

**American College of Radiology
ACR Appropriateness Criteria®
Acute Mental Status Change, Delirium, and New Onset Psychosis**

Variant 1: Acute mental status change. Increased risk for intracranial bleeding (ie, anticoagulant use, coagulopathy), hypertensive emergency, or clinical suspicion for intracranial infection, mass, or elevated intracranial pressure. Initial imaging.

Procedure	Appropriateness Category	Relative Radiation Level
CT head without IV contrast	Usually Appropriate	☼ ☼ ☼
MRI head without IV contrast	Usually Appropriate	○
MRI head without and with IV contrast	May Be Appropriate	○
CT head without and with IV contrast	May Be Appropriate	☼ ☼ ☼
CT head with IV contrast	Usually Not Appropriate	☼ ☼ ☼

Variant 2: Acute or progressively worsening mental status change in patient with a known intracranial process (mass, recent hemorrhage, recent infarct, central nervous system infection, etc). Initial imaging.

Procedure	Appropriateness Category	Relative Radiation Level
CT head without IV contrast	Usually Appropriate	☼ ☼ ☼
MRI head without and with IV contrast	Usually Appropriate	○
MRI head without IV contrast	Usually Appropriate	○
CT head without and with IV contrast	May Be Appropriate	☼ ☼ ☼
CT head with IV contrast	May Be Appropriate	☼ ☼ ☼

Variant 3: Acute mental status change. Suspected cause(s) found on initial clinical or lab assessment (intoxication, medication-related, hypoglycemia, sepsis, etc). Low clinical suspicion for trauma, intracranial hemorrhage, stroke, mass, or intracranial infection. Initial imaging.

Procedure	Appropriateness Category	Relative Radiation Level
CT head without IV contrast	May Be Appropriate (Disagreement)	☼ ☼ ☼
MRI head without IV contrast	May Be Appropriate (Disagreement)	○
MRI head without and with IV contrast	May Be Appropriate	○
CT head without and with IV contrast	Usually Not Appropriate	☼ ☼ ☼
CT head with IV contrast	Usually Not Appropriate	☼ ☼ ☼

Variant 4:

Persistent or worsening mental status change despite clinical management of the suspected underlying cause (intoxication, medication-related, hypoglycemia, sepsis, etc) or acute change in mental status of unknown cause. Initial imaging.

Procedure	Appropriateness Category	Relative Radiation Level
MRI head without and with IV contrast	Usually Appropriate	○
MRI head without IV contrast	Usually Appropriate	○
CT head without IV contrast	Usually Appropriate	☼ ☼ ☼
CT head without and with IV contrast	May Be Appropriate	☼ ☼ ☼
CT head with IV contrast	Usually Not Appropriate	☼ ☼ ☼

Variant 5:

New onset delirium. Initial imaging.

Procedure	Appropriateness Category	Relative Radiation Level
CT head without IV contrast	Usually Appropriate	☼ ☼ ☼
MRI head without and with IV contrast	May Be Appropriate (Disagreement)	○
MRI head without IV contrast	May Be Appropriate (Disagreement)	○
CT head without and with IV contrast	Usually Not Appropriate	☼ ☼ ☼
CT head with IV contrast	Usually Not Appropriate	☼ ☼ ☼

Variant 6:

New onset psychosis. Initial imaging.

Procedure	Appropriateness Category	Relative Radiation Level
CT head without IV contrast	May Be Appropriate	☼ ☼ ☼
MRI head without and with IV contrast	May Be Appropriate	○
MRI head without IV contrast	May Be Appropriate	○
CT head without and with IV contrast	Usually Not Appropriate	☼ ☼ ☼
CT head with IV contrast	Usually Not Appropriate	☼ ☼ ☼

ACUTE MENTAL STATUS CHANGE, DELIRIUM, AND NEW ONSET PSYCHOSIS

Expert Panel on Neurological Imaging: Michael D. Luttrull, MD^a; Daniel J. Boulter, MD^b; Claudia F. E. Kirsch, MD^c; Joseph M. Aulino, MD^d; Joshua S. Broder, MD^e; Santanu Chakraborty, MBBS, MSc^f; Asim F. Choudhri, MD^g; Andrew F. Ducruet, MD^h; A. Tuba Kendi, MDⁱ; Ryan K. Lee, MD, MRMD, MBA^j; David S. Liebeskind, MD^k; William Mack, MD^l; Toshio Moritani, MD, PhD^m; Robert P. Roca, MD, MPH, MBAⁿ; Lubdha M. Shah, MD^o; Aseem Sharma, MD^p; Robert Y. Shih, MD^q; Sophia C. Symko, MD, MS^r; Julie Bykowski, MD.^s

Summary of Literature Review

Introduction/Background

Altered mental status (AMS) may account for up to 4% to 10% of chief complaints in the emergency department (ED) setting and is a common accompanying symptom for other presentations [1,2]. AMS is not a diagnosis, rather a term for symptoms of acute or chronic disordered mentation [1], including: confusion, acute brain dysfunction, encephalopathy, disorientation, lethargy, drowsiness, somnolence, unresponsiveness, coma, agitation, altered behavior, inattention, hallucinations, delusions, psychosis, or behaving inappropriately [3,4]. Acute mental status changes occur over minutes to days and may be triggered by a wide range of medical conditions, including drugs, intoxication, system or organ dysfunction, metabolic or endocrine factors, and neurological processes that include traumatic brain injury and cerebrovascular disease [3]. Less frequent neurological causes include status epilepticus, nonconvulsive seizure, intracranial mass effect or globally elevated intracranial pressure, chronic subdural or subarachnoid hemorrhage (SAH), meningitis or encephalitis, dementia disorders, transient ischemic attack, and hydrocephalus [5].

Validated assessment scales, such as the Richmond Agitation Sedation Scale and Glasgow Coma Scale, may be employed to objectively quantify the severity of symptoms [3,4]. The cause of AMS in patients across all age groups remains undiagnosed in slightly greater than 5% of cases. Overall mortality in patients with AMS is approximately 8.1% and is significantly higher in elderly patients [4].

