses of action) chosen for Analysis *Alternatives*

1. Utilize bispectral index (BIS) monitoring to maintain an appropriate level of anesthesia for all patients 60 years or older.
2. Administration of intraoperative dexmedetomidine for analgesia and anesthetic purposes to decrease the utilization of volatile gas and opioids in surgical patients 60 years of age and older.
- 3.. Minimize the use of or avoid medications associated with causing cognitive impairment:
 - Benzodiazepines
 - Opioids (particularly meperidine)

- Anticholinergics
- Diphenhydramine
- Metoclopramide

4.. “Status Quo”: Continue with individual anesthesia provider preference for practice.

Analysis of Alternatives *Alternatives*

Alternative 1: Utilization of bispectral index (BIS) monitoring to maintain an appropriate level of anesthesia (40-60) for all patients 60 years or older.

Pros	Cons
Reduction in the risk of POD and POCD occurrence in this population Evidence based support Decreased costs and utilization of opioids and other anesthetics Decreased costs due to shortened PACU stays Decreased costs due to shortened admission Decreased costs of follow up, after care and referral to other specialties (neurology, etc..) Decreased risk of admissions to assisted living facilities Decreased financial burden on patients and/or families, premature departure from the labor market, and dependency on government economic assistance after hospital discharge.	Cost of time training anesthesia providers on new protocol Approval of protocol from NMCS D anesthesia department Initial cost of BIS monitor and repairs/replacements if damaged Cost of BIS quatro electrodes Limited supply of BIS monitors at NMCS D Conflicting evidence on efficacy to reduce POD and POCD occurrence Provider compliance with new protocol Least cost-effective alternative

Alternative 2: Administration of intraoperative dexmedetomidine for analgesia and anesthetic management to decrease the utilization of volatile gas in surgical patients 60 years or older and/or administration of intraoperative dexmedetomidine

Pros	Cons
Reduction in the risk of POD and POCD occurrence in this population Relatively cost effective Evidence based support Decreased costs due to shortened PACU stays Decreased costs due to shortened admission Decreased costs of follow up, after care and referral to other specialties (neurology, etc..) Decreased risk of admissions to assisted living facilities Decreased financial burden on patients and/or families, premature departure from the labor market, and dependency on government economic assistance after hospital discharge.	Cost of dexmedetomidine Cost of time training anesthesia providers on new protocol Approval of protocol from NMCS D anesthesia Department Conflicting evidence on efficacy to reduce POD and POCD occurrence Limited use: Dexmedetomidine cannot be utilized with every patient or in every anesthetic plan (risk of contraindicated use, hemodynamically unstable, low HR and hypotensive, etc...) Risk of side effects, adverse reaction, anaphylactic reaction, and hypersensitivity

Alternative 3: Minimize or avoid the use of medications associated with causing cognitive dysfunction such as benzodiazepines, opioids, anticholinergics, diphenhydramine, and metoclopramide (American Geriatrics Society 2015 Beers Criteria Update Expert Panel, 2015).

Pros	Cons
Reduction in the risk of POD and POCD occurrence in this population Cost savings in decreased utilization of these medications Evidence based support Decreased costs due to shortened PACU stays	Cost of time training anesthesia providers on new protocol Approval of protocol from NMCS D anesthesia Department

