UCSF Perioperative Delirium Prevention and Treatment Pathway

https://anesthesia.ucsf.edu/sites/anesthesia.ucsf.edu/files/wysiwyg/PDRTP.pdf

In coordination with hospital-wide delirium quality improvement efforts, we designed and implemented a perioperative clinical pathway with preoperative, intraoperative, and postoperative components (Supplement Figure 1). Contents of the pathway were based on published evidence or best practice care guidelines where available, or on multidisciplinary institutional expert consensus where evidence or guidelines were less clear. To facilitate uptake of these delirium prevention recommendations, a targeted five-component intervention and departmental quality improvement project were conducted, as discussed in the accompanying manuscript.

Details and rationale for pathway design and implementation are described below. A detailed implementation timeline and barriers and facilitators to the intervention are discussed in Supplement Tables 1 and 2, respectively.

1. Pathway Design

All phases:

Throughout pre-, intra-, and post-operative phases, we recommend general principles that are important to management of all patients at risk for delirium, regardless of the setting. These include using multicomponent non-pharmacologic delirium prevention measures (ex:, allowing

use of sensory aids whenever possible, providing frequent reorientation), avoiding the use of deliriogenic medications (including minimizing polypharmacy), and facilitating communication between teams.

Preoperative phase:

- Delirium Risk Screening: In order to identify patients at highest risk of developing POD, we began screening all adult surgical patients undergoing surgery with a planned overnight hospital stay with the AWOL tool,[1] and later the AWOL-S (surgery-specific) tool.[2] AWOL is a simple 4-point screening tool, in which patients are given one point for each characteristic: **A**ge > 80, failure to spell **W**ORLD backward, dis**O**rientation to place, and higher nurse-rated i**L**lness severity score. Patients receiving 2 points or higher are classified as high-risk for developing delirium. This tool was developed at our institution in medical and neurologic patient populations. Because fundamental differences exist in risk factors for delirium between medical and surgical patient populations, we sought to validate the tool in surgical patients. In a cohort of 2088 surgical patients at our institution, the AWOL tool did not perform well in the surgical population, with an area under the receiver operating characteristic (ROC) curve of only 0.56.[2] We therefore developed a modified risk stratification tool, termed AWOL-S, which retained the original predictors of **A**ge, **W**ORLD backward, and dis**O**rientation to place while replacing nurse-rated illness severity score with ASA physical status (**L**), and adding a term for surgery-specific risk based on NSQIP [4] and local data (**S**). The AWOL-S instrument generates a predicted probability of delirium for an individual patient using

odds ratios derived from logistic regression. The AUC of the AWOL-S score is 0.71-0.76, and remained consistent across three distinct cohorts (4135 patients total) at our institution.[2] We therefore transitioned to using the AWOL-S tool in perioperative patients, where AWOL-S predicted probability of delirium ≥5% was considered "high risk" for an individual patient. The AWOL-S tool is embedded into our Epic electronic health record (EHR); therefore, risk calculation occurs automatically for each patient once terms are entered by nursing and anesthesia staff.

- Notification of Anesthesia Team: A classification as high delirium risk by AWOL-S criteria is recorded in the comprehensive data flowsheet of the EHR, making it accessible to any provider. In order to increase visibility for anesthesia providers, a high-risk result also triggers a color-coded flag in the EHR patient banner within the anesthesia care context (See Supplemental Document 2, Part 2). This flag allows the anesthesia team to easily recognize high-risk patients and to begin modification of the anesthesia plan as indicated.
- Separation of Sensory Aids: Preoperative nurses place the glasses, hearing aids, and dentures of high-risk patients into a separate smaller container within patient belongings so that they are easily accessible in the postoperative period.

