Clinicians commonly sedate critically ill patients. Sedatives should be administered to achieve predetermined end points. Most currently available scales used to assess sedation are inadequate because they focus on a single domain, such as consciousness. The development of the American Association of Critical-Care Nurses’ Sedation Assessment Scale is described. This new scale consists of 5 domains: consciousness, agitation, anxiety, sleep, and patient-ventilator synchrony. A major advantage of the scale is that its domains parallel common goals of sedation therapy for critically ill patients. The proposed measurements for each domain are based on a comprehensive evaluation of the science and expert recommendations. Before the scale is widely used, clinical testing is required to determine its validity and reliability in a variety of critically ill patients and care situations. (American Journal of Critical Care. 2005;14:531-544)

Clinicians commonly sedate critically ill patients to facilitate patient-ventilator synchrony, relieve anxiety, promote sleep or rest, prevent self-harm, induce amnesia, alleviate agitation, promote hemodynamic stability, and reduce intracranial pressure. Sedatives should be administered to achieve predetermined end points, because both insufficient sedation and oversedation can lead to adverse outcomes. Yet, a major limitation of most scales currently used to assess sedation is the narrow focus on a single domain, usually consciousness or agitation.1

In August 2002, a group of critical care experts met in Nashville, Tenn, for a consensus conference on the assessment of sedation. The conference, phase 1 of a 3-phase project, was the result of a collaborative effort between the American Association of Critical-Care Nurses (AACN), Abbott Laboratories, Abbott Park, Ill, and Saint Thomas Health System in Nashville. The purpose was to address the critical need for a valid and reliable sedation assessment scale for use in critically ill patients.

A major limitation of currently available sedation scales is the narrow focus on a single domain, usually consciousness or agitation.

In order to obtain a broad perspective on sedation assessment and management requirements in critical care practice, healthcare providers with clinical practice expertise in medical, surgical, cardiovascular,
neurosurgical, pediatric, and adult critical care nursing were invited to participate in the consensus conference. Participants were experts in sedation management and represented hospital practice throughout the United States. In addition, members of the conference were selected on the basis of their expertise in pain management, anxiety/fear, sleep, patient-ventilator synchrony, delirium, clinical pharmacology, and development of sedation scales, concepts that are highly relevant to sedation assessment and management.

During the conference, a series of questions was posed to participants and served as the basis for the development of a new sedation assessment tool. Questions included the following:

- Are the available sedation assessment scales adequate for use in critically ill patients? Is there a need for a new sedation assessment scale?
- What is needed to improve assessment of sedation in critically ill patients?
- What subscales or domains should be included in a sedation assessment scale?
- What are the challenges to ensuring that the sedation needs of critically ill patients are adequately addressed?

A summary of the responses to these questions has been described previously. Importantly, participants recommended development of a new sedation assessment scale consisting of multiple domains that represent the goals of sedation therapy. Suggested domains included consciousness, safety/agitation, anxiety, sleep, and patient-ventilator synchrony.

Phase 2 of the project was to develop the AACN Sedation Assessment Scale, a new scale for use with critically ill patients who require either continuous or intermittent sedation. After the consensus conference, experts were identified for each suggested domain. As requested, each expert defined the concept represented in the domain, summarized validity and reliability data from previously developed measures of the concept, and recommended the best objective and subjective indicators of the concept. These recommendations were used to create the 5 subscales, 1 subscale for each domain, of the AACN Sedation Assessment Scale.

To determine face and content validity of the scale, the original members of the consensus conference and 5 additional critical care experts reviewed the proposed scale. For each subscale, individuals responded to numerous questions to determine the degree to which the domains of the scale represented sedation assessment needs of critically ill patients and whether or not the proposed indicators appeared to measure the concept. Reviewers were asked to use the draft AACN Sedation Assessment Scale in clinical practice, if feasible, before responding to the evaluation questions. Minor revisions to the scale were made on the basis of the reviews.

In this article, we present the outcome of phase 2 of the sedation assessment project, namely, development of a new sedation assessment scale for critically ill patients. We define each of the 5 scale domains and present information on how indicators were selected to assess each domain. We acknowledge that psychometric testing is required before the scale can be recommended for clinical practice. A future publication will include results of psychometric testing, rationales for any needed modifications of the scale, and detailed directions for using and scoring the scale.

**Sedation Scale Domains**

**Consciousness**

Consciousness is awareness of oneself and the environment and has discrete, interrelated components. Normal consciousness requires wakefulness or arousal activated in the brain stem and midbrain and awareness via the cerebral cortex and projections to and from subcortical brain areas. A person who is conscious selectively perceives sensations, attending to some while filtering out others. A number of events can be held in working memory, a component that is strongly related to attention. Memories can be recovered and invoked during the processing of information. Cognition is the highest level of consciousness and involves synthesis of all previously listed components.

Impaired cognition and decreases in consciousness may occur as a consequence of critical illness or injury. One example of cognitive impairment is delirium, an acute, reversible organic mental syndrome of global mental impairment due to severe medical illness. Common syndromes of impaired consciousness include stupor, coma, persistent vegetative state, and brain death.
Delirium has an acute onset and fluctuating course and impairs a person’s ability to receive, process, store, or recall information. Delirium is relatively common in patients in the intensive care unit (ICU) and is associated with numerous clinical conditions, substance intoxication or withdrawal, use of medications, or a combination of these factors. Although delirium has been erroneously termed ICU psychosis, delirium is the more accurate term.