Decreased costs due to shortened admission Decreased costs of follow up, after care and referral to other specialties (neurology, etc..) Decreased risk of admissions to assisted living facilities Decreased financial burden on patients and/or families, premature departure from the labor market, and dependency on government economic assistance after hospital discharge.	
Alternative 4:	<i>"Status Quo"</i> : Continuation with individual anesthesia provider preference for practice in anesthesia plan for patients 60 years or older.
Pros	Cons
Already the standard of care No need to implement training and new ERAS protocol Provider compliance with their standard of practice	Risk of patients developing POD and POCD Risk of increased morbidity and mortality postoperatively due to POD and POCD occurrence Individual provider preference and variability in anesthesia plan Increased costs due to lengthened PACU stays Increased costs due to lengthened admission Increased costs of follow up, after care and referral to other specialties (neurology, etc..) Increased risk of admissions to assisted living facilities Financial burden on patients and/or families, premature departure from the labor market, and dependency on government economic assistance after hospital discharge.
Assumptions <i>Assumptions</i>	
The presence of POD is strongly associated with increased hospital stay (Raats et al., 2015). Daily cost for inpatient stays: Hospital adjusted expenses per inpatient day for California state/local government hospitals in 2018 was \$3269, non-profit hospitals \$3879 and for-profit hospitals \$2392. For the U.S. the average expense per inpatient day for state/local government hospitals in 2018 was \$2260, non-profit hospitals \$2653 and for-profit hospitals \$2093 (www.kff.org/health-costs). In nearly 2.4 million Medicare patients, the presence of a postoperative neurocognitive disorder was associated with an increase of \$17275 in payments in the 1 year after the initial surgical procedure. In this study, a total of 6846 patients (15.2%) experienced mild cognitive impairment in isolation and 18,221 patients (40.5%) experienced delirium alone. Mild cognitive impairment and delirium occurred in combination in 448 patients (1.0%), delirium and dementia together occurred in 18754 patients (41.7%), and 705 patients (1.6%) experienced all 3 postoperative neurocognitive dysfunction (PND) subtypes. Patients with all PND subtypes had the highest postacute care payments (\$22160; 95% CI, \$20511-\$23 809) followed by those with delirium and neurocognitive impairment (\$20455; 95% CI, \$18311-\$22598) (Boone et al., 2020). The average costs per day among patients with POD were more than 2.5 times the costs among patients without POD. In a cohort study of 841 patients, 13% experienced POD, total cost estimates attributable to delirium ranged from \$16303 to \$64421 per patients, implying that the national burden of delirium on the health care system ranges from \$38 billion to \$152 billion each year (Leslie et al, 2008). Average daily intensive care unit (ICU) daily costs: Mean intensive care unit cost and length of stay were \$31,574 +/- 42,570 and 14.4 days +/- 15.8 for patients requiring mechanical ventilation and \$12,931 +/- 20,569 and 8.5 days +/- 10.5 for those not requiring mechanical ventilation. Daily costs were greatest on intensive care unit day 1 (mechanical ventilation, \$10,794; no mechanical ventilation, \$6,667), decreased on day 2 (mechanical ventilation: \$4,796; no mechanical ventilation, \$3,496), and became stable after day 3 (mechanical ventilation, \$3,968; no mechanical ventilation, \$3,184). Adjusting for patient and hospital characteristics, the mean incremental cost of mechanical ventilation in intensive care unit patients was \$1,522 per day (p < .001) (Dasta et al., 2005).	

The mean cost per minute for the PACU is \$4 per minute (range \$4-\$8 per minute). With a 35% reduction in PACU recovery time (average 23 minutes) there is a savings of \$92. Shorter PACU frees PACU bed space and helps to avoid overtime costs (Katznelson et al., 2006).

Patients with POD/POCD have an increased prolonged length of stay (>5days), institutional discharge, readmission within 30 days (Gleason et al., 2015)

Patients with POD had a longer length of stay 7.4 days and increased cost of care (\$8,373) (Zywiell et al., 2015).

The mean cost of readmission for those aged 65 and older was \$13,800, 5.3% higher than the cost of the initial hospital visit (Barrett et al. 2015). Total annual costs for hospital readmissions in 2011 was \$41.3 billion, with Medicare costs alone totaling \$24 billion (Hines et al., 2014).

The cost of California assisted living facilities averages \$4000 per month plus additional fees for meals and special services. The average daily cost in 2020 is \$180-400 per day for nursing home facilities. The 24 hour in-home live-in care cost in California ranges from \$15-25 per hour and \$150-\$350 per day. (www.caregiverlist.com/SeniorCareCosts.aspx)

The cost of a complete BIS monitor setup is \$5,527.64 (www.medtronic.com).

The cost of an ASPECT BIS replacement puck is \$3718.59 (www.medtronic.com).

The cost of BIS quatro electrodes (25 in a box) is \$599 (www.medtronic.com).

The cost of dexmedetomidine is around \$228 for a 200 milliliters vial (4 mcg/ml). \$123.32 for 50 ml vial (100 mcg/ml) concentration. (www.drugs.com/price-guide/dexmedetomidine)

Utilization of dexmedetomidine intraoperatively has shown a decrease in the occurrence of POD. The incidence of delirium for patients receiving dexmedetomidine was 3%, for those receiving propofol was 50%, and for patients receiving midazolam, 50%. Patients who developed postoperative delirium experienced significantly longer intensive-care stays and longer total hospitalization (Maldonado et al., 2009).

The cost reduction in utilizing BIS monitoring to maintain an adequate depth of anesthesia and in turn reduce the amount of volatile agents, opioids and other medications during surgery. The mean end-tidal sevoflurane concentration (%) during maintenance of general anesthesia was statistically significantly lower in the BIS-monitored group than in the standard clinical monitoring group. There was a 25.3% reduction in propofol consumption compared with standard clinical monitoring (Shepherd et al., 2013).

BIS-guided anesthesia reduces anesthetic exposure and decreases the risk of POCD at three months after surgery by about 3% (Bocskai et al., 2020; Chan et al., 2013). Additionally, it can reduce propofol delivery by 21%, volatile anesthetic delivery by 30%, and intraoperative fentanyl delivery by 31% (Chan et al., 2013; Recart et al., 2003). Anesthetic delivery titrated to achieve a BIS range between 40 and 60 would prevent 23 out of 1000 elderly major surgery patients from developing POCD and 83 patients from developing delirium (Chan et al., 2013).