Two recent studies found that older patients presenting to the ED with the nonspecific chief complaint of AMS are likely to have delirium [6]. Delirium is a defined and diagnosable medical condition under DSM-V, which includes inattention as a cardinal feature, may fluctuate over the course of day with lucid intervals, and may present with subtle disturbances in consciousness compared to other forms of acute AMS, making detection more difficult and thus easy to miss [3,6]. Delirium is considered a medical emergency. Early detection and accurate diagnosis are extremely important as mortality in patients may be twice as high if the diagnosis of delirium is missed [7]. Up to 10% to 31% of patients may have delirium at admission, and it may develop in up to 56% of admitted patients [8], particularly following surgery or in the intensive care unit [8]. Delirium is not explained by a pre-existing neurocognitive disorder, does not occur in a state of severely reduced arousal, such as a coma, and is thought to be directly precipitated by one or more underlying causes, including another medical condition, intoxication, toxin exposure, or withdrawal [9]. Infection is probably the most common precipitating factor, usually urinary tract infections or pneumonia. Two or more coexisting precipitating causes can be frequently encountered [3,5-7,10,11]. Management is based on treatment of the underlying cause, control of symptoms with nonpharmacological approaches, medication when deemed appropriate, as well as effective after-care planning [3,6,11]. The economic impact of delirium in the United States is profound, with total costs estimated at \$38 to \$152 billion each year [12]. Psychiatric consultation and screening tools, such as the Confusion Assessment Method (CAM) and briefer CAM variants (ie, CAM-ICU, B-CAM), may be employed in clinical practice to assess for delirium [3,7].

^aThe Ohio State University Wexner Medical Center, Columbus, Ohio. ^bResearch Author, The Ohio State University Wexner Medical Center, Columbus, Ohio. ^cPanel Chair, Northwell Health, Zucker Hofstra School of Medicine at Northwell, Manhasset, New York. ^dVanderbilt University Medical Center, Nashville, Tennessee. ^eDuke University School of Medicine, Durham, North Carolina; American College of Emergency Physicians. ^fOttawa Hospital Research Institute and the Department of Radiology, The University of Ottawa, Ottawa, Ontario, Canada. ^gLe Bonheur Children's Hospital, University of Tennessee Health Science Center, Memphis, Tennessee. ^hBarrow Neurological Institute, Phoenix, Arizona; neurosurgical consultant. ⁱMayo Clinic, Rochester, Minnesota. ^jEinstein Healthcare Network, Philadelphia, Pennsylvania. ^kUniversity of California Los Angeles, Los Angeles, California; American Academy of Neurology. ^lUniversity of Southern California, Los Angeles, California; neurosurgical consultant. ^mUniversity of Michigan, Ann Arbor, Michigan. ⁿSheppard Pratt Health System, Towson, Maryland; American Psychiatric Association. ^oUniversity of Utah, Salt Lake City, Utah. ^pMallinckrodt Institute of Radiology, Saint Louis, Missouri. ^qWalter Reed National Military Medical Center, Bethesda, Maryland. ^rNeuroradiology Consultant, Denver, Colorado. ^sSpecialty Chair, UC San Diego Health Center, San Diego, California.

The American College of Radiology seeks and encourages collaboration with other organizations on the development of the ACR Appropriateness Criteria through society representation on expert panels. Participation by representatives from collaborating societies on the expert panel does not necessarily imply individual or society endorsement of the final document.

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New onset psychosis is often listed as a separate subgroup under the AMS category. Delusions and hallucinations are two cardinal features of psychotic symptomatology. Additional symptoms may include disorganized speech or thought, disorganized or abnormal motor behavior, including catatonia or agitation, and negative symptoms, such as diminished expression of emotions [9]. In contrast to other presentations of AMS, awareness and level of consciousness in psychotic patients are frequently intact [13]. If the psychotic symptoms are related to an underlying psychiatric disorder, such as schizophrenia, bipolar disorder, schizoaffective disorder, or depression with psychotic features, it is termed primary psychosis. Secondary causes of psychosis are thought to be directly related to drug/alcohol use, withdrawal, or an underlying medical cause [1,2] and are not better explained by delirium [9]. Prevalence of psychotic disorders that are due to a general medical condition was found to be higher in those 65 years of age or older [14]. Medical conditions that may present with psychotic symptoms include endocrine disorders, autoimmune diseases, neoplasms and paraneoplastic processes, neurologic disorders, infections, genetic or metabolic disorders, nutritional deficiencies, and drug-related intoxication, withdrawal, side effects, and toxicity. For secondary causes of psychosis, treatment is aimed at the underlying medical cause and control of the psychotic symptoms [13]. Treatment of primary causes of psychosis involves pharmacologic management with antipsychotic medications, psychological therapy, and psychosocial interventions [15].

This article focuses on the appropriateness of neuroimaging in adult patients presenting with acute mental status changes, new onset delirium, or new onset psychosis. In these cases, imaging is often expedited for initial stabilization and to exclude an intracranial process requiring intervention. The diagnosis of delirium in the ED setting can be missed by inadequate screening [3,16], although ED physicians are moderately accurate at establishing the correct clinical diagnosis for the cause of AMS within the first 20 minutes of the patient encounter [17]. The complete evaluation for underlying causes, such as chest radiography to assess for pneumonia, electrocardiogram to assess for myocardial ischemia, electroencephalography for suspected convulsive or nonconvulsive seizure, and lumbar puncture to assess for central nervous system infection, is beyond the scope of this article [3,7].

