Neurological Assessment of the Hospitalized Child

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Introduction

Timely and accurate assessment of a child's neurological status is an important aspect of nursing care. All children have the potential for a neurological event, whether they have a neurological diagnosis or not. Nurses are instrumental in preventing irreversible damage by identifying subtle changes from baseline that could signal deterioration. It is within the scope of nursing practice to perform independent child assessments. Children's varying stages and delays in physical and cognitive development can pose additional challenges to their assessment. Children also may be nonverbal or uncooperative with assessments.

Currently, there is no standard of care for the neurological assessment of the hospitalized child.

According to the 3rd edition of *Neuroscience Nursing: Scope and Standards of Practice* from the American Association of Neuroscience Nurses (AANN), standards of practice describe a competent level of nursing care, as demonstrated by the nursing process. The first of these standards is assessment. As the leader in neuroscience nursing, AANN recognizes the importance of having a consistent standard assessment and appointed a task force to develop this white paper delineating that standard. This paper is a companion paper modeled on *Neurological Assessment of the Adult Hospitalized Patient*. For ease of reading, content original to the adult version is not cited within the current paper.

The purpose of this document is to describe the essential components of the neurological assessment of the hospitalized child, accounting for age and development. This should assist the nurse in recognizing early neurological changes so that interventions can be implemented in a timely manner to prevent injury.

Significance

Performing a pediatric neurological assessment can be challenging. There is a perceived complexity about what components to include, how to assess children who have varying developmental and cognitive abilities, and how to interpret assessment findings. Lack of agreement among those in the field about the correct terminology to use—neurological assessment, neurological examination, or neurological check—contributes to the confusion. These terms have overlapping definitions and can be used interchangeably. However, failure to agree on the components of a standardized pediatric assessment may prevent nurses from identifying subtle neurological changes and accurately documenting them in the health record. Failure to involve caregivers, lack of familiarity with developmental stages (**Table 1**), and inconsistent approaches to assessment and documentation can contribute to communication errors, which could result in an inadequate representation of the child's ongoing neurological status.

Considerations

The nurse should carefully collect and prioritize comprehensive data about the child's medical condition, including growth and development, to uncover evidence of neurological dysfunction. The baseline assessment should include both child and caregiver input combined with evidence-based techniques and nursing knowledge relevant to the situation. The child's age, developmental stage, baseline cognitive function, and underlying medical conditions should be considered when noting neurological

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changes. Understanding a child's prenatal history and the presence of any genetic disorders also offer important insight into neurological status. The nurse should note child and/or caregiver complaints that may indicate a neurological problem, such as headache, poor growth and feeding, nausea, regression in developmental milestones, and gait changes. Subtle changes in memory, academic performance, affect, mood, attention, and personality may be easily overlooked until the disorder has progressed. The onset of symptoms such as fever, seizures, or changes in the level of consciousness (LOC) can give clues about the underlying pathology of neurological changes. Knowledge of pathophysiology and neurological anatomy enables the nurse to correlate findings of the neurological assessment to the underlying medical illness.

The nurse should note any history that could impact neurological status, such as falls, the use of anesthetics or narcotics, or changes in the underlying medical condition(s). Note any possibility of ingestion of a toxic substance or medication. It also is prudent for the nurse to consider child maltreatment and abusive head trauma in certain circumstances in which the history does not correlate with the assessment findings. The nurse should involve the child's caregivers or other medical providers in the assessment process to collect pertinent information. Caregiver involvement is crucial when assessing a child who is nonverbal, is uncooperative, or has a developmental delay.

Focused neurological assessments and observations are vital to ensuring early recognition of deterioration due neurological insult or disease process.

Timing of Assessment

Ongoing and serial neurological assessments are critical in establishing neurological baseline, detecting decline, and evaluating interventions. Conducting these assessments consistently and at regular intervals is of utmost importance. The pediatric neurological assessment is a key component of the head-to-toe assessment conducted at the beginning of each shift. More frequent neurological assessments should be completed when there are concerns about clinical changes or after specific tests or procedures. Consider timing the assessment after the effects of sedating medications have worn off because these medications can affect the assessment findings. To ensure consistency, it is recommended that a joint neurological assessment be completed at nursing shift change or any time there is caregiver handoff, such as when the child returns from the operating room or radiology department.

