Inspired by the ABIM Foundation’s Choosing Wisely® campaign, the “Things We Do for No Reason” (TWDFNR) series reviews practices that have become common parts of hospital care but may provide little value to our patients. Practices reviewed in the TWDFNR series do not represent “black and white” conclusions or clinical practice standards but are meant as a starting place for research and active discussions among hospitalists and patients. We invite you to be part of that discussion.

**CLINICAL SCENARIO**
A 67-year-old woman with a history of hypertension and osteoarthritis was hospitalized for fever, flank pain, and dysuria with pyuria on urinalysis. She was diagnosed with acute pyelonephritis and started ceftriaxone, ondansetron for nausea, and oxycodone for pain. On hospital day two, she developed acute confusion that waxed and waned in severity throughout the day. On examination, she appeared mildly agitated, inattentive, and was noted to pick at her linens and garment. She was oriented to person only and had a nonfocal neurologic examination. Her nurse reported no recent falls or trauma. As part of the patient’s evaluation, her attending physician ordered a head computed tomography (CT) scan.

**BACKGROUND**
Delirium is commonly diagnosed in hospitalized patients. It has a prevalence of 29%-64% and is associated with longer lengths of stay, higher mortality, and costs of over $164 billion per year in the United States. While a number of practice guidelines have been created to help guide delirium diagnosis and management, there is not a clear consensus on when neuroimaging should be performed during the evaluation. Practices reviewed in the TWDFNR series do not represent “black and white” conclusions or clinical practice standards but are meant as a starting place for research and active discussions among hospitalists and patients. We invite you to be part of that discussion.

**WHY YOU MAY THINK NEUROIMAGING IS HELPFUL IN EVALUATING UNDIFFERENTIATED HOSPITALIZED PATIENTS WITH DELIRIUM**

Delirium is known to be associated with intracranial processes. For example, delirium occurs in 13% to 48% of patients with acute stroke and conversely 7% of patients with new confusion evaluated in emergency departments or inpatient settings were found to have an acute stroke. The inclusion of neuroimaging as part of a delirium evaluation is supported in certain circumstances, such as in patients with recent falls, focal neurologic signs (including papilledema), systemic anticoagulation, or increased risk of intracranial processes such as metastatic malignancy.

**WHY NEUROIMAGING IS NOT HELPFUL IN EVALUATING UNDIFFERENTIATED HOSPITALIZED PATIENTS WITH DELIRIUM**

A number of studies have evaluated the diagnostic yield of neuroimaging in hospitalized patients with delirium. Two studies included patients with delirium that developed after hospitalization and two included patients with delirium at admission. Theisen-Toupal et al. conducted a retrospective study of 220 hospitalized general medical patients who underwent head CT scans for an indication of delirium, altered mental status, confusion, encephalopathy, somnolence or unresponsiveness. Patients were excluded if they had a history of falls, head trauma, or new neurologic deficits in the preceding two weeks or if the admitting diagnosis was stroke or cerebral hemorrhage. Additionally, the authors limited patients to those who developed delirium 24 hours or more after admission. There were 6/220 (2.7%) patients identified with an acute intracranial process. Of these six patients, three were receiving anticoagulation. An additional 4/220 (1.8%) head CT scans were identified as equivocal, prompting further neuroimaging, which ultimately showed chronic findings.

Vijayakrishnan et al. performed a retrospective review of 400 hospitalized patients who underwent inpatient CT scans, then limited to those with new delirium. They identified 36 patients, of which four (11%) had acute findings on CT: one case each of acute hemorrhage, subdural hematoma, brain metastases, and septic emboli. The authors state “all the four patients had preimaging clinical symptoms and signs, which warranted imaging as per guidelines suggested by the British Geriatrics Society and the Australian and New Zealand Society for Geriatric Medicine,” though they do not provide further details. The strength of this paper is that it isolated patients
who developed delirium while hospitalized; however, conclusions were limited by the small sample size.

Lai et al.’s case-control study evaluated 300 consecutive patients admitted to a delirium unit over 18 months. Of these 300 patients, 200 (67%) had CT performed; 29/200 (14.5%) had intracranial findings on CT that explained their delirium, including 13 ischemic strokes, seven subdural hemorrhages, nine intracerebral hemorrhages, and three additional ischemic strokes that evolved on follow-up imaging but were not present on the initial scans. The authors performed univariate and multivariate analyses to identify risk factors for an intracranial cause of delirium. Only 3/29 patients with a positive scan did not have one of three main risk factors the authors identified: a fall in the preceding two weeks, new neurologic deficits, and/or recent falls were 0%, 1.4%, and 1.5%. While a rate of 1.5% may appear high for a serious outcome such as stroke or intracranial bleeding, it is comparable to rates reported for missed major cardiac events in clinical algorithms for evaluating chest pain. It should also be noted that neuroimaging is imperfect.

