Actionable Patient Safety Solutions (APSS) #18:

Post-operative delirium in older adults

How to use this guide

This guide gives actions and resources for creating and sustaining safe practices for monitoring for opioid-induced respiratory depression. In it, you'll find:

Patient Safety
MOVEMENT

Executive summary checklist

Delirium in older patients following anesthesia and surgery is frequent and often goes undiagnosed, is a significant source of short and long-term morbidity and mortality, and leads to increased cost of care (American Geriatrics Society Expert Panel on Postoperative Delirium in Older Adults). It is important to ensure that older patients and their caregivers are informed about risks of delirium and how it may be prevented (Berger, et al., 2018; Mahanna-Gabrielli, et al., 2018).. Steps to consider when implementing a delirium prevention and management strategy in a healthcare organization include:

- ☐ Establish an Oversight Committee which oversees pre-hospital and admission screening programs, multidisciplinary care programs and perioperative assessment, prevention, and care strategies. The committee reports through safety and quality care pathways.
- ☐ Develop a hospital-wide education program, targeted appropriately to relevant clinical areas, with the intent of increasing awareness of the importance of identifying cognitive impairment and delirium, and what strategies can be used to support and best manage such patients.
  - ☐ This should incorporate local/national/international recommended best practice standards and tools where they exist
- ☐ Implement liaison with relevant local medical practitioners (primary care / family medicine / general practitioners) for pre-hospital and post-discharge planning. Such planning includes assessment, optimization, implementation of appropriate referral pathways, and post-discharge medication management.
- ☐ Ensure that the patient, carers and/or family are engaged at all stages of care and can be involved with support for the at risk individual.
- ☐ Establish hospital resources including protocols and guidelines (listed below) for delirium prevention and management by identifying risk factors for delirium, minimizing trigger factors and optimizing assessment and care in the perioperative environment, including high dependency units (HDUs) and intensive care units (ICUs) again drawing on any local/national or international standards or resources that may exist
  - ☐ Screening tools administered by suitably trained personnel prior to or on admission and during the postoperative period for cognitive decline and delirium
  - ☐ Checklists for risk identification (Predisposing factors)
    - ☐ Conduct discussions with patients and caregivers about the possibility of postoperative delirium, the risks associated with delirium and the importance of its prevention.
  - ☐ Checklists for trigger factor minimization (Precipitating Factors)
    - ☐ Emphasizing multicomponent / multidisciplinary interventions in high risk patients (Hshieh, et al., 2018).; including surgery, geriatrics, anesthesiology, nursing, allied health practitioners and carers/family members
  - ☐ Intraoperative and perioperative guidelines which use best practice and evidence-based strategies to minimize the risk of postoperative delirium

- Assessment tools for ICU and ward use for bedside (point of care) delirium screening; include awareness of hyperactive, hypoactive and mixed presentations
- Management guidelines for delirium once diagnosed, based on the diagnosis and treatment of contributing factors; including minimization of restraints or antipsychotic medications unless the patient or staff are at risk of harm.
- Discharge protocols to communicate to patients and caregivers relevant issues relating to perioperative delirium.
- Discharge protocols for primary caregivers and other providers.
- Referral pathways for psychogeriatric consultation or memory clinics if concerns are identified as appropriate
- Record cognitive screening and delirium assessments in clinical records (paper, electronic) in a manner which can be retrieved and audited for prevalence, incidence and intervention effectiveness and for monitoring the patient course during hospitalization
- Regularly report delirium incidence to the oversight committee and in relevant hospital communications
- Continually ensure that all staff are aware of the delirium reduction program and educated in its implementation.
- Regular program auditing

What we know about delirium in older adults

What is delirium?

Delirium is an acute and fluctuating disturbance in thinking, characterized by inattention, confusion and often hallucinations and/or changes in consciousness (American Psychological Association, 2013). A person suffering from delirium may be restless or agitated, but alternatively may be quiet and withdrawn. It can be described as a form of "acute brain failure." Not only can delirium be distressing for the patient and loved ones, but it has been shown to be associated with poor short-term and long-term outcomes (O'Regan, et al., 2013; Rudolph & Marcantonio, 2011; Gleason, et al., 2015; Inouye, et al., 2016).

Delirium can occur at any age, but this APSS is focusing on delirium in older (65y or more) hospitalized adults having surgery and anesthesia because it is very common in this group, especially when admission to an intensive care unit occurs.

What is the significance of Postoperative Delirium (POD)?

In healthcare:

Delirium is associated with serious clinical consequences including (O'Regan, et al., 2013; Rudolph & Marcantonio, 2011; Gleason, et al., 2015; Inouye, et al., 2016):

- Behavioral disturbances, which if agitated may result in physical harm to the patient or those around them.
- Interruption to acute care by disruption of infusions or failure to comply with treatment.
- Increased complications following surgery, including falls and chest and wound infections.
- Prolonged hospital length of stay.
- Increased need for higher dependency care post discharge.
- Increased risk of acute-care readmission within 30 days.
- Increased risk of intermediate and longer-term cognitive decline (Inouye, et al., 2016; Saczynski, et al., 2012), including dementia (Lingehall, et al., 2017)
- An association with increased mortality.