Intraoperative phase:

- Medication Management (including PONV management): The *AGS Beers Criteria for Potentially Inappropriate Medication Use in Older Adults*,[21, 22] provides comprehensive medication management guidelines for elderly patients. While recognizing that

anesthetic management requires individualized judgment, we recommend avoiding Beers Criteria medications, also termed Potentially Inappropriate Medications (PIMs), whenever possible. Avoidance of PIM administration is particularly challenging in the prevention and management of postoperative nausea and vomiting (PONV), as many antiemetics have undesirable side effects in older adults. We therefore used the Beers Criteria and consensus from institutional experts from geriatrics, neurology, and pharmacy to offer management recommendations for PONV (Supplement Figure 1). Low-dose metoclopramide (5 mg administered intravenously once), despite its classification as a PIM, was agreed upon by our expert panel as the most appropriate third-line rescue medication for PONV given fewer anticholinergic side effects when compared to other antiemetic options. Considerations for haloperidol usage are discussed below in the Postoperative section.

- Patient Safety and Risk Mitigation: We recommend other best practices for care of older surgical patients including careful positioning to avoid positioning injury, goal-directed fluid management, and maintenance of normothermia (Supplement Figure 1) in accordance with guidelines published by the American College of Surgeons (ACS) National Surgery Quality Improvement Project and the American Geriatrics Society (AGS).[5]
- pEEG Monitoring: Processed electroencephalography (pEEG) monitoring to target lighter depth of anesthesia is recommended by both the AGS[11] and the European Society of Anesthesia[12] as an intervention to decrease the incidence of POD. Some studies support this practice,[13-18] while other recently published larger randomized

controlled trials have shown no benefit.[19, 20] Both because of the lack of clarity within the literature and because our institution did not have pEEG technology in all operating rooms at the time of pathway implementation, we recommend considering depth of anesthesia monitoring when available, but we intentionally provide no specific clinical target.

- Pain Management: Both pain and opioid pain medications are triggers of delirium. Therefore, provision of individualized analgesia using a multimodal and/or opioid-sparing approach has become the preferred practice in management of perioperative pain in older adults.[5, 6] While regional and neuraxial analgesic techniques have not been shown specifically to impact incidence of POD,[7] these techniques have been shown to improve pain scores, reduce opioid requirements, and reduce sedative requirements in postoperative patients, among many other putative benefits.[8-10] We therefore recommend provision of multimodal analgesia and consideration of regional or neuraxial techniques whenever appropriate (Supplement Figure 1). This includes consideration of preventative non-opioid analgesics (i.e., acetaminophen) preoperatively, where appropriate.
- Patient Handoff: The anesthesia team is encouraged to discuss delirium risk with the surgical team either intraoperatively or during patient handoff in the post-anesthesia care unit (PACU), in order to promote continuation of delirium prevention initiatives after PACU discharge.

Postoperative phase:

- Delirium Risk PACU Orderset: Our institution's standard adult PACU orderset contains opt-in orders for three PIMs: meperidine, prochlorperazine, and metoclopramide. In order to minimize inadvertent exposure to PIMs, we created a novel PACU orderset for high-risk patients, termed the delirium risk PACU orderset, with modifications including removal of the three opt-in PIMs, addition of haloperidol as an alternative agent for PONV (See Supplemental Document 2), and addition of a multi-component nursing care bundle (See Supplemental Document 2). Haloperidol is not approved by the Food and Drug Administration for the prevention and treatment of PONV, but it is a recommended medication in consensus guidelines for PONV management.[23] The safety and efficacy of low-dose haloperidol for PONV prevention and management is supported by the literature,[24-26] and on this basis our institution's Pharmacy and Therapeutics Committee approved its addition to both the standard and the delirium risk PACU ordersets. As discussed above, metoclopramide is recommended by institutional experts as a third-line rescue agent for PONV management; however, it was still removed from the PACU orderset to encourage use of other agents first and metoclopramide only on an individual case basis.
- Patient Handoff: At the time of patient handoff to PACU nursing staff, each patient's delirium risk status is discussed between the anesthesia team, surgery team, and PACU nurse. To ensure compliance, discussion of delirium risk was added to the standard PACU handoff checklist. This allows the PACU nurse to provide appropriate non-pharmacologic care interventions in the recovery period and the surgery team to continue delirium prevention initiatives after PACU discharge.

