CE

1.5 ANCC Contact Hours

Primary Prevention to Maintain Cognition and Prevent Acute Delirium Following Orthopaedic Surgery

Cheryl Holly

Cognitive impairment is a recognized predictor of acute delirium, particularly in the postoperative period. Estimates of up to 24% of patients experiencing delirium and its associated cognitive impairment during any orthopaedic procedure have been reported, with higher rates for those patients undergoing hip fracture repair. Primary prevention is the most effective strategy to maintain cognition and prevent delirium. The purpose of this article is to provide evidence-based recommendations to prevent acute delirium using bundles of care. Bundles of care are a set of 3–5 independent, evidence-based interventions that, when implemented together, result in significantly better outcomes than when implemented individually. The bundle consists of ongoing assessment of cognition, continuing orientation, and early mobilization and socialization.

Cognitive impairment is a recognized predictor of acute delirium, particularly in the postoperative period. In fact, in a recent systematic review of delirium prediction, cognitive impairment was second only to age as the most common predictor of delirium (van Meenen, van Meenen, deRooj, & terRiet, 2014). Delirium is an acute change in mental status, cognition, and attention that also includes disorganized thinking and altered levels of consciousness (see Box 1). Patients with delirium after surgery recover more slowly than those without delirium and, as a result, have an increased length of stay and hospital cost (Rudolph & Mercantonio, 2011). Although the exact mechanism of postoperative delirium is not clear, orthopaedic patients are at a heightened risk for delirium due to several predisposing and precipitating factors such as older age; depression; abnormal preoperative glucose, sodium, potassium, and albumin levels; vision and hearing impairment; and/or admission from a nursing home (Boldt, 2010; Rudolph & Mercantonio, 2011; Wang, Xu, Wei, Chang, & Xu, 2016). Estimates of up to 24% of patients undergoing any orthopaedic procedure have been reported as experiencing delirium and its associated cognitive impairment (Galanakis, Bickel, Gradinger, Von Gumppenberg, & Först, 2001). The onset time among these patients ranged from 7 hours to 16 days after the operation, with an average of 2.8 days postsurgery (Wang et al., 2016). The prevalence was highest between postoperative days 2 and 5 (Galanakis et al., 2001). Patients with a hip fracture are the most vulnerable of the orthopaedic surgery population as the incidence of delirium is the most frequently reported postoperative complication in this group; symptoms often occur as early as the first postoperative day (Robertson & Robertson, 2006). Notably, Bruce, Ritchie, Blizard, Lai, and Raven (2007) in a meta-analytic systematic review reported incidences of delirium in patients following hip fracture repair to occur up to 92% of the time and Marcantonio, Flacker, Michaels, and Resnick (2000) reported that delirium was predictive of poor postoperative recovery of functional status and mobility among patients with hip fracture. The adverse effects of delirium among those undergoing hip fracture repair warrant attention although any elderly patient undergoing an orthopaedic surgical procedure should be considered at risk for cognitive impairment and the development of acute delirium.

Given the evidence that 40% of all delirium is preventable (Leslie & Inouye, 2011) and that delirium is not always resolved at discharge (Girard et al., 2010) or even reversible in many cases, institution of measures that prevent its occurrence or shorten its duration by early recognizing its symptoms is of utmost importance. The purpose of this article, therefore, is to provide evidence-based recommendations to prevent acute delirium using bundles of care. Bundles of care are a set of three to five independent, evidence-based interventions that, when implemented together, result in significantly better outcomes than when implemented individually (Resar, Griffin, Haraden, & Nolan, 2012; Institute for Healthcare Improvement: http://www.ihi.org). Care bundles are currently being used with success to prevent ventilator-associated pneumonia, gastritis, and deep vein thrombosis often associated with mechanical ventilation and central line infections. For example, in a systematic review of 8,515 surgical patients and surgical

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The author declares no conflict of interest.