Abbreviations: AMS, altered mental status; CAM, Confusional Assessment Method; CT, computed tomography; ICH, intracerebral hemorrhage; MRI, magnetic resonance imaging; NOS, not otherwise specified; PRES, posterior reversible encephalopathy; syndrome; SAH, subarachnoid hemorrhage; SDH, subdural hemorrhage.
for acute stroke, and thus the positive or negative predictive value may be poor in the setting of low prevalence. For example, for detection of any acute stroke, the sensitivity/specificity of MRI and CT are 83%/97% and 26%/98% respectively.\(^\text{13}\)

Neuroimaging is expensive and has risks. The average charge for a head CT is approximately $1,400 at academic institutions.\(^\text{14}\) Moreover, computed tomography exposes patients to significant radiation and up to 2% of malignancies in the United States may be attributable to prior tomography exposure.\(^\text{15}\) Additionally, there are non-negligible rates of incidental findings during neuroimaging, 1% for CT\(^\text{16}\) and 2.7%-13.7% for MRI,\(^\text{17,18}\) which may result in further evaluation or treatment that causes significant patient anxiety. Obtaining neuroimaging on delirious patients can be time consuming and labor intensive, which could delay care to other patients. Additionally, sedating medications are often administered to agitated patients prior to imaging, which risk worsening delirium. Ordering neuroimaging for all patients with acute delirium, therefore, exposes the large majority to unnecessary costs and potential harms.

**WHEN NEUROIMAGING TO EVALUATE DELIRIUM IN HOSPITALIZED PATIENTS COULD BE REASONABLE**

The diagnostic yield of head CT in the evaluation of delirium is significantly higher in patients with specific risk factors. Lai et al. found adjusted odds ratios for abnormal CT of 18.2 in patients with new focal deficits, 5.6 with a fall in the preceding two weeks and 4.6 in patients with deterioration in consciousness. Patients with systemic anticoagulation had higher unadjusted, (OR 2.4) though not adjusted odds of having an abnormal CT.\(^\text{6}\)

Thiesen-Toupal et al. excluded patients with recent falls or neurologic deficits but reported that three out of six delirious patients with abnormal neuroimaging were anticoagulated.\(^\text{10}\)

Vijayakrishnan et al. found that all four delirious patients with intracranial findings met guideline criteria for neuroimaging.\(^\text{11}\)

Thus, current recommendations for neuroimaging in delirious patients with falls, focal neurologic deficits, or systemic anticoagulation are appropriate. In situations when a provider lacks an accurate history and is unable to determine if risk factors are present (for example a confused patient found sitting on the floor next to the bed), it may also be reasonable to consider neuroimaging.

Data are limited, but some authors advocate for neuroimaging in cases of delirium that do not improve with treatment.\(^\text{6}\)

Additionally, it may be reasonable to consider neuroimaging in delirium patients with predispositions to embolic or metastatic intracranial processes such as endovascular infections and certain malignancies.\(^\text{4}\)

**WHAT YOU SHOULD DO INSTEAD OF NEUROIMAGING TO EVALUATE DELIRIUM IN HOSPITALIZED PATIENTS**

Hospitalized patients with acute confusion should be assessed for delirium with a validated instrument such as the Confusion Assessment Method (CAM).\(^\text{19,20}\) The original CAM included several components: acute change in mental status with a fluctuating course and inattention, plus either disorganized thinking and/or altered level of consciousness. Multiple delirium assessment tools have been created and validated, all of which include inattention as a required feature. A recent hospital-based study using a two-item bedside test asking the patient to name the day of the week and list the months of the year backwards detected delirium with a sensitivity of 93% and specificity of 64%.\(^\text{21}\)

Once the diagnosis of delirium is established, evaluation should begin with a careful history and physical examination focused on the identification of risk factors such as physical restraints, indwelling urinary catheters, and drugs known to precipitate delirium, particularly those with withdrawal potential, anticholinergic properties, and sedative-hypnotic agents.\(^\text{22-24}\)

Delirium may be the first harbinger of serious medical illness and specific testing should be guided by clinical suspicion. In general, a thorough physical examination should look for focal neurologic deficits, hypoxia, signs of infection, and other inflammatory or painful processes that could precipitate delirium.\(^\text{25}\)

Targeted laboratory evaluation may include a basic metabolic panel to identify electrolyte (including calcium) and metabolic derangements, complete blood count, and urinalysis if infection is suspected.

**RECOMMENDATIONS**

- Use a validated instrument such as CAM to evaluate hospitalized patients who develop altered mental status.
- Delirious patients should undergo a thorough history including a review of medications, physical exam, and targeted laboratory testing aimed at identifying common risk factors and precipitants of delirium that should be addressed.
- Perform neuroimaging if there is a history of fall or head trauma in the preceding two weeks, any new focal abnormalities on neurologic exam or if the patient is receiving systemic anticoagulation.
- It may be reasonable to consider neuroimaging for patients with an atypical course of delirium, such as a sudden decline in the level of consciousness, persistence despite addressing identified factors, or if there is a high degree of suspicion for embolic or metastatic processes.

**CONCLUSIONS**

Performing neuroimaging in undifferentiated patients who develop delirium while hospitalized has a low diagnostic yield, is costly, and is potentially harmful. Neuroimaging should be reserved for those with identified risk factors for intracranial pathology. For the patient described in the initial vignette with no risk factors for intracranial cause, neuroimaging would be unlikely to contribute to her care. To change provider beliefs and behaviors regarding neuroimaging, prospective studies evaluating guideline implementation are needed. However, based on the current evidence, neuroimaging should be reserved for those with identified risk factors.

Do you think this is a low-value practice? Is this truly a “Thing We Do for No Reason?” Share what you do in your practice and join in the conversation online by retweeting it on Twitter
References


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