- Visual Identification of High-Risk Patients: In order to provide easy visual identification of patients at high delirium risk by PACU staff in a manner protective of patient privacy, laminated signs with a hat emblem are displayed at the patient's bedside.
- Patient and Family Education: PACU nurses provide educational materials on delirium to high-risk patients and/or family members. These materials were developed with the input of patients and family members. In-person education about delirium recognition, prevention, and implications is also encouraged.
- Continuity after PACU discharge: In order to ensure appropriate bed placement, nursing care assignments, and monitoring, PACU nurses sign out high delirium risk to ward or ICU nurses at the time of nursing handoff (See Supplemental Document 2, Part 1, which depicts reminder cards for nursing displayed at the PACU bedside). Surgical teams order an adult delirium floor orderset to formally continue the patient on the hospital-wide delirium care pathway.

2. Pathway Implementation

The rollout date for the complete Perioperative Delirium Prevention and Treatment pathway was December 7, 2017, which occurred after introduction of preoperative delirium risk stratification, multidisciplinary education efforts, and execution of multiple EHR enhancements. Major implementation steps are described below, and minor implementation milestones are described in Supplement Table 1. Challenges, barriers, and keys to success for pathway implementation are detailed in Supplement Table 2.

Pre-implementation Planning

Prior to pathway implementation, we fostered collaboration with the ongoing hospital-wide campaign to improve detection, prevention, and treatment of delirium, the Delirium Reduction Campaign. Partnering with this institutional project allowed the perioperative pathway to engage high-level institutional support from medical and nursing leadership. We also recruited champions from the Departments of Anesthesia and Perioperative Care, Surgery, and Nursing.

Engaging stakeholders including hospital leadership and front-line staff was a critical first step to planning our intervention. Next, we determined optimal timing and location for delirium risk screening. We first approached our anesthesia preoperative clinic, but the addition of screening procedures to existing preoperative clinic workflows was not feasible. Screening in surgical clinics was likewise infeasible given the large number and diverse locations of clinics in our system. We then turned to the preoperative setting and obtained buy-in from preoperative nursing leadership to perform screening in the preoperative area. We utilized feedback on feasibility and nursing workflow impact from nursing champions to develop the procedures below.

Nursing Education and Training

Prior to each practice change, preoperative and postoperative nursing staff received education on both the rationale for and the workflows associated with proposed initiatives. Education was provided by both anesthesia and nursing leadership in the form of formal presentations, one-

on-one or group peer training, email messages, online modules, and posted visual aids (See figures in Supplemental Document 2, which show visual aids utilized in the preoperative and postoperative clinical areas). Throughout the implementation process, tracking and feedback of compliance allowed for additional education and motivation.

Anesthesia and Surgery Education

Anesthesia providers received repeated education on the importance and impact of POD, medical management components of the pathway, and workflows associated with perioperative delirium screening and prevention initiatives prior to and throughout pathway implementation. Educational efforts included formal presentations at Grand Rounds and Morbidity and Mortality conferences, emails, pages, and posted visual and memory aids (See figure in Document 2, which shows reminder cards for anesthesia providers which were posted on anesthesia carts). The hospital-wide Delirium Reduction Campaign conducted education for surgical departments. Several surgical departments selected reduction of POD as their yearly resident quality improvement projects.

Delirium Risk Stratification

AWOL Risk Stratification: The AWOL risk stratification tool[1] was initially selected for preoperative delirium risk screening to maintain consistency between perioperative and hospital-wide delirium practices. Nurses began applying AWOL during the preoperative check-in process starting on December 7, 2016. Prior to screening implementation, components of the screening tool that were new to nursing workflows (i.e., spelling WORLD backward and nurse-

rated illness severity score) were built into the EHR [Epic electronic health record system (Verona, WI, USA) including the Optime (periop) and Anesthesia modules] in the preoperative nursing charting environment. Nurses were trained on how to calculate and chart these terms at staff meetings, via email, and by in-person small group and peer-to-peer training sessions. Compliance with screening was monitored and reported back to nursing staff. Additional education was provided to improve compliance.

