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Delirium screening and management in inpatient rehabilitation facilities

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Abstract

Delirium is an acute and fluctuating disturbance in cognition attention, and awareness that is often a reflection of abnormal physiological condition of an individual. Delirium is highly prevalent among an older population and is associated with high mortality, poor medical and functional outcomes and high healthcare cost. Delirium often has iatrogenic triggers and it has been recognized as a quality indicator of healthcare organizations. In spite of its high prevalence and significance, more than 50% of the delirium cases are underrecognized by healthcare professionals and remained untreated. Majority of patients in inpatient rehabilitation facilities are older adults with multiple risk factors for delirium including operation, intensive care stay, multiple comorbidities, and impaired mobility. Early detection, intervention as well as primary prevention of delirium will allow patients to avoid additional morbidities and reach their maximum functional potential during their rehabilitation stay. After the systematic implementation of delirium screening in our inpatient rehabilitation facility, we found that 10.3% of patients were screened positive for delirium at admission. This review discusses the systematic implementation of screening and intervention for delirium as well as the epidemiology of delirium to increase the awareness and guide clinical practice for clinicians in inpatient rehabilitation facilities.

Keywords

Delirium; Rehabilitation; Aging; Dissemination of information

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Introduction

Delirium is an acute decline in cognitive functioning manifested in fluctuating symptoms of inattention, disorganized thinking, and altered level of consciousness.[1] Delirium is the leading complication in hospitalized older adults, with prevalence of 18–64%, depending on the clinical setting.[1] Since delirium is often iatrogenic, delirium serves as an important indicator of healthcare quality for older hospitalized individuals. The Agency for Healthcare Research and Quality (AHRQ) National Quality Measures Clearinghouse of the United States includes delirium screening as a measure for healthcare quality and provides the summary of intervention guidelines.

The clinical population in the inpatient rehabilitation facility (IRF) setting is at a high risk for delirium due to multiple predisposing and precipitating factors including older age, immobilization, multiple medications, and postoperative or post-intensive care status.[1] Associated with mortality, morbidity, and functional decline, delirium increases healthcare costs 2.5 times with the estimated cost burden of up to $152 billion annually.[2] A bulk of this cost, over $100 billion per year, accrues after the discharge from the acute hospitalization including rehabilitation services, home health care, and skilled nursing facilities.[2,3] The literature often reports the care burden in post-acute care settings combining IRFs and skilled nursing facilities; however, several reports describe the burden specific to IRFs. One study demonstrated that the simultaneous presence of both delirium and dementia doubled mortality at 12 months after discharge from a post-acute rehabilitation facility.[4] Another study found that delirium was present in approximately one third of stroke survivors admitted to a rehabilitation unit, and predicted in-hospital death and further institutionalization.[5] Moreover, delirium is associated with prolonged rehabilitation services[6] and an increased risk of in-hospital falls. In spite of high prevalence of delirium and its negative impact on the patient outcomes and the cost, the implementation of proper screening and management of delirium in IRFs has been suboptimum. The purpose of this report is to provide an updated review in order to increase the awareness of delirium, provide implementation strategies of delirium screening, and suggest practical guidance to clinicians in IRF settings.

Definition and Types of Delirium

Delirium is a clinical diagnosis entirely based on behavioral symptoms, and there are no laboratory or imaging studies that can confirm the diagnosis. Delirium typically reflects the pathophysiological consequences of an acute medical illness or medication effects. Therefore, it should be perceived as a *warning sign* of potential health issues to clinicians and caregivers at all care settings. The Diagnostic and Statistical Manual of Mental Disorders (DSM-5) provides this set of diagnostic criteria for delirium: 1) a disturbance in attention (i.e. reduced ability to direct, focus, sustain, and shift attention) and awareness; 2) the disturbance develops over a short period (usually hours to days) and tends to fluctuate during the course of the day; 3) an additional disturbance in cognition (e.g. memory deficit, disorientation, language disturbance, perceptual disturbance); 4) the disturbances in cognition mentioned above are not better accounted for by a preexisting, established, or evolving neurocognitive disorder and do not occur in the context of a severely reduced level

of arousal such as coma; 5) there is evidence from the history, physical examination, or laboratory findings that the disturbance is caused by a direct physiologic consequence of a general medical condition, an intoxicating substance, medication use, or multiple etiologies.[7] Other commonly described presentations of delirium include irregular sleep-wake cycle, psychomotor disturbance (hypo- or hyper-activity), inappropriate behavior, and emotional lability.[1]

The DSM-5 classifies three subtypes of delirium: hyperactive, hypoactive, and mixed delirium. Hyperactive delirium is defined by increased motor activity, loss of control, and restlessness. Hypoactive delirium is defined by decreased activity, decreased speech, and reduced awareness.[7] Hypoactive delirium is more common and tends to be more frequently underrecognized than hyperactive delirium. Patients with rapidly fluctuating levels of hyper- and hypoactivity are classified as the mixed type. It is important to differentiate the subtypes of delirium because they are associated with different outcomes including mortality. In general, hypoactive delirium is reported to have a relatively poor prognosis compared to hyperactive delirium. The differential association between hypoactive delirium and poor outcomes may be explained by under-detection and underlying medical issues (hypoxia, metabolic disturbance, organ failure). However, among individuals with hip fractures, pure hyperactive delirium showed worse prognosis than hypoactive type possibly due to higher severity and oversedation leading to cascade of adverse events.[8] The inconsistency of outcome in the literature may result from various screening methods, classification of delirium subtypes, and patient populations.

In addition to the three types of delirium, recent research has emphasized subsyndromal delirium defined as the presence of one or more symptoms of delirium, but not meeting the DSM-5 diagnostic criteria for delirium.[9] Subsyndromal delirium has drawn the attention of clinicians due to the high prevalence of 23% among hospitalized older adults, with the same set of risk factors and similarly poor outcomes compared to the DSM-5 defined delirium.