AMS may be an accompanying feature of clinical presentations more appropriately handled by other ACR Appropriateness Criteria documents, although overlap is unavoidable. For patients with suspected stroke or focal neurological deficits also presenting with AMS, please refer to the ACR Appropriateness Criteria® topic on “[Cerebrovascular Disease](#)” [18]. If seizure is the suspected cause of AMS, please refer to the ACR Appropriateness Criteria® topic on “[Seizures and Epilepsy](#)” [19]. For patients presenting with AMS in the setting of known or suspected trauma, please refer to the ACR Appropriateness Criteria® topic on “[Head Trauma](#)” [20]. For patients presenting with headaches and AMS, please refer to the ACR Appropriateness Criteria® topic on “[Headache](#)” [21]. Chronic changes in mental status are typically synonymous with dementia, occur over a time period of months to years, and are covered in the ACR Appropriateness Criteria® topic on “[Dementia](#)” [3,22].

Special Imaging Considerations

Imaging patients with AMS, delirium, and psychosis can be challenging because of limitations in the patient’s ability to follow commands and combativeness that is due to longer examination lengths, sensitivity to motion artifact, smaller bore sizes exacerbating symptoms in anxious or claustrophobic patients, and sounds experienced by the patient during the examination. MRI may be delayed or unavailable because of the inability to obtain an accurate safety screening history. Coordination of care with the patient’s managing physician and family members is frequently critical to successful diagnostic imaging in this patient population [23,24]. To offset challenges in MRI in this patient group, it may be helpful to tailor examinations for shorter scan times, decrease the number of sequences to answer the specific clinical question, or utilize motion-reducing sequences [25].

Discussion of Procedures by Variant

Variant 1: Acute mental status change. Increased risk for intracranial bleeding (ie, anticoagulant use, coagulopathy), hypertensive emergency, or clinical suspicion for intracranial infection, mass, or elevated intracranial pressure. Initial imaging.

Identifying patients with AMS secondary to acute intracranial pathology is extremely important to guide management and ensure early appropriate triage. This variant encompasses a select group of patients presenting with acute mental status changes at a relatively higher risk of acute intracranial pathology. For patients who present with suspected stroke, focal neurologic deficit, seizure, head trauma, or headache, reference should be made to the respective ACR Appropriateness Criteria as appropriate: the ACR Appropriateness Criteria® topic on “[Cerebrovascular Disease](#)” [18], ACR Appropriateness Criteria® topic on “[Seizures and Epilepsy](#)” [19], ACR Appropriateness Criteria® topic on “[Head Trauma](#)” [20], or the ACR Appropriateness Criteria® topic on “[Headache](#)” [21].

CT Head

Evidence guiding appropriate imaging recommendations in this variant is limited. However, a noncontrast head CT is the first-line neuroimaging test of choice in this setting and can be performed safely and rapidly in all patients [2]. Yield of acute contributory findings on CT ranged from 2% to 45% based on trial design and inclusion or exclusion criteria [2,26-30]. Subgroup analysis of patients with AMS and no focal deficits in one study noted acute changes on imaging in 7.4% of patients [27]. Risk factors associated with intracranial findings included history of trauma or falls, hypertension, anticoagulant use, headache, nausea or vomiting, older age, impaired consciousness or unresponsiveness, neurologic deficit, and history of malignancy [2,26-30]. However, different studies found variable levels of significance of these associations. Risk stratification tools have been proposed to maintain sensitivity while reducing CT utilization [26]; however, they have not been prospectively validated. Therefore, determination of the need and benefit of brain imaging in this scenario falls on the evaluating clinician's judgement.

Contrast-enhanced CT examinations can be considered if intracranial infection, tumor, or inflammatory pathologies are suspected. However, the use of contrast-enhanced head CTs as a first-line test in the acute setting may not add significant value over noncontrast head CT examinations [31]. A common practice is to perform a noncontrast screening head CT followed by a more sensitive MRI brain examination performed with and without contrast (or a contrast-enhanced head CT) in this setting.

MRI Head

MRI may prove useful as a second-line test when occult pathology is suspected and initial head CTs are unrevealing, because of MRI's higher sensitivity in detecting ischemia, encephalitis, or subtle cases of SAH [26,32,33]. Many of the abnormal findings in the literature for this topic included small ischemic infarcts [26,32,33]. Notably, a retrospective study found that 70% of patients who had a missed ischemic stroke diagnosis presented with AMS [33]. MRI of the brain is complementary to an abnormal head CT for evaluation of suspected intracranial mass lesions, intracranial infection, nonspecific regions of edema, ischemia, and cases of intracranial hemorrhage (ICH) when an underlying lesion is suspected [34,35]. MRI may also be considered as a first-line test in certain situations, such as a clinically stable patient with known malignancy, HIV, or endocarditis.

Noncontrast MRI examinations of the brain are usually sufficient in the assessment of intracranial complications related to hypertensive emergency, including posterior reversible encephalopathy syndrome. Contrast-enhanced MRI examinations may be performed if intracranial infection, tumor, inflammatory lesions, or vascular pathologies are suspected. However, the literature search did not identify any studies regarding the use of contrast-enhanced MRI relevant to this variant.

Variant 2: Acute or progressively worsening mental status change in patient with a known intracranial process (mass, recent hemorrhage, recent infarct, central nervous system infection, etc). Initial imaging.

For patients who present with suspected stroke, focal neurologic deficit, seizure, head trauma, or headache, reference should be made to the respective ACR Appropriateness Criteria as appropriate: the ACR Appropriateness Criteria® topic on "[Cerebrovascular Disease](#)" [18], ACR Appropriateness Criteria® topic on "[Seizures and Epilepsy](#)" [19], ACR Appropriateness Criteria® topic on "[Head Trauma](#)" [20], or the ACR Appropriateness Criteria® topic on "[Headache](#)" [21].

CT Head

The literature search did not identify any studies regarding the use of CT in the evaluation of acute or worsening mental status changes in a patient with known intracranial pathology. Noncontrast head CT examinations are able to depict possible complications of a wide variety of intracranial pathology, including progressive mass effect, increasing edema, hydrocephalus, new or enlarging ICH, and progressive ischemia. CT is the first-line imaging test of choice for evaluating suspected progressive ICH, mass effect, or hydrocephalus in the emergent setting.