AWOL-S Risk Stratification: The AWOL-S instrument was launched on June 6, 2018 after development and validation as described previously. Prior to its launch, an additional Epic EHR build occurred, and education was provided to nursing and anesthesia staff via in-person education sessions, email, and posted visual aids. The particular focus of training included the differences between AWOL and AWOL-S [i.e., substitution of the American Society of Anesthesiologists (ASA) Physical Classification for nurse-rated illness severity score and addition of surgery-specific risk term] including how to calculate and chart the surgery-specific risk score. Compliance with AWOL-S was initially low due to missing documentation of the ASA Physical Classification and lack of clarity surrounding the surgery-specific risk ("S") component of the EHR build. We overcame these challenges by providing education to preoperative clinic staff and anesthesia providers to complete documentation of the ASA Class in the preoperative note, which was required for the EHR to calculate a score, prior to the patient being checked in for surgery. An eventual enhancement to the surgery-specific risk EHR build on October 6, 2018 resulted in automated entry of the S component of the risk score, which greatly improved compliance with use of AWOL-S in eligible patients.

Electronic Health Record Enhancements

The perioperative pathway relies heavily on the EHR for recording and communicating data. Specific new builds were required to accommodate AWOL and AWOL-S screening (including automated calculation of surgery-specific risk), communication of high-risk screening results to anesthesia providers, modifications to the PACU orderset, and intraoperative reminders for anesthesia providers (See figures in Supplemental Document 2). These enhancements required allocation of departmental and medical center resources.

Departmental Quality Improvement Project

Residents and advanced practices nurses at UCSF select a yearly departmental incentive-based quality improvement (QI) project. Both of these groups selected delirium prevention as their goal for the 2017-2018 academic year. The project focused on facilitating uptake of recommended practice changes; specifically, the metric selected by the committee to determine project success was frequency of ordering the "Delirium Prevention Interventions" in the PACU orderset (See Supplemental Document 2, Part 2) for patients with AWOL-S predicted delirium risk >/= 5% with a cumulative annual compliance of at least 50% among all anesthesia providers. The QI project was conducted between 7/1/18-6/30/19, in addition to the implementation of the broader based perioperative delirium reduction initiatives already described. During this timeframe, residents on the Anesthesia Resident Quality Improvement Committee provided intensive departmental education on best practices associated with prevention of perioperative delirium at departmental conferences, via email, and via written educational reference materials (See figures in Supplemental Document 2). Committee

members tracked monthly departmental compliance with orderset use and provided monthly feedback on compliance to the entire anesthesia department via email and pages.

Supplement Figure 1

Perioperative Delirium Prevention and Treatment Pathway

DELIRIUM REDUCTION

General principles

1. Use non-pharmacologic prevention measures
2. Avoid polypharmacy when possible
3. Communicate with preop/PACU nurses and surgical team

Delirium risk stratification and prevention

If patient is ≥ 65 years ***or*** has an AWOL-S predicted risk of delirium ≥ 5%

Intraop →
- Implement Intraop bundle (see next page)

PostOp →
- Order "Delirium Prevention Interventions" and antiemetics for patients with high delirium risk in PACU orderset
- Sign out delirium risk to PACU nurse

Delirium treatment

1 Evaluate for underlying contributors to delirium

- Physical exam: check surgical wound; check tubes/ lines/drains
- Brief neuro exam
- Vital signs, oxygen saturation, pain assessment
- Targeted Workup: Consider ABG, UA, CBC, BMP, TSH, LFTs, UTox, cultures, EKG, Chest X-ray

2 Evaluate for reversible precipitating or contributing factors

- **D**rugs/medications /polypharmacy
- **E**lectrolytes (Na, Ca, acid-base disorders), **E**nvironment change
- **L**ack of drugs (withdrawal), **L**ack of sleep
- **I**nfection, **I**mmobility (catheters, feeding tubes), **I**atrogenic
- **R**estraints, **R**educed sensory input (vision, hearing), **R**espiratory (hypoxemia/hypercarbia)
- **I**ntracranial (stroke, bleed, seizure, meningitis)
- **U**rinary retention, constipation, **U**ncontrolled pain
- **M**etabolic (hypoxemia, hypercarbia, glucose, uremia, hepatic encephalopathy, thyroid dysfunction)