Stupor and coma are characterized by impairment of the arousal system. In stupor, a person arouses only in response to strong verbal or tactile stimuli, awakens briefly, and then lapses back into a sleeplike state after the stimulation stops. In coma, a person cannot be roused to consciousness. Numerous conditions produce stupor or coma, including structural lesions, metabolic derangements, inflammatory conditions, toxins, drugs, and neurodegenerative diseases.

Patients who are in a persistent vegetative state have the capacity for wakefulness, but not for awareness. These patients have sleep and wake cycles and can be aroused by sound or touch but cannot interact or carry out any motor act that requires planning or cognition. They show no evidence of recognition of self or the environment. Brain death is the cessation of all brain function, including that of the brain stem, and is characterized by 3 cardinal findings: coma, absence of brain stem reflexes, and apnea.

Assessment of Consciousness. The neurological examination is the reference standard for measuring consciousness. The degree of obtundation is best described by noting a patient’s spontaneous activity and responsivity to stimuli. Standardized documentation of consciousness via scales is useful. Coma scales provide information on severity across levels of consciousness, from fully awake and aware to stupor and coma.

The Glasgow Coma Scale (GCS) is almost universally used to assess consciousness. This 15-point scale consists of 3 subscales with ordered items: motor response, verbal response, and eye opening. However, the GCS has not been used consistently, particularly in patients who are intubated or have orbital swelling, situations that prevent verbal response or ocular assessment. Some clinicians will not provide a score for the verbal assessment when a patient is intubated, and others will make an inference about the patient’s verbal ability from the patient’s behaviors. Furthermore, the 3-dimensional assessment has a theoretical disadvantage. The 3 motor activity scores, assumed to be independent variables, are summed to obtain the total score. However, this sum may not be valid because the motor activities covary with one another. Last, eye opening does not equate with conscious awareness, because patients in a vegetative state and patients with seizures may have spontaneous eye opening.

The Glasgow Coma Scale is used inconsistently in nonverbal patients, whereas the Reaction Level Scale can signify changes in intubated and nonverbal patients.

The Reaction Level Scale (RLS85) was developed in Sweden for use in the ICU. The RLS85 is an 8-level ordinal scale used to measure responsiveness to stimuli. Its anchors are “alert with no delay in response” and “unconscious with no responses.” Levels 2 to 7 of the RLS85 correspond to linear declines from conscious to lethargic/confused, stuporous, and unconscious. Unlike the GCS, the RLS85 can be used with patients who are intubated or have ocular swelling, and the instrument compares favorably with the GCS. The RLS85 is superior to the GCS, because any change in the RLS85 score signifies a significant change in a patient’s status. Interobserver agreement is better with the RLS85 than with the GCS; in one study, 11 observers disagreed about the GCS score, whereas only 2 observers disagreed about the RLS85 score (P < .02).

Indicators of Consciousness in the AACN Sedation Assessment Scale. The indicators for measuring consciousness in the AACN Sedation Assessment Scale (see Table) are derived from the RLS85. The 8 levels in the RLS85 were collapsed into 5 levels for the AACN scale. The first 3 levels of the AACN scale parallel the first 3 levels of the RLS85. In order to simplify the AACN scale, the 5 levels of the RLS85 representing gradations of unconsciousness were collapsed into 2 levels: unconsciousness with either localization or withdrawal from pain and unconsciousness with posturing or no response to deep pain. These categories are consistent with maintaining the linear declines in consciousness but provide simplicity in the AACN scale.

Agitation

Agitation is most often described as excessive restlessness, which is characterized by nonpurposeful mental and physical activity due to internal tension and anxiety. However, no clear, concise, and universally accepted definition of agitation in ICU patients exists. Patients with agitation have continual movement such as fidgeting, moving from side to side, pulling at...
### American Association of Critical-Care Nurses Sedation Assessment Scale

<table>
<thead>
<tr>
<th>Domain or subscale</th>
<th>Indicator</th>
<th>Score</th>
<th>Score</th>
</tr>
</thead>
<tbody>
<tr>
<td>Consciousness</td>
<td>Awake and aware of self and environment</td>
<td>Spontaneously opens eyes and initiates interaction with others</td>
<td>Wakens and responds after light verbal or tactile stimuli</td>
</tr>
<tr>
<td></td>
<td>Body movement, patient/staff safety*</td>
<td>Calm body movements and tolerance of treatments and restrictions</td>
<td>Body movements or noncompliance with treatments or restrictions do not pose a significant risk for safety of patient or staff</td>
</tr>
<tr>
<td></td>
<td>Noises of patient</td>
<td>No noises</td>
<td>Frequent moaning or calling out</td>
</tr>
<tr>
<td></td>
<td>Patients’ statements†</td>
<td>Very calm</td>
<td></td>
</tr>
<tr>
<td>Anxiety</td>
<td>Patient’s perceived anxiety† (Faces Anxiety Scale‡)</td>
<td>No anxiety</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Sleep</td>
<td>Observed sleep</td>
<td>Looks asleep, calm, resting (eyes closed, calm face and body)</td>
<td>Looks asleep, periodically awakens and returns to sleep easily</td>
</tr>
<tr>
<td></td>
<td>Patient’s perceived quality of sleep‡</td>
<td>I slept well</td>
<td>I slept fair</td>
</tr>
<tr>
<td>Patient-ventilator synchrony</td>
<td>Breathing pattern relative to ventilator cycle</td>
<td>Synchrony of patient and ventilator at all times, patient cooperative and accepting ventilation</td>
<td>Occasional resistance to ventilation, or spontaneous breathing is out of synchrony with the ventilator</td>
</tr>
</tbody>
</table>