By 2050, half of all anesthetics and surgical procedures will be provided to those aged 65 years or more. Thus, millions of individuals at high-risk of delirium and its consequences will undergo the precipitating event of surgery and anesthesia every year.

Apart from the personal impact, for hospitalized patients overall, the cost of an episode of acute care is increased 2.5 times by the occurrence of delirium, increasing the cost of healthcare in the United States by over $125 billion dollars every year (Inouye, Wastendorp, & Saczynski, 2014; Brown, et al., 2016) This health-care burden includes the cost of readmission to hospital within 30 days.

It is estimated that up to 40% of hospital-related episodes of delirium are preventable (Inouye, et al., 2014).

For the patient:

Older individuals undergoing surgery and anesthesia have a high risk of experiencing delirium during their hospitalization, especially following major or emergency operations. Patients undergo anesthesia and surgery in order to improve their quality of life, reduce pain or aid disease diagnosis and management. It is now well recognized, but not widely known in the

community, that disorders of cognition occur frequently in older patients following surgical procedures. What is critically important is that delirium should be prevented if possible. Preventing delirium in the older patient will lead to improved health outcomes, including reduced complications, improved recovery, and a likely decrease in the development of later cognitive decline, with reduced mortality and potentially improved long-term health benefits.

For carers (family / caregivers / care providers):

Observing someone you care for experiencing delirium can be very distressing for family, caregivers and nurses. In fact, carers and family members of a delirious patient may experience levels of distress similar to that experienced by the patient, and this distress may persist for 12 months or longer (Patridge, et al., 2019).

Nearly two-thirds of older post-operative patients experience some form of delirium, and it is more likely to occur in patients who already have some cognitive impairment. It is important for caregivers to contribute to planning perioperative care by informing clinicians of any memory or thinking concerns, prior episodes of delirium, and assisting with programs before, during and after the patient's hospital stay that are designed to reduce risk (Mahanna-Gabrielli, et al., 2019). It is also important for carers and/or families to be involved in discharge care and planning as patients may be discharged from hospital still experiencing hypoactive delirium, even following day case surgery.

Predisposing Factors for Postoperative Delirium: Identifying Risk for POD

Patients who present to the hospital with any of the following factors are at an increased risk for post-operative delirium (American Geriatrics Society Expert Panel on Postoperative Delirium in Older Adults, 2015):

- Increasing Age
- Frailty
- Polypharmacy
- Cerebrovascular disease
- Major cavity surgery (e.g., abdominal, thoracic)
- Emergency surgery
- Metabolic disturbances
- Pre-existing cognitive impairment
- A history of prior POD

At the time of hospital admission, these risk factors should be identified and the treatment team alerted to the need for a delirium-risk care plan. Some risk factors, such as polypharmacy or metabolic disturbances, may be mitigated given sufficient time.

Predictive tools in the general hospital surgical population:

Screening for the risk of developing delirium:

A number of tools with published performance data have been reviewed (Lindroth, et al., 2018). Not all are designed for postoperative risk. Common features included are pre-existing cognitive impairment, age, and general health status. Factors to consider when selecting a tool for routine use in any healthcare environment include use of variables and assessments that are readily available in clinical practice and are feasible to administer without extensive training or interpretation (Lindroth, et al., 2018). Examples include:

AWOL (Douglas, et al., 2013; Brown, et al., 2017)

The AWOL prediction rule was derived by assigning 1 point to each of 4 items assessed upon admission that were independently associated with the development of delirium:

- A: Age ≥ 80 years
- W: Unable to spell "World" backward,
- O: DisOrientation to place
- L: Higher iLlness severity

Higher scores were associated with higher rates of delirium with a score of 2 or higher indicating a 5% or higher risk of delirium (ROC AUC 0.69 in the validation cohort).

The AWOL-S variant takes surgical complexity into account.

NSQIP-derived predictive risk in hip fracture patients (Kim, Li, & Kim, 2019).

This is a 9-feature, 20 point maximum risk index for delirium following surgery for fractured neck of femur (ROC AUC 0.77):

- preoperative delirium (8 points);
- preoperative dementia (3 points);
- age (0–3 points);
- medical co-management (1 point);
- American Society of Anesthesiologists (ASA) physical status III–V (1 point);
- functional dependence (1 point);
- smoking (1 point);
- systemic inflammatory response syndrome/ sepsis/septic shock (1 point);
- and preoperative use of mobility aid (1 point);

Screening for cognitive impairment:

Cognitive impairment is a well-validated risk factor for developing post-operative delirium. A number of tools and resources are available. Commonly used tests such as the Mini-Mental State Examination are able to detect possible dementia but are less sensitive to milder forms of cognitive impairment. Simple tests include the Montreal Cognitive Assessment (MoCA) (Ciesielska, et al., 2016), MiniCog (Quitoriano & Hamm, 2017)and TICS (Cook, Marsiske, & McCoy, 2009) which are more sensitive to subtle impairment.