3 Review medications

- Discontinue contributing medications (ex: Beers Criteria) when possible

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All phases

General recommendations

Enable the patient to wear glasses and hearing aids for as long as possible

Provide frequent reorientation when awake

Keep it simple: avoid polypharmacy when possible

PONV management

Preferred order of anti-emetics	Avoid (when possible)
• Preventative measures: propofol infusion, aprepitant (if very high risk) • Ondansetron (4 mg IV q6h) • Haloperidol (0.5 – 1 mg q6h) • Metoclopramide (5 mg IV once)	• Dexamethasone (especially doses > 4 mg) • Diphenhydramine *(Benadryl)* • Hydroxyzine *(Vistaril)* • Lorazepam *(Ativan)* • Prochlorperazine (*Compazine)* • Scopolamine

Medication management

Medication Class	Examples	Precautions	Rationale
NSAIDs	Ketorolac Diclofenac Ibuprofen	• Avoid when GFR < 30 (Stage IV – V CKD) or in AKI • Use caution with repeated doses	Increased risk of GI bleeding, increased risk of AKI (for ketorolac specifically)
Sedative Hypnotics	Benzodiazepines	Avoid (except for specific indications such as seizure)	Increased risk of delirium, cognitive impairment, falls, fractures
	Gabapentin	• Reduce dose or avoid when GFR < 60 • Avoid in patients with ESRD	Increased risk of over-sedation
	Meperidine	Avoid, especially in patients with CKD	Higher risk of neurotoxicity including delirium
Anticholinergics	Scopolamine Promethazine (*Phenergan)* Prochlorperazine *(Compazine)* Diphenhydramine (*Benadryl)* Hydroxyzine (*Vistaril)* Tricyclic Antidepressants	Avoid	Increased risk of over-sedation, central anti-cholinergic side effects (including delirium)
Other psychoactive medications	Steroids (*dexamethasone)* Antipsychotics	Avoid or use cautiously	Increased risk of delirium

Preop

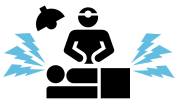
If patient is ≥ 65 years ***or*** has an AWOL-S predicted risk of delirium ≥ 5%:

- Administer PO acetaminophen
- Use caution with Potentially Inappropriate Medications (refer to table)
- Keep glasses, hearing aids, and dentures in a separate bag within patient belongings for easy access

Intraop

Patient safety and risk mitigation

- Consider age-related alterations in physiology when choosing anesthetic technique
- Account for reduction in GFR in medication dosing
- Continue necessary cardiac medications pre- and intraoperatively
- Maintain hemodynamic stability
- Carefully position and generously pad high pressure areas to avoid skin breakdown or nerve injury
- Use goal-directed fluid management strategy targeting euvolemia
- Provide pre-warming and active warming to target normothermia
- Consider depth of anesthesia monitoring when available



Pain management

- Use multimodal (opioid-sparing) analgesia
  - Consider non-opioid adjuncts when appropriate (ex: acetaminophen, lidocaine infusion, low-dose ketamine infusion, magnesium infusion)
- Use neuraxial or regional techniques when appropriate

Postop

- Use Delirium Risk PACU orderset to order delirium prevention interventions and antiemetics for patients with high delirium risk
- Sign out delirium risk to PACU nurse and surgical team
- Monitor for signs of active delirium and treat accordingly

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Supplement Table 1: Complete Implementation Timeline