*This component is assessed in all patients, regardless of the goal of sedation.
†Assumes the patient has the ability to understand directions and communicate his or her perceptions either verbally, in writing, or by pointing to words or pictures. If score is greater than 2 for this subscale, ask the patient if he or she needs something to help him or her relax.
‡Faces Anxiety Scale reprinted from McKinley et al., with permission of Blackwell Publishing.
dressings and bed sheets, and attempting to remove catheters or other tubes. Patients with agitation are usually disoriented and cannot readily follow commands. Agitation occurs often in the critically ill\(^{19-21}\) and may result in unplanned extubation, increased oxygen consumption, hemodynamic instability, injury to self or care providers, and inability to participate in therapeutic interventions.\(^{22-24}\)

The cause of agitation is multifactorial and difficult to determine.\(^{17,18}\) In critical care, pain, hypoxia, effects of drugs, confusion, delirium, and substance or medication withdrawal are the most common precursors to agitation.\(^{25,26}\) In addition, traumatic brain injury, ruptured aneurysm, ischemic stroke, brain abscesses, hyperglycemia and hypoglycemia, uremia, and elevated serum levels of lead and mercury have been associated with agitation.\(^{27}\) A patient’s exposure to loud noise, bright lights, and continuous stimuli within the ICU environment may also contribute to agitation.\(^{27}\)

**Assessment of Agitation.** Subjective and objective approaches have been used to assess agitation. The 2 subjective approaches include observations by a clinician of a patient’s physical activity and facial expressions. In general, clinicians assess patients for agitation by subjectively observing the patients’ physical activity, nonverbal behavior, and verbalizations. Consequently, findings of agitation may vary among clinicians, because of (at least in part) confusion about the definition of agitation.\(^{19}\) To minimize this variation, experts have developed scales to assess agitation; most of the scales also include measures of sedation. The most commonly used scales are the Ramsay Sedation Scale,\(^{28}\) the Riker Sedation-Agitation Scale,\(^{21}\) and the Richmond Agitation Sedation Scale.\(^{29}\) Each of these scales is used to evaluate the degree of agitation at a single point in time and describe a patient’s behavior. Most scales have been validated in critically ill patients. However, because no gold standard exists for assessment of agitation, most scales have been validated against other sedation-agitation tools.

In addition to physical activity, clinicians examine patients’ facial expressions (grimacing) to assess agitation. Although examination of facial expressions has not been used specifically to evaluate agitation, it has been used with nonverbal adults and children to assess pain or discomfort, potential causes of agitation.\(^{30-33}\) Children, like adults who are intubated, are often nonverbal and therefore cannot speak about their discomfort or distress. Thus, measures of distress used in children may be appropriate for adults as well. Facial grimacing scales for use in children include evaluation of facial actions such as brow bulge, eyes squeezed shut, and nasolabial furrow.\(^{34}\) The COMFORT Scale,\(^{35}\) originally designed to assess pain and sedation in intubated children but more recently used with adults,\(^{36,37}\) includes a 5-point measure of facial tension, for rating facial muscles from totally relaxed to contorted and grimacing. Degree of facial expression is also associated with pain intensity in adults\(^{38,39}\) and is the most commonly observed behavior related to procedural pain.\(^{36}\) Facial expressions, specifically a wrinkled mouth or brow or eyes squeezed shut, have been used to assess pain in patients with advanced dementia.\(^{39}\) Although facial expressions are not specific to agitation, an evaluation of such expressions may be an additional and meaningful measure of agitation.

**In addition to physical activity, patients’ facial expressions have been used to evaluate agitation level.**

Objective measures of agitation include hemodynamic stability, brain function (bispectral analysis), and physical activity (actigraphy). Agitation activates the sympathetic nervous system, causing the adrenal medulla to release catecholamines. Epinephrine enhances cardiac contractility, increases heart rate, and augments venous return to the heart, all of which increase cardiac output, blood pressure, and oxygen demand. In addition, norepinephrine elevates blood pressure through its constrictor effects on vascular smooth muscle. The increase in physical activity associated with agitation further increases heart rate, blood pressure, and oxygen demand. Two physiological domains of the COMFORT Scale\(^{40}\) address increases in heart rate and blood pressure related to pain and sedation and are appropriate markers for agitation. A 15% or greater change in heart rate or blood pressure is considered an indication of changes in physiological status related to lack of comfort and is an appropriate level of change that can be recognized clinically.