Recommendation and Rationale *Make a choice*

Recommendation *Make a choice*

Proposal is to recommend a combination of alternatives #1, #2, and #3 to formulate a comprehensive postoperative neurocognitive enhanced recovery after surgery (ERAS) protocol. Then present the ERAS protocol to the anesthesia providers of NMCS, evaluate and measure changes in practice utilizing ERAS protocol recommendations through patient records evaluation, anesthesia intraoperative record evaluation and survey data collection.

Rationale *Make a choice*

Alternative #1, #2, and #3 are based on evidence based recommendations found in research which have each shown the potential to decrease the risk of POD and POCD postoperatively in elderly patients and improving morbidity and mortality outcomes for this high risk

population at NMCSO. The ultimate goal of our neurocognitive dysfunction ERAS protocol is to provide a standard of care for anesthesia care of patients 60 or older at NMCSO and anesthesia provider compliance with the

Value Based Care - Investment Required by the Organization and the Associated "VALUE" or \$ GAINED. *Below represents two ways to present this information. Depending on the initiative, you may need to alter this outline. Please adjust as appropriate and if need be ... do not hesitate to create this portion on a separate document and then attach to this assignment. Outline the Value Based Care*

- I.** *Volume projection based on: Cost and savings per 1000 surgical cases performed on elderly patients. This chart is a simplified breakdown of elderly surgical cases over the past 2 years.*

Number of surgical cases performed on patients age 60 and older during 2019	3525
Number of surgical cases performed on patients age 60 and older during 2018	3365
Number of surgical cases performed on patients age 60 and older under general anesthesia during 2019	622
Number of surgical cases performed on patients age 60 and older under general anesthesia during 2018	502

DATA obtained via Surgical Scheduling System (S3). Total number of general anesthesia cases may be skewed due to providers having "choice" as an option on the reporting system. there were 1,349 "Choice" cases in 2019 and 1,362 in 2018.

- II.** *Reimbursement calculated for: Savings Per 1000 surgical cases performed on patients 60 years of age .*

Anesthetic delivery titrated to achieve a BIS range between 40 and 60 would prevent 23 out of 1000 elderly major surgery patients from developing POCD and 83 patients from developing delirium (Chan et al., 2013).

Patients with POD had a longer length of stay 7.4 days and increased cost of care (\$8,373) (Zywiell et al., 2015).

In nearly 2.4 million Medicare patients, the presence of a postoperative neurocognitive disorder was associated with an increase of \$17275 in payments in the 1 year after the initial surgical procedure. In this study, a total of 6846 patients (15.2%) experienced mild cognitive impairment in isolation and 18,221 patients (40.5%) experienced delirium alone. Mild cognitive impairment and delirium occurred in combination in 448 patients (1.0%), delirium and dementia together occurred in 18754 patients (41.7%), and 705 patients (1.6%) experienced all 3 postoperative neurocognitive dysfunction (PND) subtypes. Patients with all PND subtypes had the highest postacute care payments (\$22160; 95% CI, \$20511-\$23 809) followed by those with delirium and neurocognitive impairment (\$20455; 95% CI, \$18311-\$22598) (Boone et al., 2020).

The average costs per day among patients with POD were more than 2.5 times the costs among patients without POD. In a cohort study of 841 patients, 13% experienced POD, total cost estimates attributable to delirium ranged from \$16303 to \$64421 per patients, implying that the national burden of delirium on the health care system ranges from \$38 billion to \$152 billion each year (Leslie et al, 2008).

Cost of increased length of stay for patients that develop POD: \$8,373.00 x 83 patients	\$694,959.00
Cost of 1 year (after initial surgery) of additional care for patients that develop POCD: \$17,275 x 23	\$397,325.00
Projected total cost of additional care for elderly patients who develop POD and POCD per 1000 surgical cases.	\$1,092,284.00

BIS range between 40 and 60 would prevent 23 out of 1000 elderly major surgery patients from developing POCD

and 83 patients from developing delirium (Chan et al., 2013).

III. Costs:

Variable Costs:

BIS Quatro electrodes (box of 25=\$599; 40 boxes=1000 electrodes): 40x\$599	\$23,960.00
Dexmedetomidine (\$25.32 per vial) x 1000 vials	\$25,320.00
Supplies (paper, poster, misc.)	\$250.00
Total	\$49,530.00

The current cost of dexmedetomidine reported by NMCS D pharmacy is:
2ml dexmedetomidine vials = \$16.13 each; 50ml vials= \$25.32 each.

Fixed Costs:

4 BIS Monitors ASPECT BIS replacement pucks (\$2,500 each)	\$10,000.00
Training/hour is \$164.32 per MDA (x56), \$95.85 per CRNA (x38), 33.24 per RN (x2) (Ziprecruiter.com)	\$12,910.65
Total	\$22,910.00

NMCS D currently has 9 BIS modules with only 3 functioning "pucks." Our plan is to utilize TSNRPmini-EBP grant funds to purchase replacement pucks which were offered at a discounted rate by the vendor. The purchase of 4 new pucks would double the availability of BIS monitoring in the OR, resulting in increased utilization of the monitoring system.