Step	Date	Description / Comments / Results
UCSF Delirium Reduction Campaign hospital-wide launch	Aug 2016	Stakeholders identified and champions from various disciplines and units engaged. Comprehensive rollout plan formulated.
Inpatient Neurosciences Delirium Reduction Campaign pilot	Sept 2016	Inpatient Delirium Prevention and Management Pathway piloted on two acute care neurosciences units; significant reduction in LOS (9.6 to 7.1 days, p = 0.001) and non-significant reductions in delirium days, readmissions, and safety attendance utilization. Funding approved for a larger project.
Staged rollout across inpatient units at Moffitt Long and Mission Bay Hospitals	Sept 2016 – Feb 2018	Intensive staff education and training completed before rollout to each unit.
Rollout of preoperative AWOL delirium risk stratification	Dec 7, 2016	AWOL risk stratification commenced for all adult patients scheduled for inpatient surgery with planned overnight stay. Launch preceded by identification of preop/postop RN champions, feasibility evaluation for timing and setting of screening, Epic EHR build, and intensive nursing staff training.
Preparation for perioperative pathway rollout (i.e., Pre-implementation planning)	Jan 2016 – December 2017	AWOL compliance optimized through education and reinforcement. Input obtained on RN workflows and feasibility of screening. Nursing buy-in obtained. Education provided to nursing, anesthesia, and surgery staff. Educational materials developed. Multidisciplinary consensus medication recommendations developed. EHR builds including PACU orderset planned and executed.
Addition of haldoperidol to antiemetic options on PACU orderset, approved by Pharmacy and Therapeutics Committee	May 2017	Proposal to P&T committee made. Committee completed literature search and concluded that low-dose haloperidol was safe and effective as mono- or combination therapy for PONV prevention (evidence less clear for treatment of established PONV). Request submitted to institutional EHR committee to modify the existing PACU orderset .
Rollout of Perioperative Delirium Prevention and Treatment Pathway	Dec 7, 2017	Full pathway rolled out (ahead of new PACU orderset go-live) for adult surgical patients with scheduled inpatient stay at ML and MB. Preceded by intensive anesthesia department education and dissemination of educational materials.

Delirium risk PACU orderset go-live	Dec 20, 2017	Three PIMs removed, haloperidol added, and nursing delirium prevention intervention bundle added to the standard PACU orderset.
Proposal to perioperative leadership to add delirium risk to intraoperative timeout / debrief process	Dec, 2017	Proposal was denied.
Evaluation of AWOL performance; creation and validation of AWOL-S	Derivation cohort: 12/16-6/17, validation cohort: 6/17-8/17, post-rollout cohort: 9/17-12/17	AWOL found to have AUC of ROC curve 0.56 as a predictor of delirium in elective surgical patients. By substituting ASA class for nurse-rated illness severity score, adding procedure-specific risk, and calculating a predicted risk using a logistic regression model (i.e., new AWOL-S score), the AUC of the ROC curve improved to 0.73 and remained consistent across three cohorts. (Reference to Whitlock et al, *Anesth Analg* 2020, accepted pending revisions manuscript)
Delirium selected as resident and CRNA QI projects	Mar, 2018	Project planning occurred. Performance metrics discussed and selected. Goal: complete "Delirium Prevention Interventions" in PACU orderset in at least 50% of patients aged 65 and older and/or with positive AWOL-S score.
Originally planned AWOL-S rollout	May 20, 2018	Date pushed back as it became obvious that preparatory planning and education had been insufficient. RN education continued and additional educational materials disseminated.
Recommendation to consider using processed EEG monitoring intraoperatively added to PDPTP	May, 2018	Based on new ESA guidelines and new meta-analysis by Mackenzie, et al. (Mackenzie Anes Analg 2014).
AWOL-S rollout	Jun 6, 2018	Preceded by Epic EHR build which required RNs to manually import procedure-specific risk score. Initial compliance with screening was poor – analysis revealed that most often RNs were leaving the "procedure risk score" blank and/or ASA class was not populated in anesthesia preop note.
RN re-education for AWOL-S	Jun – Jul, 2018	RNs educated on how to enter procedure-specific risk score. Required login to EHR under a specific nursing context and manual creation of a custom view containing a reference window for each RN. Dedicated RN educators assigned to provide on-on-one education and EHR assistance. Compliance improved but was still below goal.