Screening for the clinical presence of delirium: (see later section)

Prediction of Delirium in ICU:

There are several assessment tools that can, with variable precision, predict the development of delirium in ICU patients (including post-operative patients) from various weighted clinical features. All models have been found to have moderate to good predictive abilities. While the features in Pre-DELIRIC (recalibrated) (Table 1, left column (Van de Boogaard, et al., 2014)) were most accurate, the early predictive model (Table 1, center column (Wassenaar, et al., 2015)) although slightly less sensitive had the benefit that it could be applied early in the ICU admission and may allow for timely preventive measures (Green, et al., 2019).

Prediction of Delirium in ICU Patients (Pre-DELIRIC)	Early Prediction of Delirium in ICU Patients (Wassenaar et al [20])	Lanzhou Model
Age	Age	Age
APACHE II score	History of cognitive impairment	APACHE II score
Coma (drug-induced or otherwise)	History of alcohol abuse	Mechanical ventilation
Patient classification (medical, surgical, trauma, neurologic)	Patient classification (medical, surgical, trauma, neurologic)	Emergency surgery
Presence of infection	Mean arterial pressure at ICU admission	Coma
Metabolic acidosis[a]	Use of corticosteroids	Multiple trauma
Morphine dose	Presence of respiratory failure[b]	Metabolic acidosis[a]
Use of sedatives	Blood urea nitrogen at ICU admission	History of hypertension
Urea concentration	Emergency admission	History of delirium
Emergency admission		History of dementia
		Use of dexmedetomidine

APACHE II = Acute Physiology and Chronic Health Evaluation II score.
[a]Metabolic acidosis was defined as an arterial pH < 7.35 with bicarbonate < 24 mmol/L.
[b]Respiratory failure was defined as the need for nonelective invasive mechanical ventilation or noninvasive ventilation at admission or anticipated within the first 24 hr of ICU admission.
Variables included in the prediction of delirium in ICU patients model and the Lanzhou model are collected in the first 24 hr of ICU admission, whereas variables included in the early prediction of delirium in ICU patients model are collected at ICU admission.

Table 1. Variables included in selected predictive models of ICU delirium (Green, et al., 2019).

Precipitating Factors for Postoperative Delirium

There are many factors which may precipitate delirium, especially in patients already at risk. Many are preventable, so a delirium care-plan needs to identify and manage as many of these as possible (White, et al., 2019; Scottish Intercollegiate Guidelines Network, 2019).

- Pain
    - o Poorly controlled pain
    - o Sedating analgesics, especially opioids
- Disorientation
    - o An unfamiliar environment
    - o Unfamiliar people
    - o Lack of sensory aids, for example, glasses or hearing aids
- Sleep disturbance
- Sedating drugs
    - o Especially benzodiazepines
- Polypharmacy
    - o Especially drugs with anticholinergic side effects

Drug withdrawal
    - o e.g benzodiazepines, opioids, gabapentinoids
- Dehydration and metabolic disturbances
- Local Infections and Sepsis
- Indwelling catheters
    - o especially urinary catheters
- Physical restraints

Preventive strategies to decrease POD incidence

Up to 65% older post-operative patients suffer some form of delirium following a surgical procedure, especially if requiring ICU admission (Marcantonio, 2017). . Because delirium is associated with increased morbidity; mortality; persistent physical and cognitive decline; and overall healthcare costs, prevention of this complication is of paramount importance (Berger, et al., 2018; Gleason, et al., 2015; Brown, et al., 2016; Aldecoa, et al., 2017).

There is evidence that delirium can be prevented or reduced with multicomponent and multidisciplinary strategies, especially when targeted at individuals identified as high risk (Hshieh, et al., 2018; Zhang, et al., 2013; Siddiqi, et al., 2016). Prevention involves attention to predisposing and precipitating factors along the entire clinical pathway (American Geriatrics Social Expert Panel on Postoperative Delirium in Older Adults, 2015):

Prior to hospital admission (or upon hospital admission for emergencies or day-cases)

Elective surgical patients should undergo an appropriate full history and examination either prior to or on admission to hospital which includes the identification of predisposing factors for delirium such as:

- Pre-existing cognitive impairment (history, memory complaint (patient or informant), screening tests) (Berger, et al., 2018)
- Prior experience of postoperative delirium or neurocognitive decline
- Other factors identified by risk assessment tools eg AWOL score (above) (Brown, et al., 2017)

Pharmacological review, ideally by a geriatrician or pharmacist to identify polypharmacy, drug withdrawal risk and potential drug interactions

Patient, family (or carer) involvement with concerns and support – including ensuring the provision of sensory aids (glasses, hearing aids)

Prior to the operative procedure

Factors as above if not completed.

Cognition assessment (eg MoCA, MinCog) and frailty assessment.