Contrast-enhanced CT examinations may be considered if clinical concern exists for progression of intracranial infection, such as abscesses or empyema, tumor, or inflammatory conditions. Advantages of CT are fast examination times and less susceptibility to motion artifact compared to MRI. Disadvantages of CT include less sensitivity in detection of acute ischemia and enhancement compared to MRI [27].

MRI Head

The literature search did not identify any studies regarding the use of MRI in the evaluation of acute or worsening mental status changes in a patient with known intracranial pathology. MRI is complementary to CT in the evaluation of suspected progression of intracranial mass lesions, infection, and ischemia and may be performed as a first-line test instead of CT.

MRI is the imaging test of choice in the evaluation of suspected progressive inflammatory conditions, such as multiple sclerosis or neuropsychiatric systemic lupus erythematosus. In the assessment of known ICH, MRI is usually not required unless there is suspicion for an underlying mass or lesion, or if axonal shear injury is suspected. Contrast-enhanced MRI may be performed if intracranial infection, tumor, inflammatory lesions, or vascular pathologies are suspected. Advantages of MRI include higher sensitivity for the detection of ischemia, encephalitis, subtle cases of SAH, and enhancement of pathology compared to CT and the potential to use advanced imaging applications that may provide critical information, such as diffusion-weighted imaging, MR perfusion, susceptibility-weighted sequences, and MR spectroscopy. Disadvantages of MRI include longer examination time, susceptibility to motion artifacts, and implanted devices that are not MRI safe [2].

Variant 3: Acute mental status change. Suspected cause(s) found on initial clinical or lab assessment (intoxication, medication-related, hypoglycemia, sepsis, etc). Low clinical suspicion for trauma, intracranial hemorrhage, stroke, mass, or intracranial infection. Initial imaging.

Acute mental status changes may be triggered by a wide range of medical conditions, including drugs and intoxication, system or organ dysfunction, metabolic or endocrine factors. This variant encompasses a subgroup of patients presenting with acute mental status changes at low risk of acute intracranial pathology.

CT Head

ED physicians are moderately accurate at establishing the correct clinical diagnosis for the cause of AMS within the first 20 minutes of the patient encounter [17]. A large proportion of misdiagnoses in this study were deemed insignificant because of confusing various forms of isolated or mixed intoxication. Deferring head CT imaging while observing if intoxicated patients symptomatically improve may be a safe practice and may prevent the need for imaging in large percentage of intoxicated patients [36].

The literature search did not identify any studies regarding the use of contrast-enhanced CT relevant to this variant, and contrast-enhanced CT examinations are not performed as a first-line test in this setting.

MRI Head

The literature search did not identify any studies regarding the use of MRI relevant to this variant. There may be unique instances where a brain MRI examination may be useful in confirming a suspected clinical diagnosis responsible for AMS, such as carbon monoxide poisoning, Wernicke encephalopathy (thiamine deficiency) [37], metronidazole toxicity, or additional metabolic disorders.

Variant 4: Persistent or worsening mental status change despite clinical management of the suspected underlying cause (intoxication, medication-related, hypoglycemia, sepsis, etc) or acute change in mental status of unknown cause. Initial imaging.

This is a challenging clinical scenario where common and treatable causes of AMS have been deemed unlikely, and a more exhaustive evaluation is required to find the precipitating cause of AMS. Clinical suspicion for a neurologic cause of AMS may be in an intermediate category.

CT Head

For patients with AMS not responding to initial management of the suspected underlying medical cause, neuroimaging with a noncontrast head CT is usually appropriate to evaluate for a possible neurological source of their symptoms, including acute ICH, infarct, brain mass, hydrocephalus, or mass effect. The diagnostic yield may be low in the absence of a focal neurological deficit or signs of trauma [2,17,27,29,36]. No prospectively validated clinical rule or scoring system is available to help define which of these patients benefit the most from imaging. Therefore, determining the clinical need and value of brain imaging in this scenario relies on the evaluating clinician's judgement. Unresponsive patients may have higher rates of acute findings on CT [29].

Contrast-enhanced CT examinations are usually not performed as a first-line test in this setting but may be considered as a second-line test to assess abnormalities found on the screening head CT and for patients unable or unwilling to have MRI [31]. Evidence guiding appropriate imaging recommendations in this variant is limited, as most studies in the literature search sampled undifferentiated patient populations with a broad range of risk factors and are not directly applicable to this variant [2,26,28-30].

MRI Head

MRI may prove useful as a second-line test when occult pathology is suspected and the initial head CT is unrevealing because of MRI's higher sensitivity in detecting small infarcts, encephalitis, and subtle cases of SAH [26,32,33]. MRI of the brain is complementary to CT in further evaluation of suspected intracranial mass lesions, intracranial infection, nonspecific regions of edema, and in the evaluation of certain cases of ICH for presence of

an underlying lesion, including a hemorrhagic primary or secondary brain mass, arteriovenous malformation, or cavernous venous malformation [34,35]. MRI may be considered as a first-line test in certain clinical scenarios, such as a stable patient with clinically suspected occult central nervous system malignancy, inflammatory disorder, or central nervous system infection, although, the yield of MRI in this setting may be low [32].

Noncontrast MRI examinations of the brain are usually sufficient in the assessment of intracranial complications related to hypertensive emergency, including posterior reversible encephalopathy syndrome. Contrast-enhanced MRI examinations may be performed if intracranial infection, tumor, inflammatory lesions, or vascular pathologies are suspected. However, the literature search did not identify any studies regarding the use of contrast-enhanced MRI relevant to this variant.

Variant 5: New onset delirium. Initial imaging.