The bispectral index (BIS) is calculated from electroencephalographic (EEG) data. A sensor on the forehead transmits EEG data to a computer, which translates the data into a single number ranging from 0 (absence of brain activity) to 100 (awake). The BIS was designed to monitor the depth of hypnosis during anesthesia.
and sedation. Empirically derived from the EEGs of more than 5000 anaesthetized patients, the BIS represents a bispectral analysis of information from the cortical and subcortical areas of the brain. This information changes with increasing amounts of stress and hypnotic drugs. The BIS correlated with the Ramsay Scale in multiple studies. However, associations among the BIS and other subjective and objective sedation scales vary among medical, surgical, and trauma patients. In addition, excessive muscle movement introduces error and appears to undermine the reliability of the BIS. Although the BIS may be an appropriate measure of depth of sedation in some patients, it may not accurately indicate the restlessness or increased physical activity associated with agitation.

Actigraphy, a continuous measure of activity, was initially developed to measure activity during sleep. An actimeter is a small electronic device that when strapped to the wrist or ankle continuously senses and records minimal movements or activity during predetermined epochs for as long as several days. Actigraphic data are expressions of acceleration movement in numerical form. Actigraphy has been used to track circadian rest-activity cycles and to detect states of wakefulness and sleep. Results of wrist actigraphy have shown significant agreement with sleep-wake cycles and the technique provides objective indications of changes in depth of anesthesia or sedation during surgery and recovery. More recently, actigraphy was highly correlated with subjective scales of agitation and sedation (Richmond Agitation Sedation Scale, COMFORT Scale) and with observed stimulation in critically ill adults. Although actigraphy, in its current form, may not be useful in clinical settings for assessing moment-to-moment changes in the level of agitation, its usefulness as a research tool to objectively measure the physical activity component of agitation is promising.

Indicators of Agitation in the AACN Sedation Assessment Scale. Agitation is a behavior that results from a variety of causes and can be detected by using a multifactor assessment including body movement, the noises patients make, and patients’ verbalizations (see Table). Agitation is described as excessive restlessness; therefore, measures of body and facial movement, as well as verbalizations, are appropriate indicators. In addition, these indicators include commonly observed characteristics of agitation and are similar to those used in other measures of agitation in critically ill patients. Although physiological parameters also may change and are part of any assessment of a patient’s status, they are not exclusive to agitation and thus were not included in the proposed AACN tool.

Anxiety

Anxiety is a “psychophysiological phenomenon experienced as a foreboding dread or threat to a human organism whether the threat is generated by internal, real or imagined dangers.” Anxiety has been described as a subjective feeling of distress and anguish that has affective, motivational, behavioral, and physiological components. A key feature of anxiety is its subjective nature.

Anxiety exists along a continuum from a normal response associated with a perceived threat to a pathological anxiety disorder. Although anxiety is regarded as a motivational or adaptive process, persistent anxiety may produce dysfunctional responses and ensuing adverse consequences. Both normal and pathological anxiety reactions have comparable cognitive, neurobiological, and behavioral components. Most relevant to ICU patients is state anxiety. According to Spielberger, state anxiety “refers to an empirical process or reaction which is taking place now at a given level of intensity.” Spielberger further conceptualized state anxiety as “a transitory emotional state or condition of the human organism that varies in intensity and fluctuates over time. This condition is characterized by subjective, consciously perceived feelings of tension and apprehension, and activation of the autonomic nervous system.” Importantly, many ICU patients are anxious but do not meet diagnostic criteria for an anxiety disorder.

It is well known that critically ill patients are often anxious. The source of this anxiety is situational and is related to the ICU environment, diagnostic and therapeutic procedures, physical symptoms such as dyspnea or pain, healthcare costs, and concerns about disability, disfigurement, or death.

Physiologically, anxiety is not a benign phenomenon. Anxiety may trigger an overall sympathetic nervous system response that increases myocardial oxygen demand, induces myocardial ischemia, impairs ventricular function, alters heart rate variability, and compromises immune function. Data indicate that among patients with acute myocardial infarction, in-hospital ventricular fibrillation, ischemia, and reinfarction are more likely to develop in those who have elevated levels of anxiety than in those with lower levels. Anxiety is a predictor of recurrent cardiac events and mortality for cardiac patients and has been associated with platelet aggregation, recurrent thrombus formation, and hyperventilation-induced coronary artery spasm. Other consequences of unrelieved anxiety include increased dyspnea, increased oxygen consumption, and delayed weaning from mechanical ventilation. Finally, anxiety during hospitalization has been linked to subsequent posttraumatic stress disorder.
Assessment of Anxiety. More than 200 instruments to assess anxiety are available; however, no instrument has been distinguished as the reference standard. The State-Trait Anxiety Inventory (STAI), the anxiety subscale of the Brief Symptom Inventory, the Hospital Anxiety and Depression Scale, and the Profile of Mood States are 4 valid and reliable self-report anxiety instruments that commonly have been used with critically ill patients. In addition, the Faces Anxiety Scale, a new and valid instrument designed to assess anxiety in critically ill patients, is now available.