For purposes of this budget plan: current staffing includes 56 MDAs, 38 CRNAs, and 2 RNs compensated for one hour of pay for the hour-long training.

IV. Forecasted P&L statement:

Revenue/Savings:

Reduction in POD per 1000 cases = 83 patients	\$694,959.00
Reduction in POCD per 1000 cases = 23 patients	\$397,325.00
Total revenue	\$1,092,284.00

Anesthetic delivery titrated to achieve a BIS range between 40 and 60 would prevent 23 out of 1000 elderly major surgery patients from developing POCD and 83 patients from developing delirium (Chan et al., 2013).

Costs:

Variable cost	\$49,530.00
Fixed cost	\$22,910.00
Total cost	\$72,440.00

**PROJECTED SAVINGS
FOR INITIAL 1000
CASES**

\$1,019,844.00

Risks and Mitigation Plan *Consider the risks:*

Risks	Plan
1. Provider refusal to comply with ERAS protocol	1. Explain the importance of the ERAS protocol and the literature supporting the interventions.
2. Failure to secure additional BIS monitors or supplies	2. Ensure surgeries for elderly patients have priority use for available BIS monitors.
3. "Ineffective treatment plan/course of action, resulting in increased cost with no benefit"	3. Reassess what actions were taken and what occurred as a result.
4. Increased costs due to increased dexmedetomidine utilization	4. Constantly assess cost throughout the project and determine areas of increased liability and areas of surplus.
5. Patient outcomes unchanged	5. Analyze the situations case by case to determine if the patient outcomes are a result of the ERAS or the improper application of the ERAS protocol

Implementation Plan *Implementation plan*

Phase 1:		Gather Evidence	
Milestone Description:		Search multiple databases and reputable sources for peer reviewed articles pertaining to the prevention of POD/POCD, the prevalence of POD/POCD, and the treatment of POD/POCD in surgical patients 60 years of age and older. Collaborate with NMCS D’s Tricare/business analytics department to establish baseline data such as beneficiary population size and surgical case numbers.	
Deliverables		Due Date	Accountable Person
PICOT question; Evidence table; Problem and solution synthesis paper		One month from start of project	LCDR Faris and LT Dimarucut

Resources Needed		
We will require access to databases, patient records, technology, wifi network, and personnel at the Tricare/business analytics department.		
Expected Level of Benefit		
This will serve as the foundation of our EBP project's framework and determine the direction we will follow to conduct the rest of the project. This information will help us determine which combination of evidence-based interventions will create the most effective and beneficial ERAS protocol.		
Phase 2:	Create an ERAS protocol and gain command approval.	
Milestone Description:	Work with NMCSU USUHS site director and assistant site director to create an ERAS protocol utilizing the current format used in NMCSU's anesthesia department. Present it to appropriate members of the chain of command and gain command/departamental approval for its utilization.	
Deliverables	Due Dates	Accountable Person
Create ERAS protocol in line with departmental goals and standards. Gain approval for its use.	One month after data collection (total at 2 months)	LCDR Faris and LT Dimarucut
Resources Needed		
Access to software for recording and creating an ERAS flow sheet, PowerPoint presentation, and venue/medium for presenting/disseminating information.		
Expected Level of Benefit		
The ERAS protocol will be a collection of evidence based interventions associated with decreasing the rate of POD and POCD in elderly surgical patients. An ERAS protocol tailored for NMCSU's anesthesia department will establish a single easily accessible resource that contains evidence based interventions and references for providing general anesthesia to elderly patients.		
Phase 3:	Create a pre-recorded informational presentation for staff and disseminate throughout the anesthesia department. Additionally, provide a laminated copy of the ERAS protocol flow sheet for all anesthesia offices.	
Milestone Description:	This will serve as an avenue for sustainment and continuation of training for future staff.	
Deliverables	Due Dates	Accountable Person
A recorded presentation introducing/explaining the ERAS protocol.	2 weeks (2.5 months total)	LCDR Faris and LT Dimarucut
Resources Needed		
Email access, lamination of flowsheet, printer/paper, video recording equipment (can utilize personal computer for cost savings)		
Expected Level of Benefit		

The video presentation and laminated ERAS protocol will serve as sustainment for bringing awareness to the ERAS protocol and possible anesthesia complication of POD and POCD.

Phase 4: Program evaluation

Milestone Description:

Track the amount of continued support from the staff.
Track the occurrence of POD, POCD, and length of PACU/ICU stay for patients over 60 years of age after the initiation of the ERAS protocol, and compare them to the rates prior to.

Deliverables

Due Dates

Accountable Person

-Survey results from staff
-Report of POD, POCD rates measured by CAM ICU and CAM PACU scores.
Report PACU/ICU length of stay for patients 60 years of age and older.
-Report of POD, POCD patients referred to Neurology clinic or PCM for follow up care

3 months (5.5 months total)

LCDR Faris and LT Dimarucut

Resources Needed

Access to patient records (PACU, ICU, OR). Access to paper surveys and online survey software.