DOI: 10.1097/NOR.0000000000000569

Box 1. Delirium Facts[a]

- Delirium is a manifestation of acute brain failure characterized by disturbance in attention (i.e., reduced ability to direct, focus, sustain, or shift attention) and awareness, with impaired orientation to the environment; disturbances in cognition (e.g., memory deficit, disorientation), language, visuospatial ability, or perception.
- As defined by DSM-5, delirium is a disturbance in attention that occurs over a short time span and can be associated with memory deficit, disorientation, and disturbances in language, visuospatial ability, or perception.
- Delirium can occur at any age or in any setting but happens more often during hospitalization affecting more than 2.6 million individuals in the United States each year (about five individuals every minute).
- Forty percent of delirium episodes are preventable.
- Total attributable health costs for delirium treatment are in excess of $150 billion annually.
- The number of those experiencing episodes of delirium while hospitalized is rapidly growing as hospitalized patients are more severely ill, have more polypharmacy, undergo more surgeries, and are more likely to be treated in critical care settings, all of which are risk factors for delirium.
- Delirium has been reported to occur in up to 64% of hospitalized older adults. The odds are worse for those who may have a stay in the intensive care unit where rates have been reported as high as 80% in those who are mechanically ventilated.

Note. DSM-5 = *Diagnostic and Statistical Manual of Mental Disorders*.
[a]Data from Leslie and Inouye (2011); US Department of HHS; Maldonado (2017); and American Psychiatric Association (2013).

site infections (SSI), Tanner, Padley, Assadian, Leaper, Kiernan, and Edmiston (2015) reported that surgical care bundles reduced the risk of SSI compared with standard care, with a confidence interval (CI) of 0.55 (0.39-0.77; $p = .0005$). The use of a bundled approach to reduce delirium rates has also been successful—Milisen, Lemiengre, Braes, and Foreman (2005) reported that surgical patients without premorbid dementia or functional decline benefited most from any intervention, whereas multicomponent interventions were most effective for patients who exhibited one or two risk factors of delirium, specifically visual impairment, severe illness, and cognitive impairment. In this study, delirium was prevented in one-third of patients, and the incidence of severe delirium was decreased by more than one-half. A cognitive impairment bundle should consist of establishing mechanisms for preventive strategies related to ongoing assessment of cognition, continuing orientation, and early mobilization and socialization.

Strategies for Early Identification and Prevention

Assessing Cognition

The cognitive impairment seen postoperatively among orthopaedic patients is generally mild. Mild cognitive impairment (MCI) is an intermediate stage between the cognitive decline of aging and the more severe state of dementia (Mayo Clinic, 2018). The patient may be restless and have trouble remembering, concentrating, or making decisions. Mild cognitive impairment is classified into two subtypes: amnestic and nonamnestic (Petersen, 2011). Amnestic MCI is clinically significant memory impairment that does not meet the criteria for dementia. Typically, patients are increasingly forgetful. However, other cognitive capacities, such as executive function, language, and visuospatial skills are intact. The nonamnestic MCI seen in acute delirium is characterized by a subtle decline in functions not related to memory. Although the symptoms of MCI are not severe enough to interfere significantly with daily life (see Table 1), those with MCI and delirium were more often discharged to a post–acute facility (risk ratio [RR] = 1.4, $p < .001$) and had increased risk for greater levels of impairments in cognitive functioning (RR = 3.6, $p < .001$) (Racine et al., 2017). Notably, there is a heightened risk for further cognitive decline as cognitively normal octogenarians who developed delirium during hospitalization (known as acute incident delirium) were more likely to be diagnosed with dementia at 3-year follow-up than those who did not experience delirium (Rahkonen et al., 2000; Marcantonio et al., 2001). Although some data suggest that the rate of reversion to normal cognition may be as high as 25%–30%, recent prospective studies have shown lower rates (Guo, Sun, Wang, Li, & Liu, 2014; Manly et al., 2008).