While it is counterintuitive to wake a sleeping child, the importance of conducting neurological assessments throughout the night on a child at risk for neurological decline cannot be overstated. Establishing this expectation with caregivers and coordinating these assessments with other necessary cares can alleviate additional stress.

Intervention and Documentation

In the event that a decline in neurological status is detected, appropriate escalation should follow. This may range from contacting the covering provider to initiating an emergency response. Interventions may include imaging, labs, medications, and/or procedures. The nurse should document changes in neurological status and all communications and interventions in the health record. The nurse also should ensure that caregivers, whether at the bedside or not, are promptly updated.

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Neurological Assessment Components

There are six components of the baseline focused assessment for the awake and alert hospitalized child: cranial assessment, LOC, communication, cranial nerve (CN) status (vision, pupils, facial symmetry, swallow), motor function/sensation, and vital signs (**Table 2**). Assessment of open fontanels and head circumference measurement should be included for infants (children younger than 1 year). A more detailed assessment may be performed if deficits are identified.

Cranial Assessment

Note any abnormal skull shape. Infants should have a head circumference measured at the time of admission and documented on an age-appropriate growth chart (measure widest circumference, front to back). This should be obtained weekly while the child is in the hospital to confirm head circumference is following the expected growth curve and to ensure early recognition of dramatic increases or crossing of percentiles. Head circumferences should be measured more frequently for infants at risk for hydrocephalus or other space-occupying conditions.

The anterior fontanel is a helpful clinical indicator of intracranial changes. It should be soft and pulsatile when the infant is calm and in an upright position. A bulging or tense fontanel in an otherwise calm infant requires further investigation. Cranial sutures should be well-approximated. Growing gaps between sutures may indicate increased intracranial pressure (ICP).

Level of Consciousness

LOC is the most sensitive indicator of a neurologic problem and one of the earliest. Among the more commonly used tools to assess LOC is the Modified Glasgow Coma Scale for Infants and Children, which evaluates the child's eye opening, speech, and motor response. There are several other modified scales used in pediatrics.

The nurse can engage the child in a brief interaction to assess LOC. A fully conscious child can comprehend questions, process, and respond coherently and appropriately within their developmental level. However, a child can be alert and fluent but still have deficits. Entering the child's room will help determine an initial level of arousal and/or awareness. To assess ability to follow developmentally appropriate commands, ask questions related to things in their environment, such as "What movie are you watching?" or "Who is this?" when pointing to a toy or parents. The child's ability to follow commands may rely on the examiner's knowledge of what commands a child of a certain age would be able to follow as well as the child's receptive communication and motor function. For example, a young toddler may be able to follow only a one-step command, such as "Point to your nose." Parents and caregivers who know the child well are likely to be helpful in assessing subtle changes in LOC.

Evaluate the child's response to voice (call their name) or gentle touch (tap their shoulder). Evaluating their response to noxious stimuli should only occur if the child has a decreased LOC. Infants and children who are developmentally delayed or uncooperative might not follow commands and should be assessed for response to voice or light touch, focus, and tracking.

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Communication

Communication is present at birth, so it is important to evaluate according to the child's age and developmental stage (Table 1). As with all pediatric neurological assessments, knowledge of baseline abilities and caregiver input are important to help the child communicate optimally. Many children use nonverbal forms of communication, including body language, devices, picture boards, and sign language.

Assessment of language and speech function focuses on the child's expression and comprehension of spoken language. Infants should verbalize appropriately for their developmental age (crying, cooing, and babbling). For the older child who is verbally communicative, evaluate their ability to engage in sensible conversation. Do they speak coherently? Note any inappropriate or nonsensical words. Ask the child to name objects or repeat simple sentences to evaluate their ability to understand.

Cranial Nerve Status

CNs are part of a complete neurological assessment. CN impairment refers to dysfunction of one or more of the CNs and may occur as a result of infection, tumor, head trauma, autoimmune disorders, uncontrolled hypertension, or diabetes. CN assessment should be combined with other neurological exams to identify the underlying etiology of symptoms.

The eyes, facial symmetry, and speech/swallowing can be noted on initial assessment upon room entry. Eyes should track the caregiver or healthcare provider. Bright lights or a child's favorite toy may be helpful in assessing tracking. Facial asymmetry or lack of tracking warrants a provider notification. Any deficits or history of neurological injury requires a more thorough assessment.