The STAI is a unidimensional instrument with two 20-item subscales. One subscale measures state anxiety; the other, trait anxiety. For the state anxiety subscale, responses range from 1 (not at all) to 4 (very much so). Nurses, physicians, and other allied health professionals have used the STAI in numerous clinical practice and research settings.

The Brief Symptom Inventory is a 53-item multidimensional instrument that contains 9 symptom dimensions, including anxiety. The 6-item anxiety subscale addresses symptoms that are commonly associated with elevated levels of anxiety but does not include physiological indices. Response options for each item in the anxiety subscale range from 0 (not at all) to 4 (extremely).

The Hospital Anxiety and Depression Scale is a multidimensional instrument. The 7-item anxiety subscale is used to assess anxiety without focusing on somatic symptoms. Response options range from 0 to 3 and are distinctive for each question. Unlike the situation for the STAI and the Brief Symptom Inventory, normative data are not available for the Hospital Anxiety and Depression Scale.

The Profile of Mood States is a 65-item adjective rating scale of 6 affective dimensions, including tension-anxiety. Response options range from 0 (not at all) to 4 (extremely). The instrument includes observable psychomotor manifestations of anxiety such as shakiness and restlessness.

The newly developed Faces Anxiety Scale is a unidimensional instrument that consists of 5 facial expressions, ranging from a neutral expression to an expression showing extreme anxiety. This scale was designed to measure state anxiety; patients simply select the expression that best represents their current anxiety level. Scores range from 1 to 5; higher scores indicate higher anxiety. The Faces Anxiety Scale is less burdensome to patients than are longer or more cognitively demanding instruments. In a recent study, significantly more adult ICU patients could respond to the Faces Anxiety Scale than to either the Brief Symptom Inventory or a visual analog anxiety scale. Evidence suggests that the Faces Anxiety Scale is a valid measure of anxiety for adult ICU patients with a variety of medical and surgical diagnoses at the time of admission.

Critical care nurses tend to focus on physiological markers of anxiety. In one study, critical care nurses identified agitation, increased blood pressure, and increased heart rate as the 3 most important indicators of anxiety. In another study, critical care nurses indicated that they assessed anxiety most often by using behavioral and physiological indicators of anxiety. Of the physiological indicators, nurses were most likely to use increases in heart rate, blood pressure, and respiratory rate as signs of anxiety. Remarkably, fewer than 5% of nurses indicated that a patient’s verbalization of anxiety was an important component of the anxiety assessment.

However, physiological indications of anxiety may not be important when critically ill patients are assessed for anxiety, because distinguishing between indicators of anxiety and signs that reflect changes in a patient’s overall physical condition can be challenging. Anxiety is not necessarily accompanied by physiological changes; critically ill patients may manifest anxiety in diverse manners. In 2 recent studies, anxiety levels of ICU patients were not associated with blood pressure or heart rate. Participants in other studies did not have changes in heart rate and blood pressure in response to acute anxiety. Even patients with extreme anxiety did not respond in a predictable manner; some, but not all, had a higher heart rate and blood pressure than did patients without such anxiety.

When anxiety was associated with an increased heart rate and blood pressure, the increases were so minimal that nurses either would not observe the change or would not necessarily attribute the change to anxiety.

Although anxiety can have significant physiological consequences, physiological signs and symptoms may not be useful in assessing anxiety because they come from a variety of sources.

Indicator of Anxiety in the AACN Sedation Assessment Scale. The Faces Anxiety Scale is the selected indicator of anxiety for use in the AACN Sedation Assessment Scale (see Table). Use of a simple, straightforward, and valid self-report measure is crucial, because of the need to minimize patients’ burden and because...
of the poor relationship between patient-generated and clinician-generated anxiety ratings. Use of brief and simple scales is especially important when anxiety assessments are done frequently, as is the situation for ICU patients. Anxiety is a subjective experience; therefore, an assessment of anxiety is inappropriate for patients who cannot communicate their perceptions by either verbally stating which face pertains to them or pointing to a face.

Sleep

Sleep is a multifaceted domain that is challenging to achieve and measure, particularly in critically ill, sedated patients. For the purpose of the AACN Sedation Assessment Scale, sleep is defined as a complex cycle of physiological activities that occur during reduced consciousness in an environment that minimizes arousals or awakenings.

Sleep consists of 2 physiological periods: rapid eye movement (REM) sleep and non-REM (NREM) sleep. REM sleep accounts for about 25% of sleep time; NREM sleep, for about 75%. In healthy persons, REM sleep cycles with NREM sleep every 90 minutes. REM sleep, considered essential for psychological and emotional well-being, involves rapid movement of the eyes, irregular respiration and heart rate, and paralysis of major muscle groups except the diaphragm and muscles in the upper part of the airway. Non-REM sleep progresses through 4 stages, from sleep onset to an increased proportion of slow-wave EEG patterns in the third and fourth stages wherein energy conservation, body renewal, and tissue building occur. The third and fourth stages of NREM are thus considered the most restorative stages of sleep. Unfortunately, patients in the ICU often have decreases in REM sleep and stages 3 and 4 of NREM sleep or no occurrence of these 2 types of sleep.

Rapid eye movement (REM) sleep is essential for psychological and emotional well-being. Stages 3 and 4 of non-REM sleep are most restorative, but both are reduced or absent in critically ill patients.