Screening patients for the cognitive impairment associated with acute delirium is essential for facilitating early identification and prevention and to increase the likelihood of timely delirium management. Proactively prioritizing patients through the use of a validated delirium assessment tool is the first step in managing

Table 1. Signs of Cognitive Impairment[a]

Confusion
Frequently asking the same question or repeating the same story over and over
Not recognizing familiar people and places
Having trouble exercising judgment
Changes in mood or behavior
Vision problems
Difficulty planning and carrying out tasks
Lack of coordination or restlessness

[a]Data from "Practice Guideline Update Summary: Mild Cognitive Impairment—Report of the Guideline Development, Dissemination, and Implementation Subcommittee of the American Academy of Neurology," by R. C. Petersen, O. Lopez, M. J. Armstrong, T. Getchius, M. Ganguli, D. Gloss, … A Rae-Grant, 2018, *Neurology (Special Article), 90*(3), 1–10.

orthopaedic patients at risk of developing delirium. This close monitoring and implementation of delirium-preventive strategies can assist in decreasing incident delirium rates.

The primary characteristic of impaired cognition is fading into and out of lucidity with an inability to attend (*inattention*) to the environment such that the patients appear to know what is going on at one moment and the next is disorganized in their thinking (*disorganized thinking*; Maldonado, 2017). *Inattention* is seen in the patient as difficulty focusing, being easily distracted, or having difficulty following a conversation. The patient may seem dazed or fixated on one object in the room. There may be no eye contact. Asking the patient to recite the months December to July backward is a simple and brief method to assess for inattention. Most patients should be able to recite the months forward; however, reciting the months backward requires concentration, which can be impaired in patients with delirium (Han, 2015).

Disorganized thinking is a failure to be able to *think straight*. Thoughts come and go rapidly. The patient is unable to concentrate on one thought for very long. Thoughts become fragmented making conversation difficult. The patient may ramble or make irrelevant comments, have unclear or illogical flow of ideas, or unpredictable switching from subject to subject. Reponses to questions are often nonsensical. Disorganized thinking can be assessed by asking yes/no questions and then presenting a command, for example, *Can a stone float on water*? followed by *Hold up two fingers* (Han, 2015).

When assessing for cognitive impairment, a cognitive baseline should be conducted on admission and recorded. Ongoing assessment should be conducted at least once daily. This assessment can be a brief but must include assessment of orientation, attention, and memory. There are several validated assessment tools that can be used in a noncritical care area, such as orthopaedics (see Table 2). When choosing an assessment tool, it is important to determine its sensitivity (true positive rate or probability of detection) and specificity (true negative rate or percentage of healthy people who are correctly identified as not having the condition). For example, the Rapid Assessment Test for Delirium is 90% sensitive and 84% specific and the Stanford-Proxy Test for Delirium is 79% sensitive and 90.8% specific (Maldonado, 2017). On the contrary, the Confusion Assessment Method (CAM), developed by Inouye et al. (1990), demonstrated sensitivities from 94% to 100% and specificities from 90% to 95% in a systematic review of 236 studies (Wei, Fearing, Sternberg, & Inouye, 2008). A brief CAM (bCAM) is also available (see Table 2). The bCAM takes less than 2 minutes to complete and has been found to be 84% sensitive and 96% specific for delirium (Han, 2015). Using different questions that take differing amounts of time, both the CAM and the bCAM assess the patient for acute onset of mental status change or a fluctuating course of altered mental status, inattention, disorganized thinking, and an altered level of consciousness. Patients must be awake or arousable to be assessed using either of these tools. A diagnostic interview for confusion (3D-CAM), based on the original CAM algorithm, is also available. The 3D-CAM is a 3-minute delirium assessment. The major difference between the 3D-CAM, the CAM, and the bCAM is that the 3D-CAM uses both subjective questions and observation to assess for delirium. This allows for assessment of patients with severe drowsiness or agitation, which the other two do not (Marantonio et al., 2014). The 3D-CAM has a sensitivity of 95% and specificity of 94% (Marantonio, 2014). The CAM, bCAM, and 3D-CAM require training to use and manuals are available (see Box 2).