Expected Level of Benefit

This phase will provide the information used for comparing POCD/POD rates in the elderly before and after the implementation of the ERAS protocol. The information gathered during this phase will also show how many of the anesthesia staff utilize the ERAS protocol, and how often the anesthesia staff employ elements of the protocol when caring for the elderly surgical population.

Phase 5: Presentation of data

Milestone Description:

Analysis of data collected, presentation of project summary

Deliverables

Due Dates

Accountable Person

Presentation of data and EBP project

February 2022

LCDR Faris and LT Dimarucut

Resources Needed

Access to statistical software, PowerPoint software, medium/venue for disseminating results.

Expected Level of Benefit

We will compile and disseminate the results of our EBP project, lessons learned, as well as overall cost and benefits. This will encourage discussion about POCD and POD in the elderly surgical population, the development of and ERAS protocol, and the effectiveness interventions supported by current literature. Ultimately, we wish to inspire others to Implement the ERAS protocol at their facilities with changes they may be more effective or appropriate as modern research on POCD and POD develops.

NOTE: Modified from Harvard Business Review Press. (2011). *Pocket mentor: Developing a business case*. Boston: Author (pp 82-85).

References

- American Geriatrics Society 2015 Beers Criteria Update Expert Panel. (2015). American geriatrics society 2015 updated beers criteria for potentially inappropriate medication use in older adults. *The Journal of American Geriatrics Society*, 63(11), 2227–2246.
<https://doi.org/10.1111/jgs.13702>
- Barrett, M. L., Wier, L. M., Jian, H. J., & Stiener, C. A. (2015) All-cause readmissions by payer and Age, 2009–2013: Statistical brief #199. *Agency for Healthcare Research and Quality*. Retrieved from <http://www.hcup-us.ahrq.gov/reports/statbriefs/sb199-Readmissions-Payer-Age.pdf>.
- Boone, M. D., Sites, B., Von Recklinghausen, F. M., Mueller, A., Taenzer, A. H., & Shaefi, S. (2020). Economic burden of postoperative neurocognitive disorders among US medicare patients. *JAMA Network Open*. 3(7) 1-16. <https://doi.org/10.1001/jamanetworkopen.2020.8931>
- Brain monitoring*. Medtronic. Retrieved on Oct 1, 2020 from https://www.medtronic.com/covidien/en-us/products/brain-monitoring.html?sfdcId=7014000000000vMjK&cid=PPC:GOOG:bis%20medtronic:brain-bis&gclid=EAIaIQobChMI7KWMtbyc7AIVho bACh3kdQBVEAAYASAAEgISlFD_BwE
- Caregiver List*. Retrieved Oct 3, 2020 from <http://www.caregiverlist.com/SeniorCareCosts.aspx>
- Chan, M. T., Cheng, B. C., Lee, T. M., & Gin, T. (2013). BIS-guided anesthesia decreases postoperative delirium and cognitive decline. *Journal of Neurosurgical Anesthesiology*, 25(1), 33-42.
<https://doi.org/10.1097/ana.0b013e3182712fba>
- Dasta, J. F., McLaughlin, T. P., Mody, S. H., & Piech, C. T. (2005). Daily cost of an intensive care unit day: The contribution of mechanical ventilation. *Critical Care Medicine*. 32(6) 1266-1271. <https://doi.org/10.1097/01.ccm.0000164543.14619.00>
- Dexmedetomidine processed, coupons and patient assistance programs*. Price guide. Retrieved on Oct 4, 2020 from <https://www.drugs.com/price-guide/dexmedetomidine>

- Gleason, L. J., Schmitt, E. M., Kosar, C. M., Tabloski, P., Saczynski, J. S., Robinson, T., Cooper, Z., Rogers, S. O., Jones, R. N., Marcantonio, E. R., Inouye, S. K. (2015). Effect of delirium and other major complications after elective surgery in older adults. *JAMA Surg.* 150(12) 1134-1140. <https://dx.doi.org/10.1001/jamasurg.2015.2606>
- Hines, A. L., Barrett, M. L., Jiang, J., & Steiner, C. A., (2014). Conditions with the largest number of adult hospital readmissions by payer, 2011. *Agency for Healthcare Research and Quality*. Retrieved from <https://www.hcup-us.ahrq.gov/reports/statbriefs/sb172-Conditions-Readmissions-Payer.pdf>
- Hospital adjusted expenses per inpatient day by ownership*. Kaiser family foundation. Retrieved October 3, 2020 from <https://www.kff.org/health-costs/state-indicator/expenses-per-inpatient-day-by-ownership/?currentTimeframe=0&sortModel=%7B%22colId%22:%22Location%22,%22sort%22:%22asc%22%7D>
- Leslie, D. L., Marcantonio, E. R., Zhang, Y., Leo-Summers, L., & Inouye, S. K. (2008). One-year health care costs associated with delirium in the elderly. *Arch Intern Med.* 168(1) 27-32. <https://doi.org/10.1001/archinternmed.2007.4>
- Katznelson, R., Minkovich, L., Beattie, S., Fedorko, L., & Fisher, J. (2006). Isocapnic hyperpnoea and recovery time after anesthesia with sevoflurane. *Canadian Journal of Anesthesia.* 53(26357) 1-8. <https://doi.org/10.1007/BF03016979>
- Maldonado, J. R., Wyson, A., Van Der Starre, P. J. A., Block, T., Miller, C., & Rietz, B. A. (2009). Dexmedetomidine and the reduction of postoperative delirium after cardiac surgery. *Psychosomatics.* 50(3) 206-217. <https://doi.org/10.1176/appi.psy.50.3.206>