Improvement of AWOL-S screening compliance	Jul, 2018	Continued one-on-one RN training. Additional education for preop clinic and anesthesia providers to populate ASA class in preop note prior to preop check-in.
Addition of delirium risk to OR to PACU handoff protocol	Jul, 2018	Formalized delirium-related handoff between anesthesia, surgery, and PACU nursing teams
Commence resident/CRNA QI project	Jul 1, 2018	Departmental education provided. Compliance tracking and feedback to department begun. Baseline compliance 12%.
Iterative efforts to increase departmental compliance	Jul 2018 – Jun, 2019	Conference presentations, performance feedback, reminder emails and pages, ongoing RN training, EHR enhancements occurred.
Automated entry of procedure-specific risk score launched in Epic	Oct 6, 2018	Procedure-specific risk score automatically imported by Epic for AWOL-S calculation. RN screening compliance began to improve dramatically.
AWOL-S build broken after EHR version upgrade	Nov, 2018	Anesthesia caution flag and alerts no longer functional; problem recognized and fixed quickly.
Addition of "soft-stop" intraoperative reminders for appropriate PACU orderset completion in high-risk patients	Nov, 2018	Reminders to complete delirium risk PACU orderset for high-risk patients added to the intraop sidebar and intraop viewing screen. Continued improvement in departmental quality metrics followed.
End departmental QI initiatives	Jun 30, 2019	Ongoing efforts by project leadership underway to sustain momentum.

Abbreviations: LOS, length of stay; ML, Moffitt-Long Hospital; MB, Mission Bay Hospital; RN, registered nurse; EHR, electronic health record; ASA, American Society of Anesthesiologists; PACU, post-anesthesia care unit; P&T, Pharmacy and Therapeutics; PONV, postoperative nausea and vomiting; PIMs, potentially inappropriate medications; AUC, area under the curve; ROC, receiver operating characteristic; CRNA, Certified Registered Nurse Anesthetist; QI, quality improvement; EEG, electroencephalopgraphy; PDPTP, Perioperative Delirium Prevention and Treatment Pathway; ESA, European Society of Anesthesiology; OR, operating room

Supplement Table 2: Challenges, Barriers, and Keys to Success for Pathway Implementation

Category	Challenge / Barrier	Description and/or Key to Success
Staff Buy-in	Nursing	- Obtaining early high-level support from hospital administration - Early engagement of nursing leadership and champions - Peer-to-peer coaching and education
	Anesthesia	- Departmental education - Continuous performance feedback - Incentive projects
	Surgery	- Departmental education - Incentive projects
Delirium Risk Screening	Appropriate Tool	- AWOL / AWOL-S chosen for feasibility
	Appropriate Timing / Setting	- Preop only feasible setting at our institution
	Provider Notification	- Pages to providers were not desirable per nurses and physicians - BPA alerts tightly regulated - EHR build with high visibility “Anesthesia Caution” flag
	AWOL Implementation	- Obtaining staff buy-in - High-level administrative and leadership support - Extensive planning, education, and feedback
	Compliance / Sustainability	- Considering and seeking feedback on workflow impact pre-launch - Ongoing training/education - Process automation
	AWOL-S Implementation	- RN re-training - One-on-one peer training - Automated procedure-specific risk EHR build - Anesthesia department re-training for ASA Class

Pathway Design	Lack of Evidence	- Best practice guidelines and/or expert consensus utilized where evidence lacking
	Feasibility	- Several components/workflows chosen based on feasibility
	Compliance / Sustainability	- Leveraged EHR capabilities to automate processes and provide just-in-time reminders - Departmental QI project - Ongoing education
EHR Utilization	AWOL Build AWOL-S Build	- Time and dedicated resources allocated - Recognition and correction of workflow problems - Automation of procedure-specific risk entry
	Anesthesia Notification	- Caution flag build in patient banner selected over alternatives given institutional constraints
	EHR Updates	- Recognition and repair of broken code
	Intraop Reminders	- Just-in-time reminders and low-risk passive decision support interventions utilized to improve compliance
Sustainability	Leveraging the EHR	- Institutional limitations in place on EHR features (ex: BPAs, banner utilization) - Found EHR solutions (i.e., "workarounds") that were practical and useful - Processes automated where possible (ex: automated PACU orderset selection)
	Education	- Continuous education on importance and impact of pathway to all provider groups

Abbreviations: BPA, best practice alert; EHR, electronic health record; RN, Registered Nurse; ASA, American Society of Anesthesiologists; QI, quality improvement; PACU, post-anesthesia care unit; BPA, best practice alerts

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