A newer tool that allows bedside nurses to assess patients' cognition that does not require specific training is the AWOL. The AWOL is easy to learn and requires very little time to administer and chart. It is primarily useful in identifying those at risk for cognitive impairment (see Table 2). In a study by Douglas et al. (2013) among patients with an AWOL score of 2–4, the risk of developing delirium was 25% (positive predictive value), compared with 3.0% for those with a score of 0–1 (negative predictive value, 97%); $p < .001$ using Fisher's exact test. The AWOL correctly classified 17 of the 28 patients (61% sensitivity) who developed delirium in the cohort. Specificity was 87%.

Fick et al. (2018) recently piloted a 2-step delirium detection–screening protocol among 24 hospitalized elderly patients. In Step 1, patients are asked: "Please tell me the day of the week" (screens for orientation) and "Pease tell me the months of the year backwards starting with December" (screens for inattention). If either or both items are incorrect, Step 2, a 3-minute diagnostic assessment, follows. Certified nursing assistants (CNAs) completed Step 1 and reported findings to the nursing staff. Thereafter, physicians and RNs completed the assessment. The authors reported that the protocol achieved high sensitivities and specificities among RNs, CNAs, and physicians, although the rates were not provided. This very brief screening tool using a CNA as an initial screener holds promise to improve delirium identification.

Use of an assessment tool can easily be incorporated into the admission interview process. The ideal environment to conduct this initial assessment is in a quiet room, without distractions (e.g., close the door and turn off the television/iPad/iPhone, etc.). General guidelines for the assessments include the following: (1) Make sure the patient can see and hear you. If the patient uses hearing aids or wears glasses, these should be in place at the time of each assessment; (2) Do not give verbal praise or indicate correct or incorrect answers (you may want to ask any family present to leave the room); and (3) Document exactly what you see and hear; do not interpret behaviors. Be very specific in your descriptions. Instead of *patient disoriented*, write *patient stated she was atop the Eiffel Tower*; and rather than writing *patient inattentive*, write patient *easily distracted by noises* (Marcantonio, 2017).

Continuing Orientation

Continuing orientation is the process of frequently orienting a person at risk for cognitive impairment and delirium to time, person, and place to keep the patient from becoming disoriented. It differs from reorientation as it should begin on admission before any signs of disorientation appear. Disorientation is an altered

Table 2. Delirium Assessment Tools for Use in Non-Intensive Care Unit Settings

Tool	Description	Items	Focus	Sensitivity (SN) and Specificity (SP)	Score Denoting Delirium	References
Confusion Assessment Method (CAM)	The CAM was first used in the early 1990s. It takes about 5–10 minutes to complete. A limitation of the CAM and its derivatives is that the patient needs to be able to speak.	4	1. Acute onset of mental status change or fluctuating course 2. Inattention 3. Disorganized thinking 4. Altered level of consciousness	SN: 94%–100% SP: 90%–95%	Positive response to 1 and 2 plus either 3 or 4	Inouye et al. (1990).
Brief Confusion Assessment Method (bCAM)	The bCAM is a brief delirium-screening tool based on the original CAM. It can be completed in about 2 minutes.	4	1. Acute onset of mental status change or fluctuating course 2. Inattention 3. Disorganized thinking 4. Altered level of consciousness	SN: 84% SP: 96%	Positive response to 1 and 2 plus either 3 or 4	Han et al. (2013).
AWOL	AWOL is a prediction rule for medical patients' risk for delirium at the time of hospital admission.	4	Age Ability to spell Orientation Illness Severity	SN: 61% SP: 87%	1 point is assigned to each of the 4 items. A score of 1 or above denotes risk for cognitive impairment	Brown et al. (2017).
Delirium Triage Screen	The DTS is a 20-second assessment designed to rapidly rule out delirium and reduce the number of formal delirium assessment needed by 50%.	2	1. Altered LOC assessed by using an arousal scale 2. Inattention tested by asking the patient to spell the word LUNCH backward	SN: 98% SP: 55%	If the patient has altered LOC or makes 2 or more errors on the LUNCH backward task, then the DTS is positive	Han et al. (2013).
4 AT	The 4AT is a brief delirium assessment that takes <2 minutes to perform. The 4AT assigns a score to four delirium features.	4	The 4 As are: • Alert • Altered mental status • Attention • Age (along with date of birth, current place, and year)	SN: 90% SP: 84%	1 or above is suggestive of cognitive impairment	Bellelli et al. (2014).
3-D CAM	The 3D-CAM is a 3-minute delirium assessment based upon the CAM algorithm. It utilizes both objective measures and clinical observation to determine the presence of some of the delirium features. Similar to the CAM, a patient must be inattentive (cardinal feature of delirium) in order to be 3D- CAM positive. The 3D-CAM allows assessment of "untestable" patients (i.e., patients with severe drowsiness or agitation).	4	1. Acute onset of mental status change or fluctuating course 2. Inattention 3. Disorganized thinking 4. Altered level of consciousness	SN: 95% SP: 94%	Positive response to 1 and 2 plus either 3 or 4	Marcantonio et al. (2014).