There are a wide range of precipitating factors leading to delirium onset that make evaluation challenging, some of which are life threatening. These may be related to systemic disease, such as sepsis or infection, hypoxia, metabolic derangements, hypoglycemia, hyperglycemia, hyponatremia, hypoxia, hypothermia, acute myocardial infarction, neurologic disease including stroke, ICH, Wernicke encephalopathy (thiamine deficiency), central nervous system infection, seizure, surgery, trauma, drugs such as anticholinergic drugs, sedatives, narcotics, drug or alcohol withdrawal, polypharmacy, environmental factors from restraints, stress, or pain, and sleep deprivation. There is relatively little evidence in the literature regarding appropriate use of neuroimaging with new onset delirium.

Patients with delirium who present with suspected stroke, focal neurologic deficit, seizure, head trauma, or headache should refer to the respective ACR Appropriateness Criteria as appropriate: ACR Appropriateness Criteria[®] topic on “[Cerebrovascular Disease](#)” [18], ACR Appropriateness Criteria[®] topic on “[Seizures and Epilepsy](#)” [19], ACR Appropriateness Criteria[®] topic on “[Head Trauma](#)” [20], or the ACR Appropriateness Criteria[®] topic on “[Headache](#)” [21].

CT Head

The reported detection of treatment-altering findings on head CT is very low in elderly patients with new onset delirium unless one of the following risk factors is present: focal neurologic deficit, history of recent falls or head injury, anticoagulation therapy, signs of elevated intracranial pressure, or significant deterioration of consciousness [8,38-40]. Acute pathology that resulted in a change of management was detected in a small proportion of patients on head CT, including ischemic and hemorrhagic stroke, subdural hematoma, SAH, encephalitis or meningitis, and cerebral tumors. Therefore, the low diagnostic yield of CT in this setting must be weighed against the risk of possible, preventable morbidity [8,11], acknowledging that patients may not have clinical signs on examination that predict a focal pathology [41]. There is no relevant literature regarding the use of contrast-enhanced head CT in the evaluation of delirium.

MRI Head

The reported yield of brain MRI is very low in elderly patients with new onset delirium in the absence of a focal neurologic deficit or history of recent falls. In a small proportion of patients, brain MRI did reveal acute pathology possibly accounting for delirium, including ischemic and hemorrhagic stroke, subdural hematoma, SAH, septic emboli, encephalitis, meningitis, cerebral metastases, primary brain tumor, pineal tumor, and a large meningioma [41]. MRI may be helpful for further evaluation of an abnormality detected on noncontrast CT in the workup of new onset delirium, such as space-occupying lesions or infection. Contrast-enhanced brain MRI may be helpful for definitive characterization of a focal lesion identified on initial noncontrast CT or in patients with known cancer history [11].

Variant 6: New onset psychosis. Initial imaging.

This variant addresses the role of neuroimaging in the assessment for secondary causes of new onset psychosis in the ED or inpatient setting. Some of the reported organic causes of psychosis include tumors or infarcts in specific areas of the brain, such as the temporal lobe, systemic lupus erythematosus, encephalitis, multiple sclerosis, Wilson disease, Huntington disease, or metachromatic leukodystrophy [42-44]. Patients with new onset psychosis who have suspected stroke, focal neurologic deficit, seizure, head trauma, or headache should refer to the respective ACR Appropriateness Criteria as appropriate: the ACR Appropriateness Criteria[®] topic on “[Cerebrovascular Disease](#)” [18], ACR Appropriateness Criteria[®] topic on “[Seizures and Epilepsy](#)” [19], ACR Appropriateness Criteria[®] topic on “[Head Trauma](#)” [20], or the ACR Appropriateness Criteria[®] topic on “[Headache](#)” [21].

CT Head

The reported yield of CT in detecting pathology that may be responsible for psychotic symptoms or leading to a significant change in clinical management is very low in patients with new onset psychosis and no neurologic deficit, ranging from 0% to 1.5% in the literature search [42,45-47]. In a very small proportion of patients, CT of the head revealed pathology that could account for new onset psychosis, including primary and secondary brain tumors, infarcts, moderate to large arachnoid cysts in the temporal region, and a colloid cyst causing hydrocephalus [42,47]. The evidence-based consensus guideline from the American College of Emergency Physicians Clinical Policies Subcommittee on the Adult Psychiatric Patient entitled “Clinical Policy: Critical Issues in the Diagnosis and Management of the Adult Psychiatric Patient in the Emergency Department” found that there is inadequate literature on the usefulness of neuroimaging for new onset psychosis without a neurologic deficit in the ED setting and recommended individual assessment of risk factors to guide the decision for neuroimaging in these patients [48]. The “American Psychiatric Society Practice Guidelines for Treatment of Patients with Schizophrenia, second edition” suggests that brain MRI is preferred, and either MRI or a head CT scan may provide helpful information, particularly in patients for whom the clinical picture is unclear, the presentation is atypical, or there are abnormal findings on examination [47,49]. In contrast, one study from the literature search found no significant difference in the diagnostic yield of performing CT or MRI in this setting [47]. Contrast-enhanced CT is generally not helpful for new onset psychosis in the absence of focal neurologic deficits.

MRI Head

The reported yield of MRI in the evaluation of new onset psychosis is very low in patients with no neurologic deficit, with significant or possible causative findings found in 0% to 2.7% of cases in the literature search [42,45,47,50]. In a small proportion of patients, MRI of the brain revealed pathology that may account for new onset psychosis, including encephalitis, demyelinating disease, or brain tumors [42,47]. However, one comparative study found no significant difference in the rate of clinically relevant pathology found by MRI in psychotic patients compared to a matched sample of healthy control subjects [50]. The evidence-based consensus guideline from the American College of Emergency Physicians Clinical Policies Subcommittee on the Adult Psychiatric Patient entitled “Clinical Policy: Critical Issues in the Diagnosis and Management of the Adult Psychiatric Patient in the Emergency Department” found that there is inadequate literature on the usefulness of neuroimaging for new onset psychosis without a neurologic deficit in the ED setting and recommended individual assessment of risk factors to guide decision for neuroimaging in these patients [48]. The “American Psychiatric Society Practice Guidelines for Treatment of Patients with Schizophrenia, second edition” suggests that brain MRI is preferred and that either MRI or CT may provide helpful information, particularly in patients for whom the clinical picture is unclear, the presentation is atypical, or there are abnormal findings on examination [47,49]. In contrast, one study from the literature search found no significant difference in the diagnostic yield of performing CT or MRI in this setting [47]. Subtle variations in cerebral anatomy or parenchymal volume may be detectable with advanced morphometric analysis of brain MRI [51,52]. However, these observations currently remain in the realm of research.