Delirium, dementia, and depression are common mental disturbances among older adults in IRFs. Both dementia and depression are risk factors for delirium,[1] and delirium may be superimposed on the other diagnoses. The inattention and fluctuating course of cognitive disturbance are considered as cardinal features which distinguish delirium from dementia. Subdural hematoma also commonly occurs among older adults even without reported trauma especially among those on anticoagulation. The characteristics of these diagnoses are summarized in Table 1.[10] For the patients who present with hallucination and delusions particularly with the history of psychiatric illness, psychosis is to be considered as a differential diagnosis. However, late-life onset of psychiatric illness is rare, and such psychotic symptoms are likely due to medical causes.[11]

Epidemiology of Delirium

The incidence of delirium varies greatly depending on the care settings and patient population. The highest incidence rates were reported in the intensive care unit and postoperative care settings. One systematic review showed that delirium may persist with 44.7% of patients at discharge from acute care hospital, 32.8%, 25.6%, and 21% at one,

three, and six months afterwards respectively.[12] In IRFs, delirium present at admission is of relatively great concern to clinicians since newly developing delirium appears to be less common than acute care hospital. The overall prevalence of delirium in IRFs is reported as approximately 10% to 16.3% which is consistent with our finding described in the section of implementation of delirium screening.[13,14] However, the prevalence varies based on the primary diagnosis. Stroke patients have a delirium prevalence of 33% upon admission to an IRF.[15] Eighty-nine % of patients with stupor or coma after trauma may progress to delirium which may be seen in an IRF setting. For the population with hip fractures, 41% of the patients develop delirium during acute hospitalization, and 39% of them have persistent delirium upon discharge, 32% after a month post-discharge, and 6% after 6 months[16] (Table 2).

Delirium results from complex interactions among multiple predisposing and precipitating factors (Table 3).[1,13] Predisposing factors are unmodifiable and set baseline vulnerability for an individual. Precipitating factors trigger the development of delirium and are often modifiable. Advanced age is the main predisposing factor due to reduced cholinergic reserve in the aging brain and a high prevalence of underlying cognitive impairment with aging.[1,10] For trauma patients, the delirium risk increases by 10% for one year increase in age among patients older than 50 years.[17] Dementia is also a main predisposing factor, and the risk of delirium is three to six times higher among individuals with dementia compared to those without dementia. Medications are the most common cause of reversible delirium and specific medications that can trigger delirium is listed in Table 4. Other modifiable risk factors relevant to rehabilitation include prolonged time to ambulate for patients with hip fractures and prolonged days of deep sedation, mechanical ventilation, and physical retrain in trauma patients.

Impact of Delirium on Healthcare Cost

Associated with mortality, morbidity, and functional decline, delirium increases healthcare costs 2.5 times, according to Leslie et al.'s study focused on the US health care systems between 1995 and 1998.[2] These authors estimated that the national cost burden of delirium is $38 to $152 billion annually. The costs after hospital discharge may be even higher now in 2018, given that Americans have a longer life span than decades ago, and many receive healthcare in hospital settings, post-acute rehabilitation services, home care, and informal caregiving from relatives. In IRFs, patients with delirium stay approximately 6 days longer than those without delirium.[13] The main cost factors during hospitalization are personnel expenditure and increased length of stay.[18] There have been a number of studies reporting that systematic implementation of delirium screening, prevention, and intervention programs can reduce cost, fall risks, and pressure injuries in various care settings.[3,19,20] For example, a recent meta-analysis showed that multicomponent delirium prevention and intervention reduced delirium incidence by 44%, fall rate by 64%, length of stay by up to 0.33 day, resulting in potential Medicare cost savings of approximately $16 billion per year.[20]

Pathophysiology of Delirium

Although pathophysiology of delirium is not fully elucidated, delirium is understood as a neurobehavioral syndrome caused by an alteration in neurotransmitter synthesis, function, availability, dysregulation of neuronal activity, increased peripheral and systemic inflammatory cytokines, acute stress response, and direct neuronal injury.[10] The most commonly implicated alterations in neurotransmitters are deficiencies in acetylcholine and melatonin availability, excess in dopamine and norepinephrine, glutamate. Medications (e.g. anticholinergic drugs, antiparkinsonian drugs), inflammation, and acute stress responses can all contribute to disruption of neurotransmission.[10] Peripherally secreted cytokines may trigger exaggerated response from microglia causing severe inflammation in the brain. In addition, trauma, surgery, or infection can lead to systemic inflammation. These proinflammatory cytokines may disrupt neuronal communication or have a direct neurotoxic effect. An increased cortisol level in response to acute illness and direct neuronal injury by metabolic or ischemic insults may also predispose older adults to delirium.[10]

In addition to these insults, in stroke survivors, certain focal lesions may increase delirium risk by disrupting large-scale neural networks supporting attention, orientation, and arousal.[21] Unilateral right-brain strokes double the risk of delirium compared to left-sided strokes.[22] The high risk of delirium in this patient population may be related to right brain dominance for spatial attention and action, as suggested by the prevalence of spatial attention disorders after right-brain stroke.[23] Lesions of the frontal and parietal components of the attention network and of the surrounding white matter were found in several studies of delirium. For example, hypoactive delirium is associated with right inferior and middle frontal lesions after stroke,[24] and overall delirium status is linked to right parietal subcortical white matter lesions in patients with hemorrhagic stroke.[25] Considering that attention impairment is one of the prototypical features of delirium, it is not surprising that patients with abnormalities in the attention network are more likely to experience delirium. Similarly, the arousal network, comprised of ascending projections from the midbrain nuclei to subcortical structures including basal forebrain and the thalamus, likely plays an important role in delirium. In a functional neuroimaging study of monitoring patients during and after an episode of delirium, delirious patients compared to healthy controls had an acute reversible disruption of functional connectivity between intralaminar thalamic nuclei and the basal forebrain.[26] In the same study, structural integrity, as measured using diffusion tensor imaging, of the thalamus and the basal forebrain was also predictive of post-surgical delirium status. Therefore, lesions in the right frontal, parietal, or subcortical structures may signal patient vulnerability to delirium.