Motor Function/Sensation

Motor and sensory assessments are both functional and neurological, and acute changes can reveal significant pathology. It is important that the initial assessment includes an evaluation of baseline motor and sensory deficits, such as muscle weakness, numbness and tingling, gait difficulties, dizziness, or history of falls. The sensory exam is subjective and dependent on the child's cooperation and developmental stage. It is often imprecise in children younger than school age, identifying only gross deficits. Younger children and those with cognitive impairment may not be able to understand "tingling or numbness." Instead, they may describe those feelings using words familiar to them, describing it as feeling like "someone is slapping my hands" or "buzzing bees on my skin."

The use of assistive devices (e.g., wheelchair, walker) should be noted. Age, pain (acute, chronic, or undertreated), and surgical and medical history should be considered because they may impact the assessment findings. Identifying such deficits during the initial assessment alerts the nurse and other providers that the child may be a fall risk and enables continued monitoring for changes during the child's hospitalization. Extremity movement and strength are easy and quick assessments that should be performed throughout the child's hospital stay. Examiners can start by evaluating spontaneous movements, observing how the child interacts with their environment, then progress to more interactive assessments. Making a game of the exam encourages the child's cooperation.

Motor evaluation should focus on patterns and comparison of movement between the right and left

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sides. Use resistance testing and note whether the child can move an extremity against gravity and with full strength/against resistance. The nurse also may test grip strength and note movements considering developmental stage. Note any resistance to passive movement of the extremities, such as spasticity or rigidity, and note if any flaccidity exists. Note any differences between right and left sides. The presence of any involuntary or abnormal movements such as tics or tremors, which can occur or worsen as a result of medication toxicities or infections, should be noted. These findings should be described by the extremity involved and whether the issue was noted while the child was resting or during activity. A motor strength grading scale may be used to evaluate voluntary muscle movement. Hand preference before age 2-3 years may indicate a neurologic abnormality, necessitating provider notification.

If possible, observe the child's balance and gait. An imbalance or gait impairment could suggest an underlying neurological deficit. Medical conditions such as epilepsy, spinal dysraphism, or medication toxicity may exacerbate underlying unsteady gait, potentially placing the child's safety at risk. If the child is unable to walk safely, balance can be evaluated by having them sit on the side of the bed unsupported with arms outstretched, noting any swaying or need for support to sit. Children with potential gait disturbance must be assisted when mobilizing.

Sensation can be evaluated by using light touch, comparing upper and lower extremities bilaterally. The exam should proceed in a distal to proximal direction. The nurse should note any abnormally increased sensitivity to pain (hyperalgesia) or other unpleasant sensations.

Complaints of saddle (perineum) numbness should be evaluated for bowel or bladder problems (e.g., constipation, incontinence, urinary retention), and appropriate interventions should be instituted as needed.

Vital Signs

Changes in a child's vital signs may provide clues about other medical problems. Fever, hypotension, or hypoxia may influence a child's LOC and cause secondary brain injury. It is important to look at the child as a whole, not just rely on vital signs in isolation.

Cerebral autoregulation maintains cerebral blood flow across wide ranges of arterial blood pressure and perfusion pressures. The regulation of blood pressure, heart rate, and breathing happens in the brainstem. The Cushing reflex is a physiological nervous system response to elevated ICP that causes hypertension/widened pulse pressure, bradycardia, and irregular respiration (e.g., Cheyne-Stokes respiration, central neurogenic hyperventilation). The Cushing reflex is usually a late sign of neurological deterioration, appearing just prior to or at the time of herniation. Periods of apnea and bradycardia could be precursors of deterioration, especially in neonate populations. Values of ICP and cerebral perfusion pressure (CPP) are different in children as compared with adults, and the nurse should be familiar with age-appropriate values.

Assessment of the Child with Altered Consciousness

Altered consciousness can be acute or chronic and may influence the child's participation in the assessment, but a number of functions can still be assessed (**Table 3**). If possible, the nurse should

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obtain a history of premorbid neurological symptoms, such as headaches, vision changes, or focal weakness, from the child's caregiver. The assessment will be unreliable if the child is receiving sedating medications. If the child's medical condition permits, the sedation should be titrated or held prior to performing the assessment.

Level of Consciousness and Communication

In a child with an altered LOC, the first step is to assess arousal. The nurse should initially attempt to arouse the child from sleep using little stimulation. Then, increase intensity from tactile to noxious stimuli. Noxious stimuli should be forceful yet not cause injury to the child. Peripheral stimulus such as nailbed pressure or stimulating feet or hands should be performed prior to central stimulus. Some commonly used central pressure stimuli are the trapezius squeeze and mandibular pressure.