Note. AT = assessment tool; DTS = delirium triage screen; LOC = level of consciousness.

Box 2. CAM Training Manuals

Confusion Assessment Method (CAM)	http://www.hospitalelderlifeprogram.org/private/cam-disclaimer.php?pageid=01.08.00
Brief Confusion Assessment Method (bCAM)	http://eddelirium.org/wp-content/uploads/2016/05/bCAM-Training-Manual-Version-1.0-10-15-2015.pdf
The 3-Minute Diagnostic Interview for Confusion Assessment Method (3D-CAM)	http://www.hospitalelderlifeprogram.org/uploads/delirum/3D-CAM_Training_Manual_Clinical_for_Website_Version_2.1_Final_9-8-14.pdf

mental state. A person who is disoriented may not know his or her location and identity or the time and date. The patient may think that it is nighttime during the day, may climb into the wrong bed, or eat from another patient's tray. They may also wander.

Orientation to time has been reported to be one of the most efficient measures for discriminating between those with and without delirium and in predicting cognitive decline (Lou, Dai, Huang, & Yu, 2003). Failure to identify the year correctly was reported as the single most valuable sign of cognitive impairment, combining high sensitivity (95%) and specificity (86.5%; O'Keeffe, Mukhtar, & O'Keeffe, 2011). In a stepwise logistic regression, not knowing the year (odds ratio [OR]: 37.2 [95% CI: 13.1-101.3]), not knowing the month (OR: 3.85 [CI: 1.43-10.38]), and an error of 1 hour or more in time of day (OR: 2.76 [CI: 1.0-7.46]) were independent predictors of cognitive impairment (O'Keeffe et al., 2011).

Strategies that can be used in a continuing orientation protocol are as follows:

- Provide appropriate lighting and clear signage.
- Place clocks in each patient room.
- Open the shades or blinds during the daytime.
- Provide reminders on date, time of day (day or night), and location at least twice daily. Explain to the patients where they are, who they are, and your role. Upon entering the patient room, say: *Good Morning* and patient name or *Good Afternoon* and patient, etc. You can add *I am your nurse today* for continuing time, person, and place orientation. Explain reason for admission to the unit to the patient daily.
- Facilitate regular visits from family and friends. The presence of relatives provides a sense of control for patients by encouraging feelings of security and orientation (Hunter & Cyr, 2007; Meagher, 2001).
- Ask family members to bring in familiar objects or pictures.
- Resolve any reversible causes of sensory impairment, such as impacted earwax, and ensure that hearing and visual aids are available and used by those who need them and that they are in good working order.
- Move the patient to another environment only if necessary. A change in location can cause disorientation.