Diagnostic and Screening Tools

The diagnosis of delirium is made based on the medical history, behavioral observation, and cognitive assessment.[10] Patient's history should confirm that there has been a change from the baseline in the cognitive status. It is critical to exclude other neurological diagnoses. Focal neurological deficits should be taken seriously as evidence of a potential acute neurological events. Formal psychiatric consultation and diagnosis based on DSM-5 may serve as a gold standard, but this approach may not be a practical method of screening for

individuals at risk. Considering the multiple predisposing and precipitating factors among patients in IRFs, and cognitive evaluation being one of the key rehabilitation procedures, it is ideal to incorporate a validated screening tool for delirium as a part of the clinical assessment at IRF admission.

There are a number of validated and reliable tools available for delirium screening. The Confusion Assessment Method (CAM) provides a concise diagnostic algorithm widely used in various care settings.[27] The positive diagnosis using the CAM is based on the presence of two essential features (inattention and fluctuating course) in addition to one of the two features (e.g., disorganized thinking or an alerted level of consciousness).[10] Compared to the gold standard psychiatric consultation, the CAM showed a sensitivity of 94–100%, a specificity of 90–95%.[27] Administering the CAM requires specific training, and assessment and scoring instructions are available online.[28] The 3-Minute Diagnostic Interview for Confusion Assessment Method (3D-CAM) includes 22 questions (the last two are optional) with scripted instructions (reference website is listed in the addendum). The sensitivity, specificity, and inter-rater agreement of the 3D-CAM are 95%, 94% and 95%, respectively.[29] Other screening tools include a 16-item scale of Delirium Rating Scale (DRS-R98), Memorial Delirium Assessment Scale (MDAS), and Delirium Symptom Interview (DSI). Since the severity of delirium is also an important outcome predictor, quantifying the severity is useful to guide clinical management. These scales include CAM-S (Severity) long and short forms, Confusion Rating Scale, Delirium Assessment Scale, and Delirium Rating Scale. The reference for these tools is available on the addendum.

Implementing Delirium Screening in Inpatient Rehabilitation Facilities

Potential challenges in implementing delirium screening

Many have advocated for routine screening for delirium in IRFs.[30] However, the majority of patients with delirium are undiagnosed, and because they have not been identified, they receive no delirium-specific interventions.[1] A lack of screening may be accounted for by the following reasons: 1) a perceived difficulty using a delirium screening tool or negative beliefs about older people such as assuming that mental confusion is normal in older adults among clinicians. 2) system-level limitations including time constraints in care provision and frequent staff turnover. 3) suboptimal coordination of priorities within the care team leads to suboptimal support by physician and multidisciplinary leadership, 4) ineffective communication among healthcare team members, and 5) inadequate tracking mechanism that fails to summarize or evaluate the impact of delirium-specific care.[31]

Given the obstacles identified in the literature, we developed a process to implement delirium screening and reported in this article to share our experience in overcoming specific challenges and barriers in an IRF setting. This is a stakeholder-initiated project that intends to change clinicians' behavior for the goals of improving quality of care and improving patients' outcome.

Implementation Process

Delirium Care Task Force and Framework of Implementation—The idea of delirium screening was initiated in 2013 from the perspective of quality improvement and the operational need. During an internal quarterly review of quality outcome indicators, our clinical teams identified change in mental status as the leading cause for a patient being transferred to acute care hospitals. Therefore, it became essential for clinical team to identify the reversible causes of mental status change and potentially avoid unnecessary transfer of patients to acute care hospitals. This fact drove the establishment of the Kessler Institute for Rehabilitation's Delirium Care Task Force (the Task Force), consisting of five key members: a physiatrist (the Chair of the Task Force, who had expertise in geriatric rehabilitation and neurorehabilitation), the medical director (expertise in patient safety and care quality), a clinical research coordinator (who was an occupational therapist by training), a night-shift nurse manager (a certified rehabilitation nurse), and a rehabilitation science researcher (in brain injury medicine and neurorehabilitation).

The Task Force built 3 systems, each comprises a specific personnel, based on the Interactive Systems Framework For Quality Implementation (Figure 1).[32] The Synthesis & Translation System leads the project through distilling published evidence and developing a context-specific program that can be implemented in the IRF setting. The Delivery System consists of frontline clinicians (nurses, therapists, physicians) who carry out the actual administration of screening tool (i.e., the 3D CAM) and provide feedback to the Synthesis & Translation System. The Support System provides resources to the other systems to ensure high quality implementation including administrative support for training of clinicians and tracking the implementation results.

Selecting the Instrument and Establishing the Care Procedure—At the outset, members of the Task Force (i.e., the authors of this manuscript) set the major goal of the project to establish a delirium screening process as part of routine patient care, following the strategic planning and process of implementation of delirium screening (Figure 2). As a stakeholder-initiated project, the Task Force engaged frontline clinicians, admitting nurses in particular, in the selection of the screening tool feasible for the IRF. A recent review conducted by De and Wand found that the CAM was the most widely used instrument for delirium screening in mixed inpatient settings. Thus, we attended educational courses and training at the Center of Excellence for Delirium in Aging: Research, Training, and Educational Enhancement program (CEDARTREE) Boston, MA (NIH, grant K07AG041835) obtaining the goldstandard evaluator status in using the CAM. During the period of our staff training, the 3D-CAM was published,[29] and we transitioned to use the 3D-CAM in January, 2015 based on the feedback from nursing staff.

In addition, the Task Force established a procedure for delirium screening and follow-up actions including three steps (Figure 3): 1) All patients would be screened at admission, and the result would be documented by the admitting nurse. 2) Patients with delirium would continue to be screened daily by nurses or therapists until the patients were clear of delirium for two consecutive days, or until the attending physician decided that the assessment was no longer necessary, with follow-up delirium assessment results documented in either the daily

nursing or therapy notes. 3) Attending physicians would be notified about the delirium screening result, and patient delirium status would be discussed during multi-disciplinary team meetings.

Staff Training—The Task Force organized trainings for staff of all disciplines to participate in educational sessions and learn the procedure laid out in Figure 3. During the 45–60 minute educational sessions, members of the Task Force and clinician champions lectured on the need for delirium care, facilitated discussions on exemplary cases, and addressed the need of inter-disciplinary communication using the existing documentation system (e.g., nursing notes, and team meeting records). All training of 3D-CAM administration was performed separately based on the training manual (reference website is available in the addendum).