Delirium screening test (eg 4-AT or AWOL-S, see below), with more comprehensive testing or referral if positive.

Provide awareness to ward, clinical staff and family/carers if the patient is deemed to be at risk or cognitively impaired.

Immediate preoperative period (in-hospital)

Avoid prolonged fasting, dehydration or metabolic disturbance.

Avoid precipitating factors eg benzodiazepines

Anesthesia strategies

There are many factors which can trigger or precipitate delirium in the postoperative period, and it is unlikely that modification of any one factor in isolation will have a profound effect on outcome, especially in patients with multiple comorbidities.

General principles are to avoid excessive drug exposure, minimize stress, maximize pain control and facilitate early mobilization and return to normal function (White, et al., 2019).

There is no evidence that prophylactic antipsychotic medications decrease the incidence of

delirium, and in fact may cause harm (Burry, et al., 2018)

Type of anesthesia. There is a lack of evidence to support that type of anesthesia (regional versus general) (Patel, et al., 2018) has a substantial impact on the incidence of POD. This is likely due to many factors involved including the presence of multiple risk factors and the use of sedatives to decrease psychological stress for patients. There is no consistent evidence to suggest a difference exists regarding delirium outcomes to guide choice regarding the administration of total intravenous anesthesia (TIVA) versus volatile agents (Royse, et al., 2011; Landoni, et al., 2019).

Depth of anesthesia (dose of anesthetic). Avoiding excessively deep anesthesia by titrating anesthetic agents can be achieved clinically, or supported by processed frontal EEG-based (pEEG) neuromonitoring or age-adjusted minimum alveolar concentration for volatile agents. This has been recommended in a number of guidelines (American Geriatrics Society Expert Panel on Postoperative Delirium in Older Adults, 2015; Berger, et l., 2018; Aldecoa, et al., 2017). The use of pEEG guided anesthesia results in lower doses of anesthetic agents being administered and decreased burst-suppression activity on the EEG, and a meta-analysis suggested a benefit in its use in reducing incident delirium (MacKenzie, et al., 2018; Luo & Zou, 2018). Subsequently, a large randomized controlled trial failed to confirm a benefit in this outcome - noting that the intervention was confined to volatile agents, and burst-suppression still occurred frequently in both groups (Wildes, et al., 2019). Similarly, a study in patients having hip fracture repair did not find a difference in incident delirium in patients undergoing deep or light sedation (with BIS pEEG monitoring in both groups) (Sieber, et al., 2018). Possible benefit in POD reduction with the use of intraoperative EEG monitoring awaits clarification by further studies comparing the specific targeting of pEEG and/or burst-suppression levels in appropriately controlled and randomized groups (Abbott & Pearse, 2019).

Cerebral perfusion. Cerebral perfusion monitoring and support has a plausible physiological basis, and hypotension has been associated with increased incidence of stroke (Wijeysundera, et al., 2014). A 2018 best practices statement published by the American Society of Anesthesiologists Brain Health Initiative also suggested that optimizing intraoperative cerebral perfusion may improve outcomes (Berger, et al., 2018). Limited trial data suggests that avoidance of significant blood pressure excursions (either hyper- or hypo-tension) may be important (Hori, et al., 2014; Hori, et al., 2016; Brown, et al., 2019). Near infrared spectroscopy-based (NIRS) regional cerebral perfusion monitoring may be used to provide an indirect indicator of frontal cortex perfusion. To date there are limited studies of sufficient size or quality to confirm a strong beneficial impact of NIRS on delirium or neurocognitive outcomes either during surgery (Yu, et al., 2018) or in the ICU (Bendahan, et al., 2018).

Specific drugs:

Dexmedetomidine is a potent alpha-2 adrenoceptor agonist with sedative and analgesic properties. Dexmedetomidine given postoperatively, predominantly in the ICU, has been shown to reduce the incidence of postoperative delirium in cardiac and non-cardiac surgery patients (Duan, et al., 2018). It is still uncertain that intraoperative administration on its own is of benefit, and further trials are awaited (Deiner, et al., 2017; Wu, et al., 2018).

There is growing evidence that peri-operative administration of an alpha-2 agonist (dexmedetomidine) may have efficacy in the prevention and treatment of post-operative delirium in ICU patients (Wu, et al., 2018; Flukiger, et al., 2018).

Ketamine. An early trial suggested that administering a single small dose of ketamine (ie 0.5 mg/kg) at the beginning of cardiac surgery may decrease the incidence POD, however a

meta-analysis (Hovaguimian, et al., 2018) and a large RCT failed to demonstrate any benefit in delirium reduction in major surgery (Avidan, et al., 2017).