Raats, J. W., Steunenberg, S. L., Crolla, R. M., Wijsman, J. H., Slaa, A., & Van der Laan, L. (2015).

Postoperative delirium in elderly after elective and acute colorectal surgery: A prospective cohort study. *International Journal of Surgery*. 18(2015) 216-219.

<https://dx.doi.org/10.1016/j.ijsu.2015.04.080>

Shepherd, J., Jones, J., Frampton, G. K., Bryant, J., Baxter, L., & Cooper, K. (2013). Clinical

effectiveness and cost-effectiveness of depth of anaesthesia monitoring (E-Entropy, Bispectral Index and Narcotrend): A systematic review and economic evaluation.

National Institute for Health Research. 17(34) 1-284. <https://doi.org/10.3310/hta17340>

What is the average anesthesiologist salary by state? Zip Recruiter. Retrieved October 4, 2020 from

<https://www.ziprecruiter.com/Salaries/What-Is-the-Average-Anesthesiologist-Salary-by-State>

What is the average CRNA salary by state? Zip Recruiter. Retrieved October 4, 2020 from

<https://www.ziprecruiter.com/Salaries/What-Is-the-Average-CRNA-Salary-by-State>

What is the average RN salary by state? Zip Recruiter. Retrieved October 4, 2020 from

<https://www.ziprecruiter.com/Salaries/What-Is-the-Average-RN-Salary-by-State>

Zywiell, M. G., Hurley, R. T., Perruccio, A. V., Hancock-Howard, R., L., Coyte, P. C., Rampersaud,

Y. R. (2015). Health economic implications of perioperative delirium in older patients after surgery for a fragility hip fracture. *Journal of Bone and Joint Surgery*. 97(10)

829-836. <https://dx.doi.org/10.2106/JBJS.N.00724>

Appendix I

Project Timeline

Project Year 1 (2020)												
Activity/Month	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
Phase 1: Literature Review -Gather evidence from literature				X	X	X	X	X	X			
Phase 2: Protocol Creation and Approval -Task 1: Stakeholder engagement meetings -Task 2: Create ERAS Protocol -Task 3: Gain command approval									X	X	X	X
TSNRP Mini EBP Grant Application Submission										X		
Site IRB Submission and Approval											X	
Phase 3: Staff Education and Initial Survey -Task 1: Present ERAS protocol through in-person and pre-recorded presentations -Task 2: Disseminate initial staff surveys												X
Project Year 2 (2021)												
Activity/Month	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
Phase 3 (continued): Staff Education and Initial Survey -Task 1: Present ERAS protocol through in-person and pre-recorded presentations Task 2: Disseminate initial staff surveys	X											
Phase 4: Data Collection, analysis, evaluation -Task 1: Data collection and analysis -Retrospectively collect data about anesthesia interventions from the targeted patient population 3 months prior to initiation of ERAS protocol -Concurrently collect data about ERAS protocol interventions used in the targeted patient population during the 3 months after the initiation of ERAS protocol -Task 2: Program evaluation -Conduct 3-month post survey with providers to assess possible barriers to ERAS use and suggested changes.	X	X	X	X	X	X	X	X				

Project Year 2 (2021) continued												
Activity/Month	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
Phase 5: Dissemination and presentation of Data -Task 1: Formulating results into understandable material -Task 2: Create presentation and flyers of results for anesthesia department -Task 3: Email department with project results and analysis of data									X	X	X	X
Project Year 3 (2022)												
Activity/Month	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
Phase 5 (continued): Dissemination and presentation of Data - Task 4: Create PowerPoint and poster presentation for USU Research Week - Task 5: Create and submit abstract and poster presentation for Tri Service Nursing Research Program (TSNRP) Dissemination Course - Task 6: Create and submit abstract for AANA Annual Congress	X	X	X	X								
Tri Service Nursing Research Program (TSNRP) Dissemination Course				X								
USU Research Week- Bethesda, MD					X							
AANA Annual Congress- Chicago, IL								X				

DOCTOR OF NURSING PRACTICE PROJECT
DNP Project Clinical Question and Team Mentor (Committee Membership) Agreement Form