Results of the Taskforce's Evaluation of Implementation and Exploration of Delirium—We randomly audited medical records of 424 admissions over three months. There was only one admission missing the document of the 3D-CAM and 8 with unscorable 3D-CAM results. The reasons for unscorable 3D-CAM included global aphasia (n = 5), reduced level of consciousness (n = 1), severe agitation (n = 1), and language barrier (n = 1). After excluding 16 readmissions and 8 unscorable cases, we had 399 patients screened for delirium at their first admissions and 41 out of 399 (10.3%) were scored 3D-CAM positive for delirium. Patients with brain disorders have higher prevalence of delirium at admission compared to those with orthopedic conditions (17.4% vs 3.7%). Twenty-one % of patients with delirium at admission were transferred back to acute care hospitals compared to 6% of individuals without delirium.

Currently, intervention and prevention of delirium is being implemented in the IRF with promising quality outcomes such as reduced rates of transfers to acute care hospitals by approximately 30%. The mainstay of intervention and prevention is elaborated in the next section.

Workup and Intervention for Patients with Delirium

There are number of clinical practice guidelines and recommendations available from the American Geriatrics Society, AHRQ, British Geriatric Society, and National Institute for Health and Care Excellence (NICE) (resource websites are listed in the addendum). The Joint Commission offers Disease-Specific Certification in Geriatric Delirium. These guidelines universally emphasize early screening, a non-pharmacological multi-component approach, collaboration among the patient, patient's family, and the inter-professional care team. It is strongly recommended that healthcare systems and hospitals should implement formal educational programs, with ongoing formal and informal sessions for healthcare professionals on delirium.

Prevention of medical complications, identifying for the underlying etiologies, and managing delirium symptoms are the main stay of the delirium treatment.[1] Patients with delirium are at risk of further medical complications including aspiration, dehydration, malnutrition, pressure injuries, and falls. Therefore, preventive measures should be implemented to minimize these complications (e.g., oral care, hydration, swallowing

evaluation). Use of restraints and bed alarms are discouraged, since they increase the risk of prolonging delirium and precipitating injuries.

Identification of the Underlying Etiologies—Once a patient is given a diagnosis or suspicion of delirium, medical workup for underlying etiologies should be initiated considering the poor outcomes and minimal risk associated with interventions.[1] Patients should be screened for acute metabolic disturbance (e.g. hypoxemia, hypoglycemia, hypercarbia) and acute medical event (e.g. myocardial infarction) if clinically indicated. Patients also need to be evaluated for poor pain relief, constipation, incontinence, and sleep quality. Laboratory testing and neuroimaging should be targeted based on the history and physical examination. The role of neuroimaging is very limited in patients with confusion without other neurological deficits.[33] The guidelines for neuroimaging make specific recommendations against the routine use of CT brain scanning except those with history of recent falls, head injury, fever with suspicion of encephalitis, decreased level of consciousness with no identified etiology, or focal neurological signs.

Since medication is a leading cause of delirium which can be reversible, prescribers should avoid "deliriant" medications which may trigger delirium. The list of deliriants are summarized in Table 4. Our previous study showed that 75% of the patients screened positive for delirium at admission to the IRF were prescribed at least one of the deliriants from acute care hospital, and 50% and 25% were prescribed at least two and three medications respectively.[34] For patients with postoperative delirium, suboptimal pain control increases the risk of delirium. It is well known that opioid medications can trigger delirium, yet, the evidence for prescribing nonopioid alternatives to reduce delirium is not compelling.[35] A recent case report showed that a lidocaine patch applied locally triggered delirium in older patient admitted to an IRF and delirium was subsequently reversed by discontinuation of the patch.[36]

The workup and intervention protocol in our institution was published previously.[36] We found medications, dehydration, and infections as common causes for delirium. Once delirium diagnosis is established, clinicians at our organization first review medications focusing on deliriants and clinical evaluation of dehydration, dysphagia, and silent aspiration pneumonia. The rest of the workup is continued afterwards based on clinical suspicion. The reversal of delirium depends on the duration and severity of the symptoms, underlying cognitive impairment, and general health of the patient.

Nonpharmacological Intervention—Nonpharmacological approaches including behavioral intervention are the mainstay of delirium management (Table 5), including hydration, nonpharmacologic approaches to sleep, creating a quiet and comfortable environment, and providing optimal pain relief.[1] As it was emphasized in clinical practice guidelines (listed in the addendum), earning the buy-in from multiple disciplines of healthcare professionals and family members via formal and informal education is prerequisite for successful intervention. Delirium does not only affect patients, but also affects their families, who are usually not well informed about the sudden mental change that their loved ones are experiencing. Furthermore, families are usually not well-prepared to cope with the consequences of delirium.[37] Thus, it is crucial that a care procedure for

delirium, including patient and family education, is implemented in clinical practices. With proper education about delirium, family members and caregivers often do an excellent job in reorienting patients using familiar items such as family photos or talking about specific upcoming events for the patients and their family. The resources for family education is listed in addendum. For patients with impaired sensory functions, they should have proper devices, such as hearing aids or glasses, for optimal interaction with family members and the care team. Mobilization of patients is often taken granted at IRFs settings; however, educated family members can increase the mobilization time with safety instructions provided by therapists. Sleep quality may improve with maintaining a quiet and calm environment at night by adjusting time of the lab work, medication administration, and the rounds.

Prevention of delirium using nonpharmacological approach—Primary prevention for the individuals at risk of developing delirium has shown to be the most effective strategy to minimize delirium in various healthcare settings.[1] The Hospital Elder Life Program (HELP) is a model of care targeting the modifiable risk factors by orientation, therapeutic activities, early mobilization, vision and hearing protocols, oral volume repletion, and sleep enhancement. The estimated savings in healthcare cost per patient on the HELP are approximately $9,000 per year.[1] In spite of improving quality of care and cost savings, sustainability of a delirium prevention program can be challenging. Successful implementation depends on gaining support from the leadership and frontline clinicians, creating champions in multiple disciplines, maintaining evidence-based practice, documenting and sharing positive outcomes among stakeholders, and obtaining long-term funding and resources.