Contrast-enhanced brain MRI may be performed for definitive characterization of a focal lesion identified on initial noncontrast CT examination or in patients with suspected autoimmune disorders, such as multiple sclerosis or neuropsychiatric lupus [44,45].

Summary of Recommendations

- **Variation 1:** A CT head without intravenous (IV) contrast or an MRI head without IV contrast is usually appropriate for the initial imaging of acute mental status changes associated with increased risk for intracranial bleeding (ie, anticoagulant use, coagulopathy), hypertensive emergency, or clinical suspicion for intracranial infection, mass, or elevated intracranial pressure. A noncontrast head CT is usually the initial test of choice. MRI is complementary to CT, but may also be used as a first-line test based on clinical judgement.
- **Variation 2:** A CT head without IV contrast, MRI head without and with IV contrast, or MRI head without IV contrast is usually appropriate for the initial imaging of an acute or progressively worsening mental status change in a patient with a known intracranial process (mass, recent hemorrhage, recent infarct, central nervous system infection, etc). These procedures are equivalent alternatives, and the choice of imaging will be based on clinical judgement.
- **Variation 3:** An MRI head without and with IV contrast may be appropriate for the initial imaging of an acute mental status change when the suspected cause is found on initial clinical or lab assessment (intoxication, medication-related, hypoglycemia, sepsis, etc), and there is a low clinical suspicion for trauma, intracranial

hemorrhage, stroke, mass, or intracranial infection. The panel did not agree on recommending a CT head without IV contrast or an MRI head without IV contrast in this clinical scenario. There is insufficient medical literature to conclude whether or not these patients would benefit from these procedures. The use of CT or MRI without IV contrast in this patient population is controversial but may be appropriate. Deferring neuroimaging while observing for symptomatic improvement may be a safe alternative.

- **Variation 4:** An MRI head without and with IV contrast, MRI head without IV contrast, or CT head without IV contrast is usually appropriate for the initial imaging of a persistent or worsening change in mental status despite clinical management of the suspected underlying cause (intoxication, medication-related, hypoglycemia, sepsis, etc) or an acute change in mental status of unknown cause. A noncontrast head CT is usually the initial imaging test of choice. MRI is complementary to CT, but may also be used as a first-line test based on clinical judgement.
- **Variation 5:** A CT head without IV contrast is usually appropriate for the initial imaging of new onset delirium. The panel did not agree on recommending an MRI head without and with IV contrast or an MRI head without IV contrast in this clinical scenario. There is insufficient medical literature to conclude whether or not these patients would benefit from these procedures. The use of an MRI head without and with IV contrast or an MRI head without IV contrast in this patient population is controversial but may be appropriate. The yield of neuroimaging may be low in the absence of a focal neurologic deficit or trauma.
- **Variation 6:** A CT head without IV contrast, MRI head without and with IV contrast, or MRI head without IV contrast may be appropriate for the initial imaging of new onset psychosis. The yield of neuroimaging may be low in the absence of a neurologic deficit.

Supporting Documents

The evidence table, literature search, and appendix for this topic are available at <https://acsearch.acr.org/list>. The appendix includes the strength of evidence assessment and the final rating round tabulations for each recommendation.

For additional information on the Appropriateness Criteria methodology and other supporting documents go to www.acr.org/ac.

Appropriateness Category Names and Definitions

Appropriateness Category Name	Appropriateness Rating	Appropriateness Category Definition
Usually Appropriate	7, 8, or 9	The imaging procedure or treatment is indicated in the specified clinical scenarios at a favorable risk-benefit ratio for patients.
May Be Appropriate	4, 5, or 6	The imaging procedure or treatment may be indicated in the specified clinical scenarios as an alternative to imaging procedures or treatments with a more favorable risk-benefit ratio, or the risk-benefit ratio for patients is equivocal.
May Be Appropriate (Disagreement)	5	The individual ratings are too dispersed from the panel median. The different label provides transparency regarding the panel's recommendation. "May be appropriate" is the rating category and a rating of 5 is assigned.
Usually Not Appropriate	1, 2, or 3	The imaging procedure or treatment is unlikely to be indicated in the specified clinical scenarios, or the risk-benefit ratio for patients is likely to be unfavorable.

Relative Radiation Level Information

Potential adverse health effects associated with radiation exposure are an important factor to consider when selecting the appropriate imaging procedure. Because there is a wide range of radiation exposures associated with different diagnostic procedures, a relative radiation level (RRL) indication has been included for each imaging examination. The RRLs are based on effective dose, which is a radiation dose quantity that is used to estimate population total radiation risk associated with an imaging procedure. Patients in the pediatric age group are at inherently higher risk from exposure, because of both organ sensitivity and longer life expectancy (relevant to the long latency that appears to accompany radiation exposure). For these reasons, the RRL dose estimate ranges for pediatric examinations are lower as compared with those specified for adults (see Table below). Additional information regarding radiation dose assessment for imaging examinations can be found in the ACR Appropriateness Criteria® [Radiation Dose Assessment Introduction](#) document [53].