Individual, environmental, and pharmacological factors affect the sleep of critically ill patients (see Figure). Individual factors that disturb sleep include pain, mechanical ventilation, and severe sepsis. Goals of comfort and patient-ventilator synchrony may need to be achieved before the effects of sedation on sleep are evaluated. In patients with severe sepsis who did not receive continuous sedation 24 hours before study, EEG patterns remained the same while their eyes were open or closed; no definitive sleep or wake states were identifiable.

The ICU environment often is not conducive to sleep. Critical care units involve noise, bright lights, and bustling activity that may be unavoidable during intensive, emergent situations. Such an environment creates a context for disturbed sleep despite adequate management of sedation.

Pharmacological measures for sedation, analgesia, and other common conditions encountered in critical care may hinder, rather than promote, sleep. Critically ill patients who receive low to moderate doses of sedatives or analgesics intermittently often experience severe disturbances in sleep architecture. Disturbances include fragmented sleep, reduced or no REM and slow wave sleep, and a disrupted 24-hour circadian cycle. Little is known about how continuous, nocturnal, or heavy doses of sedatives affect physiological sleep. Critically ill patients who received a hypnotic or a sedative during the night reported worse sleep than did critically ill patients who did not receive a hypnotic or sedative during the night; however, it is difficult to discern whether patients’ reports reflected poor sleep before or after the medication. Critically ill patients’ perceived quality of sleep did not improve significantly after nocturnal sedation with midazolam or propofol, but polysomnography was not used.

Assessment of Sleep. Polysomnographic findings, the reference standard for measuring physiological sleep activities, remain an ideal, but impractical, indicator of sleep in critical care patients. EEG, electromyograph, and electrooculograph recordings graphically

538 AMERICAN JOURNAL OF CRITICAL CARE, November 2005, Volume 14, No. 6
depict REM and NREM sleep. Knowledge about physiological activities derived from polysomnographic data underscores the importance of sleep as a distinct domain. Cyclic periods of REM and NREM activities confirm that sleep is more than a composite score of consciousness and agitation domains, because sleep involves physiological behaviors that protect, restore, and conserve body functions.

BIS values used to monitor sedation levels are an unreliable indication of sleep, because the values vary widely within each sleep stage. A BIS threshold value indicated the onset of sleep in healthy unsedated volunteers; however, such a threshold in sedated patients may reflect onset of sedation but not onset of sleep. Thus, although BIS values correlated with wakefulness in the validation of a sedation-agitation scale, the adequacy of sedation should not be equated with successful attainment of sleep.

**The bispectral index, a measure of sedation, should not be equated to successful attainment of sleep.**

Although nurses routinely differentiate between a patient’s sleep and wake behaviors, their assessments alone may not accurately indicate the depth and quality of sleep in critically ill patients. In one study, nurses’ observations of awakening from sleep correlated with polysomnographic recordings of awakening, enhancing the validity of nurses’ ability to differentiate wake from sleep behaviors. Similarly, in another study, nurses observed sleep-wake status accurately in critically ill patients about 82% of the time when the observations were compared with polysomnographic recordings coded simply as “awake” or “asleep.” However, because REM and NREM stages were not analyzed in relation to nurses’ observations, conclusions could not be drawn about whether nurses’ assessment of sleep accurately indicated the physiological depth and quality of sleep. In a separate, small study of 9 patients recovering from major surgery, compared with objective data on REM and NREM sleep stages, nurses’ observations resulted in overestimates of sleep. Consequently, sleep assessment remains incomplete if nurses’ observations are relied on as the only indicator.

Patients’ perceptions about their sleep offer an additional indicator for evaluating sleep as an outcome of sedation. Critically ill patients repeatedly report poor-quality sleep. Several aspects of perceived sleep can be measured, such as sleep depth, sleep effectiveness, awakenings, and return to sleep. Patients’ perceived quality of sleep was inversely associated with the extent of sleep disturbances from environmental factors. Patients reported that interruptions such as sudden increased noise, lights, and loud conversation disturbed their sleep. Patients’ perceived awakenings were associated with polysomnographic evidence of awakenings lasting longer than 4 minutes. Yet, perplexingly, noise and interruptions related to patients’ care accounted for less than one third of arousals and awakenings in polysomnographic recordings of critically ill patients (sedation protocol unclear). However, the investigators did not report other factors that could have interrupted sleep, such as sudden changes in lights.

**Indicators of Sleep in the AACN Sedation Assessment Scale.** Clinical indicators of sleep for the AACN scale include nurses’ observations of sleep behavior and patients’ perceived quality of sleep. These indicators arise from a framework of individual, environmental, and pharmacological factors that may affect sleep in critical care units and confound goal achievement (see Figure). Nurses observe sleep by assessing a patient’s physical appearance over time. Patients’ perceived quality of sleep is an overall measure suitable for a clinical assessment scale. For brevity, patients rate whether they slept well, fair, or poorly. Pictures can be used for patients who have difficulty with language or verbal communication. The use of these practical and research-based indicators should enhance convergent validity regarding the effect of sedation on sleep.