Pharmacological Intervention—Currently, there is no medication approved by The Food and Drug Administration (FDA) for prevention and treatment for delirium. Pharmacologic management should be reserved for patients with severe agitation and threatening substantial harm to self and/or others, if behavioral interventions have failed or are not possible.[1] For these patients, the lowest effective dose of antipsychotics for the shortest duration may be used. Haloperidol is the most widely used and studied agent for its suggested benefit in reducing symptom severity and duration. For hypoactive type of postoperative delirium, use of antipsychotic or benzodiazepine medications is not recommended.[35]

Future Directions

Delirium is a challenging condition to the healthcare providers as it leads to poor outcomes and increases healthcare costs in the all healthcare settings. Although the vast majority of patients in IRFs have multiple risk factors of delirium including old age, immobility, high comorbidities, and brain conditions, the identification, intervention, and prevention of delirium in IRFs is suboptimal. Valid and reliable screening methods and interventions for delirium are available and can be implemented at IRF settings. Implementing a new care procedure requires leadership support for institutional priority, negotiating and developing shared understandings among clinicians about the beliefs, risks, and advantages of the new methods over the old approach.[38] For the sustainability of delirium intervention in IRF

settings, future research should include cost-effectiveness examination. In addition, further research is also needed for characterization of patients with delirium of different subtypes, understanding the underlying medical and neural mechanisms of delirium, and investigating the effectiveness of interventions utilizing IRF specific tools (e.g., body supported treadmill training as mobilization tool).

Supplementary Material

Refer to Web version on PubMed Central for supplementary material.

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References

1. Inouye SK, Westendorp RG, Saczynski JS. Delirium in elderly people. Lancet. 2014; 383:911–22. [PubMed: 23992774]
2. Leslie DL, Marcantonio ER, Zhang Y, et al. One-year health care costs associated with delirium in the elderly population. Arch Intern Med. 2008; 168:27–32. [PubMed: 18195192]
3. Rubin FH, Neal K, Fenlon K, et al. Sustainability and scalability of the hospital elder life program at a community hospital. J Am Geriatr Soc. 2011; 59:359–65. [PubMed: 21314654]
4. Bellelli G, Frisoni GB, Turco R, et al. Delirium superimposed on dementia predicts 12-month survival in elderly patients discharged from a postacute rehabilitation facility. J Gerontol A Biol Sci Med Sci. 2007; 62:1306–9. [PubMed: 18000153]
5. Turco R, Bellelli G, Morandi A, et al. The effect of poststroke delirium on short-term outcomes of elderly patients undergoing rehabilitation. J Geriatr Psychiatry Neurol. 2013; 26:63–8. [PubMed: 23504308]
6. Saczynski JS, Marcantonio ER, Quach L, et al. Cognitive trajectories after postoperative delirium. N Engl J Med. 2012; 367:30–9. [PubMed: 22762316]
7. Diagnostic and Statistical Manual of Mental Disorders. 5. Washington DC: American Psychiatric Press; 2013.
8. Marcantonio E, Ta T, Duthie E, et al. Delirium severity and psychomotor types: their relationship with outcomes after hip fracture repair. J Am Geriatr Soc. 2002; 50:850–7. [PubMed: 12028171]
9. Cole MG, Ciampi A, Belzile E, et al. Subsyndromal delirium in older people: a systematic review of frequency, risk factors, course and outcomes. Int J Geriatr Psychiatry. 2013; 28:771–80. [PubMed: 23124811]
10. Fong TG, Tulebaev SR, Inouye SK. Delirium in elderly adults: diagnosis, prevention and treatment. Nature reviews Neurology. 2009; 5:210–20. [PubMed: 19347026]
11. Oldham MA, Flanagan NM, Khan A, et al. Responding to Ten Common Delirium Misconceptions With Best Evidence: An Educational Review for Clinicians. J Neuropsychiatry Clin Neurosci. 2018; 30:51–7. [PubMed: 28876970]
12. Cole MG, Ciampi A, Belzile E, et al. Persistent delirium in older hospital patients: a systematic review of frequency and prognosis. Age Ageing. 2009; 38:19–26. [PubMed: 19017678]
13. Jang S, Jung KI, Yoo WK, et al. Correction: Risk Factors for Delirium During Acute and Subacute States of Various Disorders in Patients Admitted to Rehabilitation Units. Annals of rehabilitation medicine. 2017; 41:168. [PubMed: 28289652]