Graduation Year: 2022 **Phase 2 Site(s) Name:** NMCS D

Name(s) of DNP Project Student Team:

- | | | | | | |
|------------------------|--------------------------------|------------------------------|--------------------------------|---|-------------------------------|
| 1. LT Joseph Dimarucut | AGCNS ☐ | FNP ☐ | PMHNP ☐ | RNA ☒ | WHNP ☐ |
| 2. LCDR Sarah Faris | AGCNS ☐ | FNP ☐ | PMHNP ☐ | RNA ☒ | WHNP ☐ |
| 3. _____ | AGCNS ☐ | FNP ☐ | PMHNP ☐ | RNA ☐ | WHNP ☐ |
| 4. _____ | AGCNS ☐ | FNP ☐ | PMHNP ☐ | RNA ☐ | WHNP ☐ |
| 5. _____ | AGCNS ☐ | FNP ☐ | PMHNP ☐ | RNA ☐ | WHNP ☐ |
| 6. _____ | AGCNS ☐ | FNP ☐ | PMHNP ☐ | RNA ☐ | WHNP ☐ |

The tentative title of the DNP Project Proposal for this student group is:

Enhanced Recovery for Elderly Surgical Patients Receiving General Anesthesia

Committee Approved DNP Project Clinical Question:

Will introducing an ERAS protocol aimed at decreasing the rate of POD and POCD in elderly surgical patients undergoing general anesthesia change the practice of anesthesia providers?

Names of DNP Project Team Mentors *(type the name and obtain digital signatures):*

I agree to serve as a member of the DNP Project Team (Team Mentors) for the above DNP Student Project Team. As a Project Team Mentor, I agree to the duties and responsibilities outlined within the DNP Project Manual which include but are not limited to the provision of consultation and guidance supporting the entire DNP project journey and to ensure the DNP project is of sufficient rigor and demonstrates doctoral level scholarship to meet the requirements for USUHS GSN graduation.

NOTE: *You may have 3-4 DNP Team Mentors [committee members including your DNP Senior Mentor (Chair)]. The Phase II Site Director may also be a member of the group, as well as other USUHS faculty or others who may serve as content experts. All non-USUHS faculty selected as a Team Mentor must be approved by the DNP Project Director.*

Senior Mentor (Chair): CDR Danielle Cuevas Signature: CUEVAS.DANIELLE.KAY.1275198877 Date: 2020.12.18 09:27:55 -08'00'

Team Mentor (Member): Signature: Date:

Team Mentor (Member): Signature: Date:

Team Mentor (Member): Signature: Date:

Appendix K CITI Certificates



Completion Date 19-Mar-2020
Expiration Date 19-Mar-2023
Record ID 35965541

This is to certify that:

Joseph Dimarucut

Has completed the following CITI Program course:

Not valid for renewal of certification through CME.

OUUSD P&R Human Research

(Curriculum Group)

Biomed Research Coordinators, Clinical Coordinators, Study Coordinators & Research Administrators

(Course Learner Group)

1 - Basic Course

(Stage)

Under requirements set by:

Office of the Under Secretary of Defense (Personnel and Readiness)

CITI
Collaborative Institutional Training Initiative

Verify at www.citiprogram.org/verify/?w5a0914fd-23ca-42f4-8b7f-d720943beeb3-35965541



Completion Date 30-Mar-2020
Expiration Date 30-Mar-2023
Record ID 36114587

This is to certify that:

sarah faris

Has completed the following CITI Program course:

Not valid for renewal of certification through CME.

OUUSD P&R Human Research

(Curriculum Group)

Biomed Research Coordinators, Clinical Coordinators, Study Coordinators & Research Administrators

(Course Learner Group)

1 - Basic Course

(Stage)

Under requirements set by:

Office of the Under Secretary of Defense (Personnel and Readiness)

CITI
Collaborative Institutional Training Initiative

Verify at www.citiprogram.org/verify/?w1d3b0d2a-6bfc-44e4-8cbd-723874ed662e-36114587



Clinical Investigation
Department Naval Medical
Center, San Diego 34800 Bob
Wilson Drive, Suite 5 San Diego,
CA 92134-1005
Tel: (619) 532-8125
E-mail: Johanna.peterson2.civ@mail.mil

90

9 November 2020

From: NMCSO IRB, Clinical Investigation Department

To: LT Joseph Dimaricut, NC, USN

Subj: REVIEW AND RESEARCH DETERMINATION OF SUBMITTED QUALITY IMPROVEMENT / PROCESS IMPROVEMENT PROJECT: QI # NMCSO.QI.2020.110902, Entitled: "Enhanced recovery for elderly surgical patients receiving general anesthesia: Introduction of an evidence based enhanced recovery after surgery (ERAS) protocol aimed at reducing the rate of postoperative delirium (POD) and postoperative cognitive dysfunction (POCD) in noncardiac surgical patients age 60 and older."