**Patient-Ventilator Synchrony**

Patient-ventilator synchrony occurs when the inspiratory and expiratory phases of a patient receiving mechanical ventilation and the same phases of the ventilator occur in a coordinated manner. During the inspiratory phase, synchrony occurs when the patient either accepts a mandatory mechanical breath or initiates a spontaneous breath that is in phase with the ventilator breath inspiratory time period. The patient’s chest wall is relaxed; thus, it rises on inspiration, allowing gases to flow in freely with minimal resistance. During the expiratory phase of mechanical ventilation, synchrony is evident when the patient passively exhales and the chest falls.

Dyssynchronous patient-ventilator breathing may occur if the gas flow setting is insufficient to meet the patient’s inspiratory demand. In this situation, which may occur with mandatory or spontaneous breathing modes, the peak inspiratory flow requirement results...
in a greatly increased muscle workload. Conditions such as auto-positive end-expiratory pressure (ie, incomplete exhalation) result in inadequate sensing by the ventilator and thus increased effort by the patient to “trigger” a spontaneous breath. Chest movement appears extreme and is not coordinated with ventilator cycling. During the expiratory phase of ventilation, an expiratory time that precludes complete exhalation or is too long, thus interfering with a spontaneous inspiration, may result in dyssynchrony. Forceful or extreme inspiratory or expiratory chest movements, frequent or sustained coughing, and/or tightening of the chest wall muscle during any phase of the ventilatory cycle are all evidence of dyssynchrony. Consequently, dyssynchrony causes inadequate gas exchange, hemodynamic instability, and distress for patients. In addition, resistance to flow increases peak airway pressure, placing patients at risk for ventilator-induced lung injury.

Selected pressure- and volume-targeted ventilator modes, flow delivery options, and mechanisms that trigger spontaneous breathing promote improved patient-generated breathing, mimic more physiological breathing patterns, and enhance patients’ comfort. Efficient use of these options may help patients adapt to the ventilator or achieve complete ventilatory control, and thereby reduce or eliminate the need for deep sedation. Nonetheless, sedation is often necessary to facilitate mechanical ventilation and may be integral to management of patients with severe respiratory failure.112,113

Patient-ventilator dyssynchrony should prompt clinicians to perform a rapid, systematic assessment of the patient and the ventilator to determine the cause of distress.114-116 Once problems are identified and ventilation of patients with severe respiratory failure.112,113

The use of continuous infusions of sedatives is associated with prolonged duration of mechanical ventilation,117-119 ICU length of stay,117-119 and hospital length of stay.118 Prolonged mechanical ventilation may predispose patients to ventilator-associated pneumonia, lung injury, and other complications related to the presence of an artificial airway.120

The effect of sedation on outcomes of mechanical ventilation and weaning has spawned discussion about the best method to ensure that patients are maintained at the lightest level of sedation. As a result of these concerns, concepts such as the “daily interruption” or “sedation vacation” and “continuous titration to lowest dose” are becoming more formalized.17 Daily interruption of sedative infusions and the use of nurse-managed algorithms for administering sedatives appear to prevent oversedation and improve outcomes in these patients. Kress et al129 reported that daily interruption of sedative infusions was associated with shorter duration of both mechanical ventilation and ICU length of stay. However, caution is warranted because insufficient sedation may precipitate patient-ventilator dyssynchrony and associated physiological alterations in thoracic pressures and gas exchange. Inadequate sedation is also associated with unplanned extubation.121

Weinert et al122 conducted focus group interviews of nurses to determine factors that affect nurses’ delivery of sedative therapy. Nurses identified improved patient-ventilator synchrony as a goal of sedation and considered oversedation a possibility when patients did not initiate spontaneous breaths at a rate greater than the set ventilator rate. This research indicates that nurses recognize the relationship between sedation management and optimal outcomes of mechanical ventilation.

**Assessment of Patient-Ventilator Synchrony.** De Jonghe et al123 reviewed instruments used to assess sedation and determined that patient-ventilator synchrony is one of the most frequently assessed aspects of sedation. Many instruments have been designed for research investigations in which the purpose was to compare sedative medications or to assess the effectiveness of a sedative regimen. These instruments address pattern of breathing,124 evidence of spontaneous respiratory effort,125 physiological responses such as compromised oxygenation or ventilation,126 cough,30,127 and patient-ventilator synchrony.127,128

Hartwig et al128 developed an instrument to evaluate the effectiveness of midazolam for sedation in intubated children. Although the respiration subscale of the instrument includes the ideal indicators of synchrony and spontaneous breathing, reliability and validity data are unavailable.

The COMFORT Scale is a valid and reliable scale that was developed to assess the efficacy of pharmacological and psychological interventions used to reduce distress in children who are intubated.30 To construct
the scale, Ambuel et al \(^{30}\) reviewed the literature on distress in children and surveyed critical care nurses about variables used to assess patients’ distress. The respiratory response subscale includes the indicators of spontaneous respiration, coughing, choking, and resistance to ventilation. The Pearson interrater reliability coefficient for the respiratory response subscale was .70, indicating that clinicians had some difficulty discriminating among the levels.