14. Stelmokas J, Gabel N, Flaherty JM, et al. Delirium Detection and Impact of Comorbid Health Conditions in a Post-Acute Rehabilitation Hospital Setting. PLoS One. 2016; 11:e0166754. [PubMed: 27902744]
15. Turco R, Bellelli G, Morandi A, et al. The effect of poststroke delirium on short-term outcomes of elderly patients undergoing rehabilitation. J Geriatr Psychiatry Neurol. 2013; 26:63–8. [PubMed: 23504308]
16. Marcantonio ER, Flacker JM, Michaels M, et al. Delirium is independently associated with poor functional recovery after hip fracture. J Am Geriatr Soc. 2000; 48:618–24. [PubMed: 10855596]
17. Bryczkowski SB, Lopreiato MC, Yonclas PP, et al. Risk factors for delirium in older trauma patients admitted to the surgical intensive care unit. J Trauma Acute Care Surg. 2014; 77:944–51. [PubMed: 25248058]
18. Weinrebe W, Johannsdottir E, Karaman M, et al. What does delirium cost? An economic evaluation of hyperactive delirium. Z Gerontol Geriatr. 2016; 49:52–8. [PubMed: 25801513]
19. Chen CC, Li HC, Liang JT, et al. Effect of a Modified Hospital Elder Life Program on Delirium and Length of Hospital Stay in Patients Undergoing Abdominal Surgery: A Cluster Randomized Clinical Trial. JAMA surgery. 2017; 152:827–34. [PubMed: 28538964]
20. Hshieh TT, Yue J, Oh E, et al. Effectiveness of multicomponent nonpharmacological delirium interventions: a meta-analysis. JAMA Intern Med. 2015; 175:512–20. [PubMed: 25643002]
21. Boukrina O, Barrett AM. Disruption of the ascending arousal system and cortical attention networks in post-stroke delirium and spatial neglect. Neurosci Biobehav Rev. 2017; 83:1–10. [PubMed: 28963037]
22. Kostalova M, Bednarik J, Mitasova A, et al. Towards a predictive model for post-stroke delirium. Brain Inj. 2012; 26:962–71. [PubMed: 22571183]
23. Chen P, Chen CC, Hreha K, et al. Kessler Foundation Neglect Assessment Process uniquely measures spatial neglect during activities of daily living. Arch Phys Med Rehabil. 2015; 96:869–76. e1. [PubMed: 25461827]
24. Mori E, Yamadori A. Acute confusional state and acute agitated delirium. Occurrence after infarction in the right middle cerebral artery territory. Arch Neurol. 1987; 44:1139–43. [PubMed: 3675246]
25. Naidech AM, Polnaszek KL, Berman MD, et al. Hematoma Locations Predicting Delirium Symptoms After Intracerebral Hemorrhage. Neurocritical care. 2016; 24:397–403. [PubMed: 26503511]
26. Choi SH, Lee H, Chung TS, et al. Neural network functional connectivity during and after an episode of delirium. AJ Psychiatry. 2012; 169:498–507.
27. Inouye SK, van Dyck CH, Alessi CA, et al. Clarifying confusion: the confusion assessment method. A new method for detection of delirium. Ann Intern Med. 1990; 113:941–8. [PubMed: 2240918]
28. Inouye SK. The Confusion Assessment Method (CAM): Training Manual and Coding Guide. Boston: Hospital Elder Life Problem; 2003.
29. Marcantonio ER, Ngo LH, O'Connor M, et al. 3D-CAM: derivation and validation of a 3-minute diagnostic interview for CAM-defined delirium: a cross-sectional diagnostic test study. Ann Intern Med. 2014; 161:554–61. [PubMed: 25329203]
30. Kean J, Trzepacz PT, Murray LL, et al. Initial validation of a brief provisional diagnostic scale for delirium. Brain Inj. 2010; 24:1222–30. [PubMed: 20645705]
31. Brummel NE, Vasilevskis EE, Han JH, et al. Implementing delirium screening in the ICU: secrets to success. Crit Care Med. 2013; 41:2196–208. [PubMed: 23896832]
32. Wandersman A, Duffy J, Flaspohler P, et al. Bridging the gap between prevention research and practice: the interactive systems framework for dissemination and implementation. Am J Community Psychol. 2008; 41:171–81. [PubMed: 18302018]
33. Hufschmidt A, Shabarin V. Diagnostic yield of cerebral imaging in patients with acute confusion. Acta Neurol Scand. 2008; 118:245–50. [PubMed: 18336626]
34. Dabaghian L, Yonclas PP, Seidel B, et al. Poster 30 Use of Delirium Triggering Medications Among Patients with Delirium at Admission to Inpatient Rehabilitation Facility. PM R. 2016; 8:S170.

35. https://geriatricscareonline.org/Home
36. Byun EK, Berry KM, Lee A, et al. Delirium Associated With Lidocaine Patch Administration: A Case Presentation. PM R. 2016; 8:597–601. [PubMed: 26772419]
37. Toye C, Matthews A, Hill A, et al. Experiences, understandings and support needs of family carers of older patients with delirium: a descriptive mixed methods study in a hospital delirium unit. Int J Older People Nurs. 2014; 9:200–8. [PubMed: 23383980]
38. Kitson A, Harvey G, McCormack B. Enabling the implementation of evidence based practice: a conceptual framework. Qual Health Care. 1998; 7:149–58. [PubMed: 10185141]