The older child with a higher level of awareness will acknowledge the stimuli and purposefully try to remove the irritant by pulling away or reaching for the examiner's hand. Pulling away or withdrawing the extremity represents a lower-level reflex response. Infants will not respond by purposefully trying to remove an irritant such as central stimuli, but they should pull away from peripheral stimuli. Observe any abnormal movements of the extremities in response to the stimuli and whether the child displays any verbal (e.g., moaning) or nonverbal (e.g., grimacing) behaviors. Abnormal extension, flexion (posturing), and no response are only seen in comatose children, and these reactions indicate severe brain injury.

Communication may be altered due to underlying neurological insult or sedation due to intubation.

Cranial Nerves

Open the child's eyes and determine the position of the eyes at rest and note any deviation or abnormal eye movements (nystagmus). Evaluate the size, shape, and reaction of the pupils to light and check for accommodation (CN II and III) (**Table 4**). Pupillometry, if available, may be used to evaluate pupil response.

Observe for lid droop and inability to close the eyes completely. The child may resist the eyes being open; note if this response is symmetrical and observe for symmetrical extraocular movements (EOMs). Observe eye tracking by engaging the child. If needed, utilize a toy or caregiver.

It is important to establish the presence of protective reflexes in a child who is in a state of altered consciousness. Assess the child's ability to chew, swallow, and communicate. To prevent aspiration, cough and gag reflexes (CNs IX and X; Table 4) should be assessed before administering oral nutrition, fluids, or medications. Note if the child is unable to handle secretions, in which case alternative routes for feeding may need to be considered.

If the child is comatose, evaluate for the presence of a corneal reflex (CN V and CN VII; Table 4). The absence of a corneal reflex will warrant special attention to prevent corneal abrasions because the protective mechanism of eye closure may be lost.

Acute change in reflexes—such as asymmetrical pupillary light responses not induced by medication, the absence of the corneal reflex, or abnormal flexion or extension (posturing)—may indicate brainstem injury, increased ICP, or the possibility of herniation.

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Motor Response

An important aim of the assessment is to determine whether there are asymmetries or differences between the child's right and left sides. Also note differences in motor response and strength between upper extremities and lower extremities. Observe the child's posture at rest, noting any awkward or abnormal positions of the head, extremities, or trunk, and assess for abnormal motor movements. Note if there is spontaneous movement of the extremities and whether one side moves more than the other. If there is no spontaneous movement, the child's arms can be lifted, one at a time, and allowed to drop to the bed. A weaker or paralyzed extremity will fall freely compared with an extremity with intact motor innervation, which will fall sluggishly. Evaluate the legs by flexing them at the knees and noting whether they fall outward or if they exhibit strength in maintaining the position. Palpation of the muscles may reveal loss of normal muscle bulk. For a child with decreased consciousness, the sensory assessment is limited to a response to noxious stimuli.

Conclusion

Although there are challenges to performing a neurological assessment of the hospitalized pediatric patient, using a standardized approach can assist with rapid identification of neurological changes and prompt initiation of interventions. The nurse should provide safety measures for children with neurological deficits, including CN deficits, such as eye care, swallow screening, fall prevention, and oral care, to prevent complications and optimize clinical outcomes (**Table 5**). Input from the child's parents or caregiver and a knowledge of developmental milestones are key. A list of assessment components guides the nurse, creating structure around the identification of neurological changes in the child. Reflecting those components in the health record enables the nurse to document findings consistently. This standard neurological assessment will help nurses identify changes that may affect the child's outcome.