Post-operative care

Daily non-pharmacologic interventions include early mobilization, noise reduction, orientation (day, time, place), reducing polypharmacy, use of hearing and visual aids and maintenance or restoration of normal sleep-wake cycles (Scottish Intercollegiate Guidelines Network, 2019). . Sleep deprivation is especially prominent in surgical intensive care patients who tend to attain an average of less than 2 hours of sleep per day (Aurell & Elmqvist, 1985).. In this circumstance, maintaining more normal sleep-wake cycles pharmacologically has also been shown to be helpful in preventing postoperative delirium (Aizawa, et al., 2002).. Soothing music therapy has also been noted to decrease the severity of delirium, to some degree, in older joint replacement patients (McCaffrey, 2009).

The ABCDEF bundle (**A**ssess, prevent and manage pain, **B**oth spontaneous awakening trials (SAT) and spontaneous breathing trials (SBT), **C**hoice of analgesia and sedation, **D**elirium: assess, prevent and manage, **E**arly mobility and exercise, and **F**amily engagement and empowerment) is effective in reducing the incidence of delirium in the ICU and involves multi-disciplinary clinicians and families (Pun, et al., 2019).. This applies to patients of all ages. The use of a portion of the ABCDEF bundle is successful in reducing the risk of poor outcome in a dose-dependent manner.

Dexmedetomidine. As noted above, dexmedetomidine has been shown to decrease the incidence of delirium in elderly cardiovascular surgery patients by more than 50% when administered upon admission to the ICU and continued until the next post-operative day (Duan, et al., 2018). Other studies suggest that another drug (clonidine) in the same class of drugs (alpha-2 agonists) may produce similar results (Rubino, et al., 2010). Alternatively, anti-psychotics, both typical (haloperidol) and atypical (risperidone, olanzapine) have little benefit in preventing delirium (Wu, et al., 2019) and should only be used in treatment if considered essential for safe care (Burry, et al., 2018; Oh, et al., 2017).

Identification of the presence of delirium

Opinions vary widely on the most appropriate screening tool for delirium in hospitalized patients, noting that patients may manifest hypoactive or hyperactive psychomotor forms. It should be noted that a screening tool is not diagnostic and needs to be sensitive rather than specific. Any tool should also be easy and quick to administer, have a high inter-rater reliability and ideally need minimal training. A patient who screens positive for delirium should have an escalated care plan including appropriate support and treatment strategies, have the managing medical team notified, and be considered for geriatric, neuropsychiatric or psychological referral.

Screening tools should be applied pre-operatively, especially to patients identified as high risk (see predisposing factors above). This can include at the time of pre-admission assessment, or in a modified form at the time of admission to hospital - especially for an acute or emergency procedure. In the latter situation, quick pre-screening questions testing orientation may be sensitive enough to trigger a more specific test be used.

There are many screening tools available of varying ease of use, and sensitivity and specificity (Scottish Intercollegiate Guidelines Network, 2019). Screening tools aid risk assessment and can guide 'next steps' including clinical intervention and support and/or referral. Simple one or two questions tests such as the Single Question to Identify Delirium (SQID) are usually based on orientation to time and place (Hendry, et al., 2016) and have only moderate sensitivity and specificity.

When applying tests for delirium, especially in the perioperative/ICU setting, an assessment of the state of alertness of the patient should be part of this and made using a tool such as the Richmond Agitation and Sedation Scale (RASS) (Aldecoa, et al., 2017). This is because delirium can present in different psychomotor forms (ie hyperactive versus hypocative (and mixed). Some specific tests for delirium can then be applied and include:

4AT

The 4AT is a screening instrument designed for rapid (< 2 mins) initial assessment of delirium and cognitive impairment using 4 test domains. A total score of 4 or more (maximum 12) suggests delirium but is not diagnostic. Sensitivity is 86-100%; specificity is 65-82%. Any score >0 suggests possible cognitive impairment (http://patient.sm/LRwgGe).

3D-CAM

The 3D-CAM is a derivative of the Confusion Assessment Method CAM, taking less time (under 5 mins) and requiring less operator training. Sensitivity is 66-100%; specificity is 90-99% (Marcantonio, et al., 2014).

Nu-DESC

The Nursing Delirium Screening Scale (Nu-DESC) is designed to be completed quickly with minimal training using nurse administration (Gaudreau, et al., 2005).. It comprises an observational five-item scale. Sensitivity is 32-96%; specificity is 69-92% (Scottish Intercollegiate Guidelines Network, 2019).

The gold standard for diagnosis of POD is by an appropriately qualified physician according to the DSM-5 criteria. For suitably trained experts (or research), tools that may be used include the CAM, Comprehensive Geriatric Assessment or DRS-R-98 (Delirium Rating Scale- Revised). For non-experts options include (with appropriate training): 3D-CAM; CAM-ICU (only validated in ICU).

Implementation of optimal management plans for POD

Delirium, once diagnosed, should be managed promptly as for any other acute medical condition. A pre-determined escalated care plan should be implemented including appropriate treatment strategies, the managing medical team must be notified, and the patient considered for geriatric, psychiatric or psychological referral. Follow-up plans must also be in place.