Early Mobilization and Socialization

Early mobilization is getting the patient out of bed to sit in a chair and/or walk around the nursing unit as close to the time of surgery as possible. Originally used to reduce the risks associated with bed rest, the beneficial effects of early mobility now include shorter duration of delirium and reduced postoperative complications (Schweickert et al., 2009) and reduction in length of stay (Muehling et al., 2009; Muller et al., 2009) and mechanical ventilation days (Schweickert et al., 2009), thus lowering overall costs. In a study of intensive care unit patients, early physical and occupational therapy led to reduced incidence and duration of delirium, less days intubated, and a more likely return to independent functional status at discharge (Guerra, Parminder, Singh, & Taylor, 2015).

Strategies for early mobilization and socialization protocol include the following:

- Work with physical therapists to devise a mobilization program that includes strategies to be used on the nursing unit and is based on patient needs and capabilities.
- Ensure that mobilization (in or out of bed) is begun within 24–48 hours of admission.
- Use physical restraints only to control episodes of dangerous agitation.
- Allow the patient to walk independently as possible.
- Engage the patient in conversation while mobilizing. Encourage the patient to talk with others while walking in the corridor.

Conclusion

Primary prevention is the most effective strategy to maintain cognition and prevent delirium. To decrease the incidence of delirium, keep patients safe, maintain their functionality, or plan for safe discharge to their original place of residence, all older adults admitted for orthopaedic surgical procedures should be cared for using a cognitive impairment bundle. Up to 24% of patients undergoing any orthopaedic procedure experience delirium and its associated cognitive impairment. Patients with a hip fracture are the most vulnerable of the orthopaedic surgery population as the incidence of delirium is the most frequently reported postoperative complication in this group.

References

Bellelli, G., Morandi, A., Davis, D. H., Mazzola, P., Turco, R., Gentile, S., ... MacLullich, A. M. (2014). Validation of the 4AT, a new instrument for rapid delirium screening: A study in 234 hospitalised older people. *Age Ageing*, *43*, 496–502.

Boldt, J. (2010). Use of albumin: An update. *British Journal of Anaesthesia*, *104*, 276–284.

Brown, E., Josephson, S., Anderson, N., Reid, M., Lee, M., & Douglas, V. (2017). Predicting inpatient delirium: The AWOL delirium risk-stratification score in clinical practice. *Geriatric Nursing*, *38*(6), 567–572.

Bruce, A., Ritchie, C., Blizard, R., Lai, R., & Raven, P. (2007). The incidence of delirium associated with orthopaedic surgery: A meta-analytic review. *International Psychogeriatrics*, *19*, 197–214.

Douglas, V. C., Hessler, C. S., Dhaliwal, G., Betjemann, J. P., Fukuda, K. A., Alameddine, L. R., ... Josephson, S. A. (2013). The AWOL tool: Derivation and validation of a delirium prediction rule. *Journal of Hospital Medicine*, *8*(9), 493–499.

Fick, D. M., Inouye, S. K., McDermott, C., Zhou, W., Ngo, L., Gallagher, J., ... Marcantonio, E. R. (2018). Pilot study of a two-step delirium detection protocol administered by certified nursing assistants, physicians, and registered nurses. *Journal of Gerontological Nursing*, *29*, 1–7.

Galanakis, P., Bickel, H., Gradinger, R., Von Gumppenberg, S., & Först, H. (2001). Acute confusional state in the elderly following hip surgery: Incidence, risk factors and complications. *International Journal of Geriatric Psychiatry*, *16*(4), 349–355.

Girard, T. D., Jackson, J. C., Panharipande, P. P., Pun, B. T., Thompson, J. L., Shintani, A. K., ... Ely, E. W. (2010). Delirium as a predictor of long-term cognitive impairment in survivors of critical illness. *Critical Care Medicine*, *38*, 1513–1520.

Guerra, M., Parminder, J, Singh, P., & Taylor, N. (2015). Early mobilization of patients who have had a hip or knee joint replacement reduces length of stay in hospital: A systematic review. *Clinical Rehabilitation*, *29*(9), 844–854.

Guo, Y., Sun, T., Wang, X., Li, S., & Liu, Z. (2014). Cognitive impairment and 1-year outcome in elderly patients with hip fracture. *Medical Science Monitor: International Medical Journal of Experimental and Clinical Research*, *20*, 963–968.