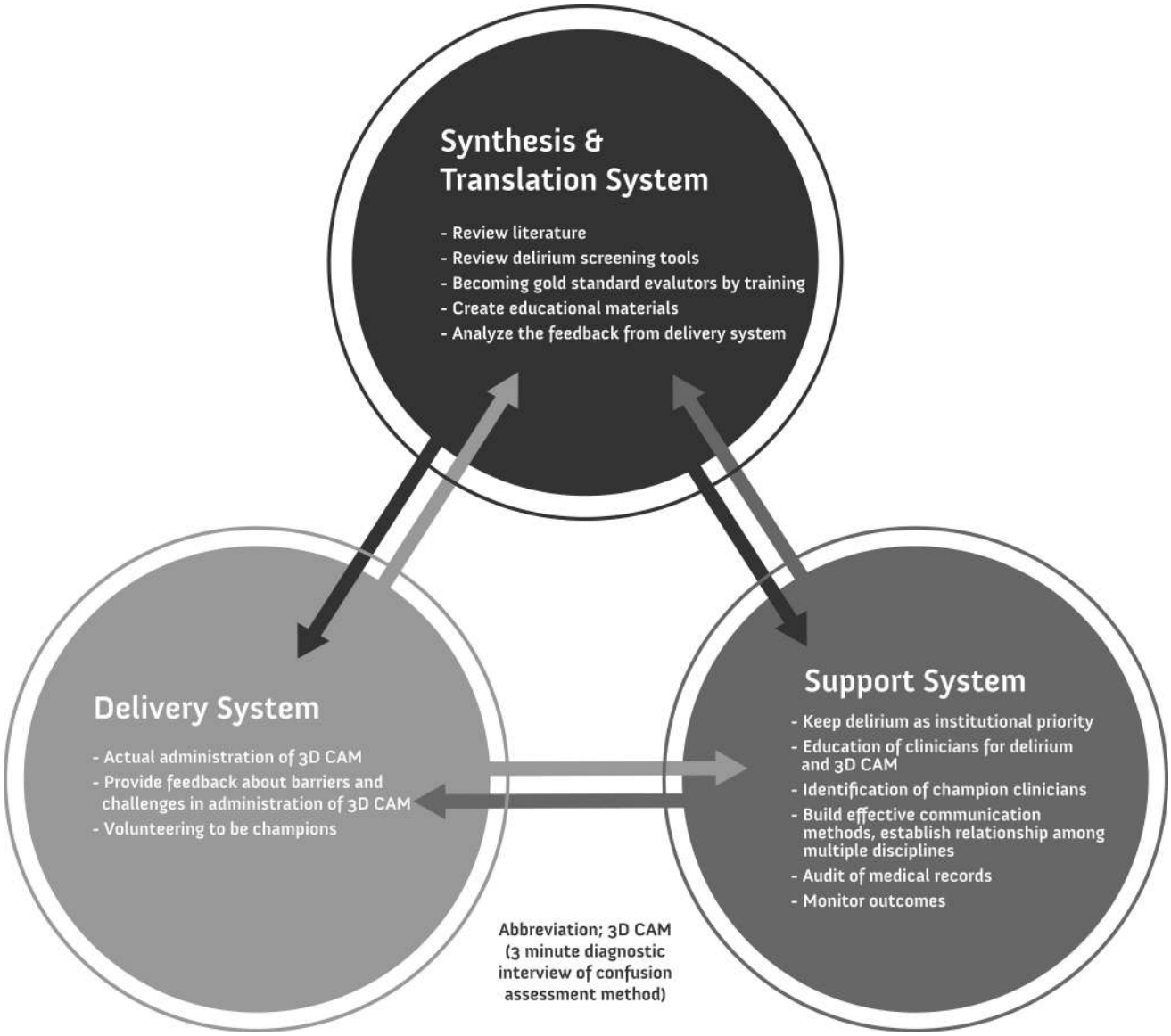

Figure 1.
Three Systems of Implementing Delirium Screening.

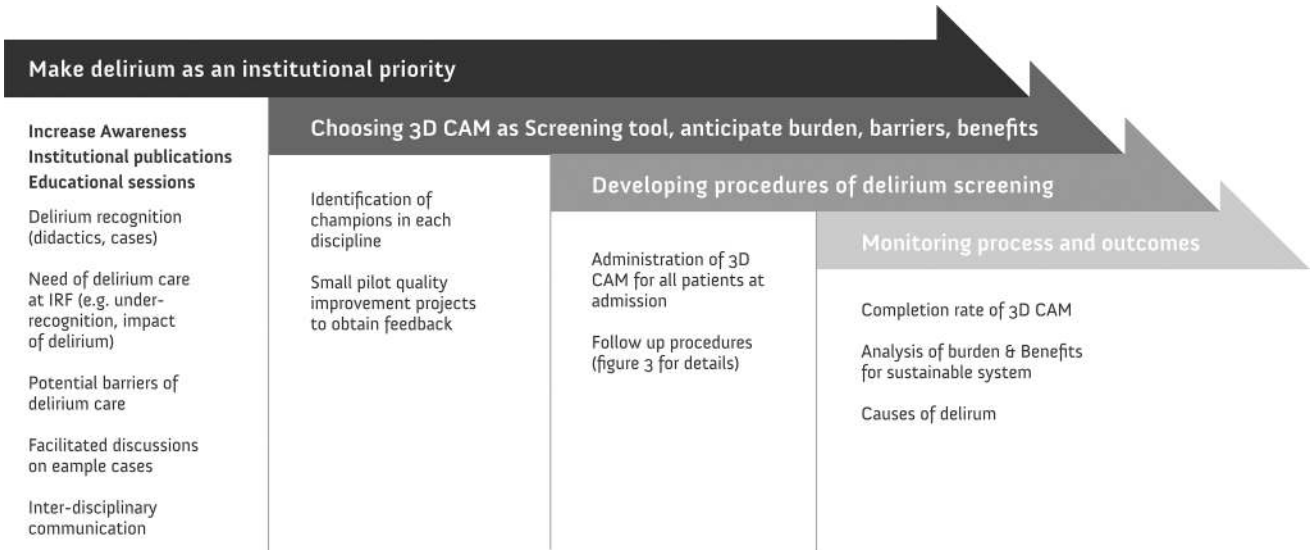

Figure 2.
Strategic planning and process of implementing delirium screening.