Ref: (a) Part 219 of Title 32 Code of Federal Regulations (CFR) Protections of Human Subjects (32 CFR 219)
(b) Department of Defense Instruction 3216.02
(c) Deputy Assistant Secretary of Defense for Health Affairs Operating Instruction for the Research Regulatory Oversight Office (3 October 2019)

Review Date: 9 November 2020
Review Type: Exempt Determination Review
Determination: Quality Improvement Project, Not Human Subject Research
EIRB Ref: 932556

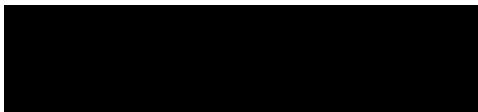
All research projects are required to be reviewed by the NMCSO Human Research Protection Program whether or not the protocol is Human Subject Research or a Quality Improvement/Process Improvement Project. All research involving human subjects is required to be reviewed and approved by the Institutional Review Board (IRB) before research activities begin. Quality Improvement/Process Improvement (QI/PI) Projects are required to be reviewed and issued a formal determination by an appointed Exempt Determination Official before publication and or presentation of QI/PI Projects.

Summary of Review and Determination: NMCSO Human Research Protection Program, Exempt Determination Official(s) performed a review of the above entitled project and determined it does not qualify as Human Subject Research (either exempt or non-exempt) and therefore is not subject to IRB review and approval, nor Human Subject Research Protections and IRB Oversight.

Please retain this determination outcome letter for your records. Public Affairs Office (PAO) may request documentation of review for this project.

Naval Medical Center San Diego holds Office of Human Research Protections Federal Wide Assurance number **FWA00002342**, IRB #**IRB00002061** and **DOD Navy Assurance number P60022**.

Please contact the IRB Research Administration Division (RAD) if you have any questions regarding this determination.



Robert M. Marks, MD
CDR, MC, USN
Chairman, Institutional Review Board
Naval Medical Center San Diego

NOTICE OF PROJECT APPROVAL

Change Number: Original

VPR Site Number: GSN-61-12076
Principal Investigator: Dimarucut, Joseph
Department: Graduate School of Nursing
Project Type: Student
Project Title: Enhanced Recovery for Elderly Surgical Patients Receiving General Anesthesia
Project Period: 8/9/2021 to 4/1/2022

Assurance and Progress Report Information:

<u>Name</u>	<u>Sup</u>	<u>Approval Type</u>	<u>Status</u>	<u>Approved On</u>	<u>Forms Received</u>
Progress Report	0			To be Submitted	N/A

Remarks:

This Notice Of Project Approval has been reviewed and approved. Please remember that you must submit a final Progress Report (Form 3210) upon completion of this project.

Questions regarding this approval should be directed to the following person in the Office of Research:
Sharon McIver, (301) 295-9814.

RANDOLPH.TOY Digitally signed by
A.V.1242107698 RANDOLPH.TOYA.V.1242107698
Date: 2021.08.10 12:37:40 -04'00'

Mark G. Kortepeter, MD, MPH Date
FACP, FIDSA, FASTMH
COL (R) MC US Army
Vice President for Research
Uniformed Services University of the Health Sciences

cc: File
Dr. Kennett Radford
Laura Taylor

Appendix O

DNP Project Completion Verification Form

The DNP Project titled "Enhanced Recovery for Elderly Surgical Patients Receiving General Anesthesia" was completed at Naval Medical Center San Diego by the following:

LCDR Joseph Dimarucut	DIMARUCUT.JOSEPH.H.J.1292202535 Digitally signed by DIMARUCUT.JOSEPH.H.J.1292202535 Date: 2022.03.25 13:34:00 -07'00'	25-Mar-2022
LCDR Sarah Faris	FARIS.SARAH.ELIZABETH.1300687241 Digitally signed by FARIS.SARAH.ELIZABETH.1300687241 Date: 2022.03.28 08:37:18 -07'00'	28-Mar-2022

The committee verifies that the following components of the DNP project, accomplished by the above students, is of sufficient rigor and demonstrates doctoral level scholarship to meet the requirements for USUHS GSN graduation:

- Presentation of DNP project to the leadership/stakeholders at the Phase II Site,
- Abstract/Impact Statement (*Appendix F*), and
- DNP Project written report.

Verified by:

CDR Danielle Cuevas	CUEVAS.DANIELLE.E.KAY.1275198877 Digitally signed by CUEVAS.DANIELLE.E.KAY.1275198877 Date: 2022.03.25 13:56:06 -07'00'	25-Mar-2022
Senior Mentor/Phase II Site Director	<i>(signature)</i>	<i>(date)</i>
LCDR Kenneth Barber	BARBER.KENNETH.D.OUGLAS.1177263644 Digitally signed by BARBER.KENNETH.D.OUGLAS.1177263644 Date: 2022.03.29 15:38:48 -04'00'	29-Mar-2022
RNA Project Director	<i>(signature)</i>	<i>(date)</i>