Han, J. H., Wilson, A., Vasilevskis, E. E., Shintani, A., Schnelle, J. F., Dittus, R. S., ... Ely, E. W. (2013). Diagnosing delirium in older emergency department patients: Validity and reliability of the delirium triage screen and the brief confusion assessment method. *Annals of Emergency Medicine*, *62*(5), 457–465.

Han, J. H. (2015). Brief Confusion Assessment Method (bCAM) Instruction Manual I Vanderbilt University School of Medicine; Department of Emergency Medicine Center for Quality Aging. Retrieved from http://eddelirium.org/wp-content/uploads/2016/05/bCAM-Training-Manual-Version-1.0-10-15-2015.pdf

Hunter, K. F., & Cyr, D. (2007). The effect of delirium education on use of target PRN medications in older orthopaedic patients. *Age Ageing*, *36*(1), 98–101.

Inouye, S., van Dyck, C., Alessi, C., Balkin, S., Siegal, A. P., & Horwitz, R. I. (1990). Clarifying confusion: the confusion assessment method. A new method for detection of delirium. *Annals of Internal Medicine*, *113*(12), 941–948.

Leslie, D. L., & Inouye, S. K. (2011), The Importance of delirium: Economic and societal costs. *Journal of the American Geriatrics Society*, *59*, S241–S243. doi:10.1111/j.1532-5415.2011.03671.x

Lou, M. F., Dai, Y. T., Huang, G. S., & Yu, P. J. (2003). Postoperative cognitive changes among older Taiwanese patients. *Journal of Clinical Nursing*, *12*, 579–588.

Maldonado, J. (2017). Pathophysiology, diagnosis, management, and sequelae of delirium. *Critical Care Clinics*, *33*(3), 461–519.

Manly, J. J., Tang, M. X., Schupf, N., Stern, Y., Vonsattel, J. P., & Mayeux, R. (2008). Frequency and course of mild cognitive impairment in a multiethnic community. *Annals of Neurology*, *63*, 494–506.

Marcantonio, E. (2017). *Delirium Assessment: Overview Confusion Assessment Method (CAM)*. Lecture presented at the NIDUS delirium boot camp, Harvard University, Boston, MA.

Marcantonio, E. R., Flacker, J. M., Michaels, M., & Resnick, N. M. (2000). Delirium is independently associated with poor functional recovery after hip fracture. *Journal of the American Geriatrics Society*, *48*, 618–624.

Marcantonio, E. R., Flacker, J. M., Wright, R. J., & Resnick, N. M. J. (2001). Reducing delirium after hip fracture: A randomized trial. *Journal of the American Geriatrics Society*, *49*(5), 516–522.

Marcantonio, E. R., Ngo, L., O'Connor, M. A., Jones, R. N., Crane, P. K., Metzger, E. D., & Inouye, S. K. (2014). 3D-CAM: Validation of a 3-minute diagnostic interview for cam-defined delirium. *Annals of Internal Medicine*, *161*(8), 554–561.

Mayo Clinic. (2018). Mild cognitive impairment (MCI). Retrieved from https://www.mayoclinic.org/diseases-conditions/mild-cognitive-impairment/symptoms-causes/syc-20354578.

Meagher, D. (2001). Delirium: The role of psychiatry. *Advances in Psychiatric Treatment*, *7*(6), 433–442.

Milisen, K., Lemiengre, J., Braes, T., & Foreman, M. (2005). Multi-component intervention strategies for managing delirium in hospitalized older people: Systematic review. *Journal of Advanced Nursing*, *52*, 79–90.

Muehling, B., Schelzig, H., Steffen, P., Meierhenrich, R., Sunder-Plassmann, L., & Orend, K. (2009). A prospective randomized trial comparing traditional and fast-track patient care in elective open infra-renal aneurysm repair. *World Journal of Surgery*, *33*(3), 577–585.