Relative Radiation Level Designations		
Relative Radiation Level*	Adult Effective Dose Estimate Range	Pediatric Effective Dose Estimate Range
○	0 mSv	0 mSv
☼	<0.1 mSv	<0.03 mSv
☼ ☼	0.1-1 mSv	0.03-0.3 mSv
☼ ☼ ☼	1-10 mSv	0.3-3 mSv
☼ ☼ ☼ ☼	10-30 mSv	3-10 mSv
☼ ☼ ☼ ☼ ☼	30-100 mSv	10-30 mSv

*RRL assignments for some of the examinations cannot be made, because the actual patient doses in these procedures vary as a function of a number of factors (eg, region of the body exposed to ionizing radiation, the imaging guidance that is used). The RRLs for these examinations are designated as "Varies".

References

1. Clinical policy for the initial approach to patients presenting with altered mental status. *Ann Emerg Med* 1999;33:251-81.

2. Leong LB, Wei Jian KH, Vasu A, Seow E. Identifying risk factors for an abnormal computed tomographic scan of the head among patients with altered mental status in the Emergency Department. *Eur J Emerg Med* 2010;17:219-23.
3. Han JH, Wilber ST. Altered mental status in older patients in the emergency department. *Clin Geriatr Med* 2013;29:101-36.
4. Xiao HY, Wang YX, Xu TD, et al. Evaluation and treatment of altered mental status patients in the emergency department: Life in the fast lane. *World J Emerg Med* 2012;3:270-7.
5. Aslaner MA, Boz M, Celik A, et al. Etiologies and delirium rates of elderly ED patients with acutely altered mental status: a multicenter prospective study. *Am J Emerg Med* 2017;35:71-76.
6. Inouye SK. Delirium in older persons. *N Engl J Med* 2006;354:1157-65.
7. Wilber ST, Ondrejka JE. Altered Mental Status and Delirium. *Emerg Med Clin North Am* 2016;34:649-65.
8. Theisen-Toupal J, Breu AC, Mattison ML, Arnaout R. Diagnostic yield of head computed tomography for the hospitalized medical patient with delirium. *J Hosp Med* 2014;9:497-501.
9. American Psychiatric Association. *Diagnostic and statistical manual of mental disorders : DSM-5*. 5th ed. Washington, D.C.: American Psychiatric Association; 2013.
10. Ahmed S, Leurent B, Sampson EL. Risk factors for incident delirium among older people in acute hospital medical units: a systematic review and meta-analysis. *Age Ageing* 2014;43:326-33.
11. Michaud L, Bula C, Berney A, et al. Delirium: guidelines for general hospitals. *J Psychosom Res* 2007;62:371-83.
12. Leslie DL, Marcantonio ER, Zhang Y, Leo-Summers L, Inouye SK. One-year health care costs associated with delirium in the elderly population. *Arch Intern Med* 2008;168:27-32.
13. Griswold KS, Del Regno PA, Berger RC. Recognition and Differential Diagnosis of Psychosis in Primary Care. *Am Fam Physician* 2015;91:856-63.
14. Perala J, Suvisaari J, Saarni SI, et al. Lifetime prevalence of psychotic and bipolar I disorders in a general population. *Arch Gen Psychiatry* 2007;64:19-28.
15. *National Institute for Health and Care Excellence (UK). Psychosis and Schizophrenia in Adults: Treatment and Management: Updated Edition 2014*. London: ; 2014.
16. Han JH, Schnelle JF, Ely EW. The relationship between a chief complaint of "altered mental status" and delirium in older emergency department patients. *Acad Emerg Med* 2014;21:937-40.
17. Sporer KA, Solares M, Durant EJ, Wang W, Wu AH, Rodriguez RM. Accuracy of the initial diagnosis among patients with an acutely altered mental status. *Emerg Med J* 2013;30:243-6.
18. Salmela MB, Mortazavi S, Jagadeesan BD, et al. ACR Appropriateness Criteria(R) Cerebrovascular Disease. *J Am Coll Radiol* 2017;14:S34-S61.
19. American College of Radiology. ACR Appropriateness Criteria®: Seizures and Epilepsy. Available at: <https://acsearch.acr.org/docs/69479/Narrative/>. Accessed November 30, 2018.
20. Shetty VS, Reis MN, Aulino JM, et al. ACR Appropriateness Criteria Head Trauma. *J Am Coll Radiol* 2016;13:668-79.
21. Douglas AC, Wippold FJ, 2nd, Broderick DF, et al. ACR Appropriateness Criteria Headache. *J Am Coll Radiol* 2014;11:657-67.
22. Wippold FJ, 2nd, Brown DC, Broderick DF, et al. ACR Appropriateness Criteria Dementia and Movement Disorders. *J Am Coll Radiol* 2015;12:19-28.
23. Fan E, Shahid S, Kondreddi VP, et al. Informed consent in the critically ill: a two-step approach incorporating delirium screening. *Crit Care Med* 2008;36:94-9.
24. Hartjes TM, Meece L, Horgas AL. CE: Assessing and Managing Pain, Agitation, and Delirium in Hospitalized Older Adults. *Am J Nurs* 2016;116:38-46.
25. Lavdas E, Mavroidis P, Kostopoulos S, et al. Improvement of image quality using BLADE sequences in brain MR imaging. *Magn Reson Imaging* 2013;31:189-200.
26. Bent C, Lee PS, Shen PY, Bang H, Bobinski M. Clinical scoring system may improve yield of head CT of non-trauma emergency department patients. *Emerg Radiol* 2015;22:511-6.
27. Khan S, Guerra C, Khandji A, Bauer RM, Claassen J, Wunsch H. Frequency of acute changes found on head computed tomographies in critically ill patients: a retrospective cohort study. *J Crit Care* 2014;29:884 e7-12.
28. Lim BL, Lim GH, Heng WJ, Seow E. Clinical predictors of abnormal computed tomography findings in patients with altered mental status. *Singapore Med J* 2009;50:885-8.
29. Narayanan V, Keniston A, Albert RK. Utility of emergency cranial computed tomography in patients without trauma. *Acad Emerg Med* 2012;19:E1055-60.
30. Segard J, Montassier E, Trewick D, Le Conte P, Guillon B, Berrut G. Urgent computed tomography brain scan for elderly patients: can we improve its diagnostic yield? *Eur J Emerg Med* 2013;20:51-3.