- Elements of acute care include:
- Making all staff (and family) interacting with the patient aware of the patient's cognitive state.
- Reviewing potential precipitating factors (see above) and correcting any abnormalities.
- Reviewing the patient's environment to ensure it is safe, calm and supportive for orientation.
- Regularly re-evaluating at least once per nursing shift and at discharge
- Reducing the use of pharmacologic interventions or physical restraints unless the patient or staff are at risk of harm (usually from excessive agitation).

Documentation and reporting of POD incidence

Delirium episodes when diagnosed should be entered in the patient's medical record (ideally in a specific section in an Electronic Medical Record), and the managing medical team must be notified. It is essential that the patient and their family and/or carers (as appropriate) are

informed of the occurrence of delirium and its importance in future care (Mahanna-Gabrielli, et al., 2019).

Discharge documentation should include mention of any episodes of delirium.

Leadership and Implementation Plan

In order to build an effective and sustainable postoperative delirium prevention program, it is necessary to engage members from key stakeholder groups across the perioperative continuum. Such a program is truly a team effort with many stakeholders, and requires broad support and buy-in. Much of the work to prevent postoperative delirium occurs prior to hospital admission, and on the ward or in the ICU after surgery.

Key Points
- Formation of a leadership group such as an Executive Implementation Committee (eg Cognitive Care Oversight Committee) to initiate and support policy change and implementation (incl content experts / broad representation / ideally change management) including medical, nursing, allied health, pharmacy, informatics and patient/carer representation..
- The committee chair should be an appropriately experienced clinician.
- Consultation must involve all relevant stakeholders including members of the wider community
- Resources need to be allocated (staff time / IT / educators)
- EMR should be leveraged to trigger reminders / alerts (medication/need for consults) / order-sets
- Time course for implementation needs to be mapped with an expectation of months to years.

Possible stakeholders (and suggested roles) include:

All phases
- Hospital / health system leadership
  - o   support, time, funding
- Family and/or carers

Prior to admission
- Anesthesia preoperative clinic
  - o   screening for frailty, cognitive dysfunction, nutritional status, etc; delirium prevention education
- Surgical clinics
  - o   screening for frailty, cognitive dysfunction, nutritional status, etc; delirium prevention education
- Pharmacy review of medications
- Social workers, case workers
  - o   discharge planning
- Dieticians, Physiotherapy, Occupational Therapy
  - o   preoperative optimization

- Geriatricians, palliative care providers
  - o medical optimization, surgical decision-making and goals of care support

Perioperative
- Preoperative nursing
  - o screening or identification of high-risk patients, keeping sensory aids accessible to patient, patient/family education
- Anesthesia providers
  - o choice of anesthetic technique, use of appropriate monitoring, best-practice intraoperative care
- Recovery room nursing
  - o delirium screening, appropriate medication administration, non-pharmacologic delirium prevention measures, communicating delirium risk to ward or ICU nurse, patient/family education

Postoperative
- Surgical teams, ICU teams
  - o ordering of diagnostic / prevention measures, appropriate medication prescribing, appropriate consultation and hand-over
- Ward and ICU nursing
  - o delirium screening, non-pharmacologic delirium prevention/treatment measures, patient/family education
- Physiotherapy / Occupational Therapy staff
  - o early mobilization, discharge planning
- Pharmacists
  - o medication review
- Dieticians
  - o nutrition advice
- Case workers/social workers
  - o discharge planning
- Geriatricians, palliative care providers
  - o medical consultation, assistance with goals of care and symptom management
- Caregivers and family members of the patient
  - o monitor and report changes in mental status, actively support early mobilization and other non-pharmacological prevention measures

Action Plan

Following the information outlined in preventive strategies (above), recommended specific actions relating to implementation of a delirium prevention program include (American Geriatrics Society Expert Panel on Postoperative Delirium in Older Adults, 2015; Scottish Intercollegiate Guidelines Network, 2019; Aldecoa, et al., 2017):

1. During the development of educational resources and protocols/guidelines, Include a Patient Family Advisory Committee (PFAC) representative on the Delirium Workgroups/Committees.

2. All patients over age 65 should be informed of the risks following an operation of developing POD including confusion, inattention, and memory problems. This discussion should include mention of post-discharge care and involve other family members and/or carers where appropriate.

3. Baseline cognition should be objectively evaluated with a brief screening tool during preoperative evaluation in all patients over the age of 65 and in any patient with risk factors for preexisting cognitive impairment.

    3.1. Tools include: MiniCog; MoCA, TICS (see above).

    3.2. The 4AT can also be used as a sensitive but not specific tool for assessing cognitive impairment.

4. A management plan should be implemented for patients at risk, focusing on reducing precipitating events

5. Perioperative care

    5.1. Implement a strategy for avoiding excessive anesthesia dosing

        5.1.1. Consider monitoring depth of anesthesia using pEEG including processed frontal EEG / burst suppression indices (Siddiqi, et al., 2016)

        5.1.2. monitoring age-adjusted end-tidal MAC fraction

    5.2. Avoid relative hypotension

    5.3. Maintain normothermia

    5.4. Provide adequate pain assessment and treatment

        5.4.1. Use strategies to minimize opioid-based analgesia

    5.5. Identified at-risk patients should not leave the recovery room without being screened for POD

        5.5.1. If positive, patients should not be discharged to the ward without having started specific interventions to modify precipitating factors for delirium.