Muller, S., Zalunardo, M. P., Hubner, M., Clavien, P. A., Demartines, N., & Zurich Fast Track Study Group. (2009). A fast-track program reduces complications and length of hospital stay after open colonic surgery. *Gastroenterology*, *136*(3), 842–847.

O'Keeffe, E., Mukhtar, O., & O'Keeffe, S. T.. (2011). Orientation to time as a guide to the presence and severity of cognitive impairment in older hospital patients. *Journal of Neurology, Neurosurgery & Psychiatry*, *82*, 500–504.

Petersen, R. (2011). Mild cognitive impairment. *The New England Journal of Medicine*, *364*(23), 2227–2234.

Petersen, R. C., Lopez, O., Armstrong, M. J., Getchius, T., Ganguli, M., Gloss, D., ... Rae-Grant, A. (2018). Practice guideline update summary: Mild cognitive impairment—Report of the Guideline Development, Dissemination, and Implementation Subcommittee of the American Academy of Neurology. *Neurology. Special Article*, *90*(3), 1–10.

Racine, A. M., Fong, T. G., Gou, Y., Travison, T. G., Tommet, D., Erickson, K., ... Inouye, S. K. (2017). Clinical outcomes in older surgical patients with mild cognitive impairment. *Alzheimer's & Dementia*, *S1552-5260*(17), 33814-1.

Rahkonen, T., Luukkainen-Markkula, R., Paanila, S., Sivenius, J., & Sulkava, R. (2000). Delirium episode as a

sign of undetected dementia among community dwelling elderly subjects: A 2 year follow up study. *Journal of Neurology, Neurosurgery & Psychiatry*, *69*, 519–521.
Resar, R., Griffin, F. A., Haraden, C., & Nolan, T. W. (2012). *Using care bundles to improve health care quality (IHI Innovation Series white article)*. Cambridge, MA: Institute for Healthcare Improvement.
Robertson, B. D., & Robertson, T. J. (2006). *Postoperative delirium after hip fracture*. *The Journal of Bone & Joint Surgery (American)*, *88*(9), 2060–2068.
Rockwood, K., Cosway, S., Carver, D., Jarrett, P., Stadnyk, K., & Fisk, J. (1999). The risk of dementia and death after delirium. *Age Ageing*, *28*, 551–556.
Rudolph, J. L., & Marcantonio, E. R. (2011). Postoperative delirium: Acute change with long-term implications. *Anesthesia & Analgesia*, *112*(5), 1202–1211.
Schweickert, W. D., Pohlman, M. C., Pohlman, A. S., Nigos, C., Pawlik, A. J., Esbrook, C. L., ... Kress, J. P. (2009). Early physical and occupational therapy in mechanically ventilated, critically ill patients: A randomized controlled trial. *The Lancet*, *373*(9678), 1874–1882.
Tanner, J., Padley, W., Assadian, O., Leaper, D., Kiernan, M., & Edmiston, C. (2015). Do surgical care bundles reduce the risk of surgical site infections in patients undergoing colorectal surgery? A systematic review and cohort meta-analysis of 8,515 patients. *Surgery*, *15*(1), 66–77.
van Meenen, L. C. C., van Meenen, D. M. P., de Rooij, S. E., & ter Riet, G. (2014). Risk prediction models for postoperative delirium: A systematic review and meta-analysis. *Journal of the American Geriatrics Society*, *62*(12), 2383–2390.
Wang, L.-H., Xu, D.-J., Wei, X.-J., Chang, H.-T., & Xu, G.-H. (2016). Electrolyte disorders and aging: Risk factors for delirium in patients undergoing orthopaedic surgeries. *BMC Psychiatry*, *16*, 418.
Wei, L. A., Fearing, M. A., Sternberg, E. J., & Inouye, S. K. (2008). The Confusion Assessment Method (CAM): A systematic review of current usage. *Journal of the American Geriatrics Society*, *56*(5), 823–830.
World Health Organization. *Health topics: Risk factors, para 1*. Retrieved September 12, 2012 from: https://www.who.int/topics/risk_factors/en/

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