**Indicator of Patient-Ventilator Synchrony in the AACN Sedation Assessment Scale.** The indicator for the AACN scale for measuring patient-ventilator synchrony is breathing pattern relative to the ventilator cycle (see Table). Implied within patient-ventilator synchrony is that the patient may initiate spontaneous breaths. Therefore, the ventilator synchrony indicator incorporates assessment of spontaneous breathing. The scale also includes assessment of the pattern of breathing to determine patient-ventilator concordance. The literature does not contain reliable and valid scales for measuring patient-ventilator synchrony in adults; therefore, indicators from 2 instruments used in children \(^{30,128}\) were adapted for the AACN scale. A 3-level indicator was chosen to enhance clinicians’ discrimination among the levels.

**Additional Elements of the AACN Sedation Assessment Scale**

Before they use any sedation assessment scale, clinicians should assess and treat potential physiological causes of a patient’s distress or agitation. For example, hypoxemia, pneumothorax, ventilatory failure, and hypoperfusion cause distress and hemodynamic instability that will be refractory to sedation therapy. Pain should also be assessed by using a valid and reliable scale and should be treated before sedation is assessed.

Another important precursor to assessment of sedation is determining the goals of sedation management. Members of the multidisciplinary team should determine the goals of sedation therapy, which can then be used to guide titration of sedative agents. Common goals of sedation therapy are to alleviate agitation, prevent patients’ self-harm, facilitate patient-ventilator synchrony, relieve anxiety, promote sleep/rest, induce amnesia, promote hemodynamic stability, and reduce intracranial pressure. The directions that accompany the AACN Sedation Assessment Scale will remind clinicians to assess pain and identify the goals of sedation management before assessing sedation.

**Next Steps**

Currently, the AACN Sedation Assessment Scale is not ready for use in clinical practice. The next step in development of the scale, phase 3, is to conduct large, rigorous clinical trials to test the reliability and validity of the scale in various diagnostic groups and care situations common in critical care. Because the scale must be tested, details on how to score, interpret, and document the sedation assessment are beyond the scope of this article; they will be described in future publications. Funding is being sought to support the clinical trials needed to test the scale.

In addition to determining the validity and reliability of the proposed scale, data from the clinical trials will help detect which of the scale’s 5 domains are required for sedation assessment based on the sedation goals selected. Some domains (eg, consciousness or agitation) may need to be assessed regardless of which sedation goals are selected, whereas other domains (eg, patient-ventilator synchrony) may require assessment only for specific sedation goals.

The results of clinical trials may also elucidate the need for additional domains. For instance, although the AACN Sedation Assessment Scale does not include hemodynamic parameters, debate exists about whether physiological stability should be a separate domain.

Finally, during clinical testing of the scale, information will be obtained to determine whether delirium should be assessed before or after sedation assessment and treatment. Delirium in critically ill patients is common but may be difficult to differentiate from behaviors that indicate the need for sedation. Treatment of delirium requires use of neuroleptic drugs, such as haloperidol and chlorpromazine, not sedatives. No data are available to guide a recommendation on whether delirium assessment and management should occur before or after sedation assessment and management.

**Summary and Conclusions**

In summary, critical care experts propose a new sedation assessment scale, the AACN Sedation Assessment Scale, which consists of 5 domains: consciousness, agitation, anxiety, sleep, and patient-ventilator synchrony. A major advantage of the scale is that its domains parallel common goals of sedation therapy. The proposed measurements for each domain are based on a comprehensive evaluation of the science and expert recommendations. Before the scale is widely used, clinical testing is required to determine its validity and reliability in a variety of critically ill patients.

**ACKNOWLEDGMENTS**

We thank Abbott Laboratories, the American Association of Critical-Care Nurses, and Saint Thomas Health System, Nashville, Tenn, for their generous support of the expert panel and the development of the sedation assessment scale. Special thanks to Ramon Lavandero and Gladys Campbell for their interest and support in the development of a new sedation assessment scale and to additional members of the
sedation assessment expert panel, Mary Kay Bader, Dorrie Fontaine, Jill Luer, Kathleen Vollman, and Lorie Wild, who provided pivotal insight and guidance in the early development of the scale.

The opinions or assertions contained herein are the private views of the authors and are not to be construed as official or as reflecting the views of the Department of the Air Force or the Department of Defense.

Commentary by Mary Jo Grap (see shaded boxes).

REFERENCES


Development of the American Association of Critical-Care Nurses' Sedation Assessment Scale for Critically Ill Patients
Maj Marla J. De Jong, Suzanne M. Burns, Margaret L. Campbell, Marianne Chulay, Mary Jo Grap, Lynelle N.B. Pierce and Terri Simpson

Am J Crit Care 2005;14 531-544
Copyright © 2005 by the American Association of Critical-Care Nurses
Published online http://ajcc.aacnjournals.org/

Personal use only. For copyright permission information:
http://ajcc.aacnjournals.org/cgi/external_ref?link_type=PERMISSIONDIRECT

Subscription Information
http://ajcc.aacnjournals.org/subscriptions/

Information for authors
http://ajcc.aacnjournals.org/misc/ifora.xhtml

Submit a manuscript
http://www.editorialmanager.com/ajcc

Email alerts
http://ajcc.aacnjournals.org/subscriptions/etoc.xhtml