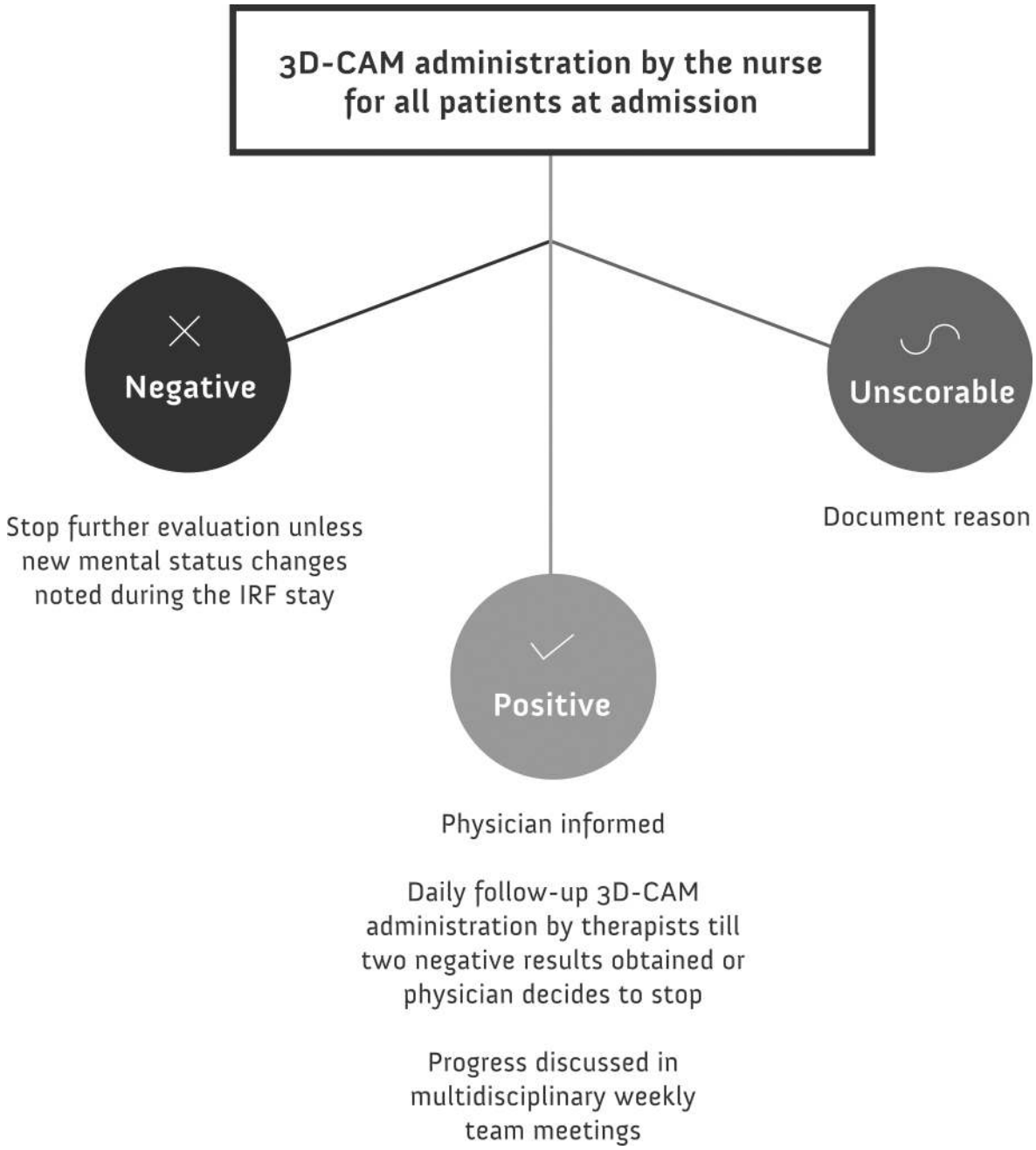

Figure 3.
Delirium screening and follow-up procedures.

Table 1

Differential features of delirium, dementia, depression, and subdural hematoma

	Delirium	**Dementia**	**Depression**	**Subdural hematoma**
Onset of symptoms	hours or days	months to years	weeks to months can occur after specific events (health issues, life events)	gradual, often unknown onset
Duration and course of symptoms	hours to one month, but can be longer than one month, fluctuating symptoms noted during short interview, usually worse at night and upon waking	gradual deterioration over months to years	weeks (at least 2 weeks) to years	days to months stationary or progressive, no significant fluctuation
Reversibility	can be reversible if underlying causes are addressed	not reversible	often reversible with treatment	can be reversible in some cases
Attention	impaired	generally normal till later stage	normal	impaired
Self-awareness	may or may not be aware of cognitive change	conceal or be unaware of cognitive impairment	generally concerned about memory loss	impaired in variable degree
Thinking	disorganized	cognitive decline with problems in memory and other domains (e.g. aphasia, apraxia, executive function)	intact	impaired in variable degree
Alertness	fluctuating	normal	normal	may not be alert, no significant fluctuation
Mood	fluctuating in emotions-crying, fearful	depressed mood in early dementia apathy	depressed mood, decreased interest in activities	some fluctuation noted
Perception	distorted (e.g. illusions, delusions, hallucination) difficulty in distinguishing between reality and misperceptions	generally normal	generally intact	Impaired in variable degree
Psychomotor activity	depending on subtypes (e.g. hyperactive type-agitated, hypoactive type-slow in motion, mixed type)	withdrawn or wandering	generally withdrawn	withdrawn or wondering

Adapted from Ontario Psychogeriatric Association (2005) Basics of the 3Ds.

Table 2

Prevalence of delirium relevant to rehabilitation

Rehabilitation Impairment Category	Prevalence
Overall prevalence in IRF	10%–16.3%
Stroke patients upon admission to IRF	33%
Progression to delirium among trauma patients with stupor or coma	89%
Post hip fracture	
during acute hospitalization	41%
upon discharge from acute hospitalization	39%
one month after discharge from acute hospital	31%

Abbreviation: IRF; inpatient rehabilitation facilities

Table 3

Predisposing and precipitating factors for delirium[1,9]

Predisposing Factor	Precipitating Factor
Age 65 years or older	Polypharmacy, Deliriant medications
Cognitive impairment, Dementia	Physical restraints
History of delirium	Bladder catheter
Gait disorder	Surgery, trauma
Sensory impairment (vision, hearing)	Pain
Depression	Emotional distress
Multiple comorbidities	Infection
Neurological disorder	Metabolic derangement
stroke (usually right parietal)	elevated serum urea
intracranial hemorrhage	electrolyte imbalance
meningitis	metabolic acidosis
encephalitis	Sleep deprivation
	Environmental factors (lack of day light exposure, hospitalization, institutionalization)

Table 4

List of deliriants (medications with risk of triggering delirium)

Benzodiazepines
Anticholinergics (Cyclobenzaprine, Oxybutynin, Prochlorperzarine, Pomethazine, Tricycle antidepressants, Paroxetine)
Diphenhydramine
Hydroxyzine
Histamine$_2$-receptor antagonists (e.g. cimetidine)
Sedative-hypnotics
Meperidine
Medications increasing the level of serotonin (selective serotonin reuptake inhibitors, linezolid, tramadol, amphetamines)
Corticosteroids

Table 5

Workup and Management of Patients with Delirium[1,18,24,29]

Workup
• Review medications for addition, change, drug interaction, and use of deliriants (e.g., benzodiazepine, anticholinergics)
• Assess pain and discomfort (e.g., constipation, pressure ulcer)
• Assess vital signs including oxygen saturation and glucose level
• Evaluate hydration status and dysphagia (aspiration risk)
• Search for infection in urinary track, lung, and skin
• Search for neurological deficit
• Laboratory tests tailored based on history and clinical findings
Electrolytes and basic metabolic panel (Ca, glucose),
Complete blood count
Renal and liver function
Urinalysis and urine culture
Additional tests (vitamin B12, toxicology, ammonia, cortisol, drug level, blood culture, arterial blood gas, electrocardiogram, chest x-ray)
• Neuroimaging in case of focal neurological deficit or falls history.
Do
• Ensure safety of patients (e.g. fall, pressure ulcers, malnutrition)
• Ensure glasses and hearing aids are available and in working condition
• Promote safe mobility
• Restore sleep wake cycle in quiet room
• Reorient patients for space and person with the help of family or caregiver
• Maintain hydration
• Pharmacologic agent is only reserved for those with severe agitation
Do not
• Catheterize
• Use restraint
• Sedate routinely
• Argue with the patient