31. Shuaib W, Tiwana MH, Chokshi FH, Johnson JO, Bedi H, Khosa F. Utility of CT head in the acute setting: value of contrast and non-contrast studies. *Ir J Med Sci* 2015;184:631-5.
32. Hammoud K, Lanfranchi M, Li SX, Mehan WA. What is the diagnostic value of head MRI after negative head CT in ED patients presenting with symptoms atypical of stroke? *Emerg Radiol* 2016;23:339-44.
33. Lever NM, Nystrom KV, Schindler JL, Halliday J, Wira C, 3rd, Funk M. Missed opportunities for recognition of ischemic stroke in the emergency department. *J Emerg Nurs* 2013;39:434-9.
34. Lim CC, Gan R, Chan CL, et al. Severe hypoglycemia associated with an illegal sexual enhancement product adulterated with glibenclamide: MR imaging findings. *Radiology* 2009;250:193-201.
35. Malatt C, Zawaideh M, Chao C, Hesselink JR, Lee RR, Chen JY. Head computed tomography in the emergency department: a collection of easily missed findings that are life-threatening or life-changing. *J Emerg Med* 2014;47:646-59.
36. Granata RT, Castillo EM, Vilke GM. Safety of deferred CT imaging of intoxicated patients presenting with possible traumatic brain injury. *Am J Emerg Med* 2017;35:51-54.
37. Sparacia G, Anastasi A, Speciale C, Agnello F, Banco A. Magnetic resonance imaging in the assessment of brain involvement in alcoholic and nonalcoholic Wernicke's encephalopathy. *World J Radiol* 2017;9:72-78.
38. Hardy JE, Brennan N. Computerized tomography of the brain for elderly patients presenting to the emergency department with acute confusion. *Emerg Med Australas* 2008;20:420-4.
39. Lai MM, Wong Tin Niam DM. Intracranial cause of delirium: computed tomography yield and predictive factors. *Intern Med J* 2012;42:422-7.
40. Vijaykrishnan R, Ramasubramanian A, Dhand S. Utility of Head CT Scan for Acute Inpatient Delirium. *Hosp Top* 2015;93:9-12.
41. Hufschmidt A, Shabarin V. Diagnostic yield of cerebral imaging in patients with acute confusion. *Acta Neurol Scand* 2008;118:245-50.
42. Goulet K, Deschamps B, Evoy F, Trudel JF. Use of brain imaging (computed tomography and magnetic resonance imaging) in first-episode psychosis: review and retrospective study. *Can J Psychiatry* 2009;54:493-501.
43. Murphy R, O'Donoghue S, Counihan T, et al. Neuropsychiatric syndromes of multiple sclerosis. *J Neurol Neurosurg Psychiatry* 2017;88:697-708.
44. Tan Z, Zhou Y, Li X, et al. Brain magnetic resonance imaging, cerebrospinal fluid, and autoantibody profile in 118 patients with neuropsychiatric lupus. *Clin Rheumatol* 2018;37:227-33.
45. Robert Williams S, Yukio Koyanagi C, Shigemi Hishinuma E. On the usefulness of structural brain imaging for young first episode inpatients with psychosis. *Psychiatry Res* 2014;224:104-6.
46. Strahl B, Cheung YK, Stuckey SL. Diagnostic yield of computed tomography of the brain in first episode psychosis. *J Med Imaging Radiat Oncol* 2010;54:431-4.
47. Khandanpour N, Hoggard N, Connolly DJ. The role of MRI and CT of the brain in first episodes of psychosis. *Clin Radiol* 2013;68:245-50.
48. Nazarian DJ, Broder JS, Thiessen MEW, Wilson MP, Zun LS, Brown MD. Clinical Policy: Critical Issues in the Diagnosis and Management of the Adult Psychiatric Patient in the Emergency Department. *Ann Emerg Med* 2017;69:480-98.
49. Lehman AF, Lieberman JA, Dixon LB, et al. Practice guideline for the treatment of patients with schizophrenia, second edition. *Am J Psychiatry* 2004;161:1-56.
50. Sommer IE, de Kort GA, Meijering AL, et al. How frequent are radiological abnormalities in patients with psychosis? A review of 1379 MRI scans. *Schizophr Bull* 2013;39:815-9.
51. Landin-Romero R, Sarro S, Fernandez-Corcuera P, et al. Prevalence of cavum vergae in psychosis and mood spectrum disorders. *J Affect Disord* 2015;186:53-7.
52. Walterfang M, McGuire PK, Yung AR, et al. White matter volume changes in people who develop psychosis. *Br J Psychiatry* 2008;193:210-5.
53. American College of Radiology. ACR Appropriateness Criteria® Radiation Dose Assessment Introduction. Available at: <https://www.acr.org/-/media/ACR/Files/Appropriateness-Criteria/RadiationDoseAssessmentIntro.pdf>. Accessed November 30, 2018.

The ACR Committee on Appropriateness Criteria and its expert panels have developed criteria for determining appropriate imaging examinations for diagnosis and treatment of specified medical condition(s). These criteria are intended to guide radiologists, radiation oncologists and referring physicians in making decisions regarding radiologic imaging and treatment. Generally, the complexity and severity of a patient's clinical condition should dictate the selection of appropriate imaging procedures or treatments. Only those examinations generally used for evaluation of the patient's condition are ranked. Other imaging studies necessary to evaluate other co-existent diseases or other medical consequences of this condition are not considered in this document. The availability of equipment or personnel may influence the selection of appropriate imaging procedures or treatments. Imaging techniques classified as investigational by the FDA have not been considered in developing these criteria; however, study of new equipment and applications should be encouraged. The ultimate decision regarding the appropriateness of any specific radiologic examination or treatment must be made by the referring physician and radiologist in light of all the circumstances presented in an individual examination.