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Appendix

TABLE 1
Developmental Milestones

	Gross Motor	Fine Motor	Speech/ Language	Cognitive/ Problem Solving	Social/ Emotional
Newborn	Primitive reflexes: step, moro, Babinski	Primitive reflexes: grasp	Primitive reflexes: root, suck; alerts to sound, startles to loud sounds	Fix and follow slow horizontal arc; prefers contrast, colours, faces	Bonding (parent-child); self-regulation/ soothing
2 months	Head steady when held	Hands open half of time; bats at objects	Turns to voice; coos	Prefers usual caregiver; follows past midline	Social smile
4 months	Sits with support; head up 90 degrees from prone, arms out; rolls both ways	Palmar grasp; reaches for and obtains items; brings objects to midline	Laugh, razz, "ga," squeal	Anticipates routines; purposeful sensory exploration of objects (eyes, hands, mouth)	Turn-taking conversations; explores parent's face
6 months	Postural reflexes; sits tripod; rolls both ways	Raking grasp; transfers hand to hand	Babble	Stranger anxiety; looks for dropped or partially hidden object	Expresses emotions: happy, sad, mad; memory lasts 24 hours
12 months	Walks a few steps; wide-based gait	Fine pincher; voluntary release; throws objects; finger-feeds self	1 word with meaning; inhibits with "no!"; responds to own name; 1-step command with gesture	Cause and effect; trial and error; imitates gestures and sounds; uses objects functionally	Explores from secure base; points at wanted items; narrative memory begins
18 months	Stoops and recovers; runs	Carries toys while walking; removes clothing; tower of 2 blocks	Points to object, 3 body parts; 10-25 words; embedded jargoning; labels familiar objects	Imitates housework; symbolic play with dolls/ bears	Increased independence; parallel play

continues on p. 12

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Continued from Page 11

	Gross Motor	Fine Motor	Speech/ Language	Cognitive/ Problem Solving	Social/ Emotional
2 years	Jumps on 2 feet; up and down stairs	Handedness established; uses fork	Follows 2-step command; 50+ words, 50% intelligible; 2-word phrases; "I," "me," "you"	New problem-solving strategies without rehearsal; searches for hidden object	Testing limits, tantrums; negativism; possessive
3 years	Pedals tricycle; goes up stairs alternating feet	Undresses; toilet trained; draws circle; turns pages of books	3-step commands; 200 words, 75% intelligible; 3- or 4-word phrases; "W" questions; states full name, age, gender	Simple time concepts; identifies shapes; compares 2 items; counts to 3	Separates easily; sharing, empathy; cooperative play; role play
4 years	Hops on one foot; walks down stairs alternating feet	Draws X, square; cuts shapes with scissors	Sentences; 100% intelligible; tells a story; past tense	Counts to 4; opposites; identifies 4 colours	Has preferred friend; elaborate fantasy play
5 years	Balances on 1 foot 10 seconds; skips	Draws person with 10 body parts; tripod pencil grasp; prints name; independent ADLs	5,000 words; future tense; word play, jokes; phonemic awareness	Counts to 10 accurately; recites ABCs; preliteracy/ prenumeracy skills	Has group of friends; follows group rules; games with rules

Adapted from *Snapshots Developmental Milestones* by D. Andrews, 2009, and amended by D. Andrews and C. Dosman, 2014 (https://pedscases.com/sites/default/files/SNAPSHOTS_Developmental_Milestones_Chart_UPDATED_Aug_2014.pdf). Copyright 2014 by Debbi Andrews and Cara Dosman. Adapted with permission.

TABLE 2
Checklist of Baseline Focused Neurological Assessment for the Alert Child

- ☐ Level of consciousness (LOC)
- ☐ Language and speech
- ☐ Cranial nerves (pupil response and eye movement, corneal reflex, cough/gag reflex)
- ☐ Motor function/sensation
- ☐ Cranial assessment (<2 years; shape, head circumference, fontanels, sutures)

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TABLE 3
Checklist of Baseline Focused Neurological Assessment for the Child with Altered Consciousness

- ☐ Cranial nerves (pupil response and eye movement, corneal reflex, cough/gag reflex)
- ☐ Motor response
- ☐ Vital signs
- ☐ Cranial assessment (<2 years; shape, head circumference, fontanels, sutures)

TABLE 4
Cranial Nerve Assessment—Altered Consciousness

Assessment	Cranial Nerve
Pupil reaction, size, shape	II, III
Corneal reflex	V, VII
Gag/cough reflex	IX, X

TABLE 5
Nursing Interventions Related to Neurological Deficits

Neurological Deficit	Nursing Intervention
Ptosis (inability to completely close eyelids)	Eye care (i.e., artificial tears, lubricant)
Dysphagia	Swallow screen, speech evaluation
Facial droop, imbalance	Reinforce oral care
Visual deficits	Fall prevention
Speech	Communication devices

Additional Assessment Scales

Motor Strength Grading Scale

Glasgow Coma Scale (GCS)

Modified Glasgow Coma Scale for Infants and Children

Full Outline of UnResponsiveness (FOUR) Score

Serial Neurological Assessment in Pediatrics (SNAP)

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