    5.6. In the postoperative and ICU setting, it is important that both a sedation/agitation tool such as the Richmond Agitation-Sedation Scale (RASS) and a delirium screening tool are used

6. For routine implementation, it is mandatory to train the team on the basic features of delirium as well as the features of any tools that will be used.

7. On the postoperative ward, POD should be monitored at least once per shift in higher risk patients, due to the fluctuating course of POD.

    7.1. A high sensitivity (to detect POD as early as possible) may be achieved with tests such as the SQID, the Nursing Delirium Screening Scale (Nu-DESC) or the 4AT (see above for details) n.b. the Confusion Assessment Method (CAM) is sensitive and specific but needs specific training and takes longer.

8. Pre-discharge screening for POD should be done in all at risk patients or patients who have had an episode of POD.

9. Manage delirium with a multidisciplinary and multifactor approach

10. Discharge planning should include notification to the patient's primary physician (GP) if an episode of POD was detected or if baseline cognitive impairment was found.

Suggested considerations

1. Implement fast track surgery (ERAS program) with early mobilization and discharge to

prevent POD

2. Avoid routine premedication with benzodiazepines for at-risk patients except for patients with severe anxiety

Technology plan

Technology is an enabler of good clinical care. In some cases technology is the only practical means by which some objectives can be achieved (eg EMR medication alerts or audit; online tools). In many cases recommendations for the use of technology are based on 'best practice' recommendations, awaiting further evidence (eg pEEG monitoring) and in others, possible applications of technology are listed as they are 'emerging' (eg motion tracking or regional cerebral oximetry).

Technology can support

- EMR - linkages / alerts
- On-line tools (home assessment / tablet)
- clinical assessment of cognitive impairment
- bedside diagnosis of POD
- risk minimization strategies, including:
  - o Preoperative risk assessment and postoperative diagnosis checklists
  - o Electronic medication management (with warnings)
  - o Optimizing intraoperative depth of anesthesia control including EEG-based and MAC-o   based anesthetic titration (best practice recommendation)
  - o Optimizing cerebral perfusion (specific evidence weak)
- Audit and review

System or Practice	Available technology
Preoperative clinical risk assessment and screening of cognitive impairment should be performed and documented in patients > 65 years of age or at high risk of postoperative cognitive impairment	- On-line risk assessment questionnaire - On-line / tablet-based cognitive tests - o For use by clinical staff and / or patients
Screening for Postoperative Delirium • Simple tests • Quick to apply • Minimal training needed • Sensitive (not necessarily specific)	- On-line / tablet-based cognitive tests - o For use by clinical staff

Diagnosis of postoperative delirium should: • Be performed by a healthcare provider trained to perform delirium assessments using accepted diagnostic tools (listed above) • Include assessments for hyperactive, hypoactive, and mixed subtypes (includes application of the Richmond Agitation and Sedation Scale)	• Masimo* rainbow Acoustic Monitoring (Mimoz *et al.*, 2012)

Employing brain monitoring strategies
• Avoidance of deep anesthesia (and sedation) during surgery
• Optimize cerebral perfusion
• Monitoring for low cerebral perfusion / oxygenation (intra-operative and ICU)
	• Titrate volatile and intravenous anesthesia using processed EEG-based technology (best practice recommendations based on limited evidence)
	  o Avoidance of burst-suppression EEG which may reflect anesthesia excess
	• Optimize cerebral perfusion (best practice recommendation)
	  o Specific technology eg regional Cerebral Oximetry (NIRS) (low level evidence currently)
	• Limited ICU evidence only for post-operative use

Titrate volatile anesthesia to appropriate age-adjusted minimum alveolar concentration (MAC)	• End-tidal anesthetic agent monitoring (best practice recommendation)
Future technologies: Activity monitoring	• Eye tracking • Motion / activity tracking
Audit and review	• Built into EMR system reports

Patient, Carer & Family Engagement

The inclusion of a patient's family and/or support persons (friends and other support) in a patient's care planning preoperatively and while in the hospital is vital to providing complete care for the patient and provides an opportunity to implement delirium prevention strategies (Mahanna-Gabrielli, et al., 2019). Include STOP & THINK, family engagement strategies.

For patients identified at risk in the preoperative period, provide education to the patient and support persons on postoperative delirium, potential risks and preventative measures. Informed consent should include risks of postoperative delirium based on pre-operative screening (Berger, et al., 2018; Hogan, Scenning & Hogan, 2018). .

Risk reduction strategies include inviting a carer or family member to be with the patient at risk of delirium throughout as much of the perioperative period as possible - this includes accompanying the patient to the OR holding/preparation area and being present in the post-anaesthesia care unit (recovery room) as they emerge from anaesthesia. The benefits of orientation at these times with a familiar person present may be significant.

For patients identified with postoperative delirium provide education to support persons regarding postoperative delirium and management of postoperative delirium, especially nonpharmacological interventions. Engage support person(s) in nonpharmacological interventions as appropriate, including bedside presence and ongoing post-discharge support.

During the development of educational resources and protocols/guidelines, include a Patient Family Advisory Committee (PFAC) representative on the Delirium Workgroups/Committees. In the development of educational materials/handouts and protocols for patients and support persons, engage with the Patient, Family Advisory Committee (PFAC) to review educational materials from a patient's perspective.

Public Awareness: Provide public education on Postoperative delirium to include signs, symptoms and treatment. Incorporating patient and family stories is a powerful way to engage practitioners and how they perceive the issue of delirium.

Measuring outcomes

To evaluate the effectiveness of the early identification, prevention and management of older patients at risk for postoperative delirium, key process and outcome metrics need to be documented. Key population subgroups might include emergency versus elective patients, identified high-risk versus low-risk, and different surgical specialties.

Topic: postoperative delirium

Outcome Measure Formula:
Numerator: Number of surgical patients, 65 years and older, who develop postoperative delirium

Denominator: Number of surgical patients, 65 years and older,

Rate is typically displayed as: Number of surgical patients, 65 years and older, who develop postoperative delirium per 1,000 surgical patients, 65 years and older,

Outcome Measure Formula 2:
Numerator: Number of surgical patients, 65 years and older, who require readmission within 30 days of surgery who have experienced post-operative delirium in their primary care episode

Denominator: Number of surgical patients, 65 years and older.

Rate is typically displayed as: Number of surgical patients, 65 years and older, who require readmission for post-operative delirium within 30 days per 1,000 surgical patients, 65 years and older.

Process Measure Formula:
Numerator: Number of surgical patients, 65 years and older, who are screened pre-operatively for cognitive impairment and/or delirium

Denominator: Number of surgical patients, 65 years and older,

Rate is typically displayed as: Number of surgical patients, 65 years and older, who are screened pre-operatively for cognitive impairment and/or delirium per 1,000 surgical patients, 65 years and older,

Process Measure Formula 2:
Numerator: Number of surgical patients, 65 years and older, who are evaluated post-operatively for delirium at prescribed intervals using standardized clinical assessment tool

Denominator: Number of surgical patients, 65 years and older,

Rate is typically displayed as: Number of surgical patients, 65 years and older, who are evaluated post-operatively for delirium at prescribed intervals using standardized clinical assessment tool per 1,000 surgical patients, 65 years and older,

Process Measure Formula 3:
Numerator: Number of surgical patients, 65 years and older, with positive delirium screens who receive postoperative preventative interventions (pharmacologic and nonpharmacologic)

Denominator: Number of surgical patients, 65 years and older, with positive delirium screens

Rate is typically displayed as: Number of surgical patients, 65 years and older, who receive postoperative preventative interventions (pharmacologic and nonpharmacologic) per 1,000 surgical patients, 65 years and older, with positive delirium screens

Metric recommendations:
Direct Impact: surgical patients, 65 years and older,

Elimination of patient harm: As measured by 1) elimination of postoperative delirium among surgical patients, 65 years and older, or 2) reduction in time from onset of delirium symptoms post-operatively to implementation of treatment protocols/guidelines.

Lives spared harm:
Lives spared harm = (postoperative delirium rate_baseline – postoperative delirium rate_measurement) x surgical patients, 65 years and older_measurement

Lives saved:
Lives saved = (surgical patients, 65 years and older, postoperative delirium mortality rate_baseline – surgical patients, 65 years and older, postoperative delirium mortality rate_measurement) × surgical patients, 65 years and older, postoperative delirium cases_measurement

Notes:
Limitations: It may be difficult to define the patient population. Pre Screening should be helpful in determining if there is a pre-existing condition such as dementia versus postoperative delirium.

Data Collection:
Manual chart review of surgical patients, 65 years and older, with any of the following post-operative delirium diagnosis codes:

CM Diagnosis Code F05 – Delirium due to known physiological condition or the following codes with any diagnosis and a POA of No: R404, R410, R440, R441, R443

Settings:

All inpatient and outpatient settings.

Mortality (will be calculated by the Patient Safety Movement Foundation):
The PSMF, when available, will use the mortality rates associated with Hospital Acquired Conditions targeted in the Partnership for Patient's grant funded Hospital Engagement Networks (HEN). The program targeted 10 hospital acquired conditions to reduce medical harm and costs of care. "At the outset of the PfP initiative, HHS agencies contributed their expertise to developing a measurement strategy by which to track national progress in patient safety—both in general and specifically related to the preventable HACs being addressed by the PfP.

In conjunction with CMS's overall leadership of the PfP, AHRQ has helped coordinate development and use of the national measurement strategy. The results using this national measurement strategy have been referred to as the "AHRQ National Scorecard," which provides summary data on the national HAC rate.

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