CHAPTER e109.1

Assessment of the Child in the Emergency Department: A Practical Application of Normal Child Development

Peter Mellis

Children account for approximately 30% of visits to most EDs. The majority have minor or self-limited illness, which may optimally be cared for in a nonemergent setting. However, the recognition of acutely ill children who are at risk for organ system failure from the larger number of children with similar complaints who will recover spontaneously represents one of the most important and challenging diagnostic skills for emergency physicians. The key to mastering this process of identifying ill children is knowledge of child development as applied to the emergency setting.

GENERAL PRINCIPLES OF THE DEVELOPMENTAL APPROACH

Although there are many specific aspects of the developmental approach, a few general principles are applicable to all age groups of children and their families.

COMMUNICATE WITH THE CHILD

Approach children with a positive and gentle manner. The child's first impression sets the tone for the encounter. Review the emergency record for patient name and age so that an introduction and a developmentally structured interaction may be planned, based upon the child's age-related communication skills and perspective. Whenever possible, look at the child at his or her own eye level or below. Use the child's motor skills, vocabulary, and specific life experiences as reference points. Hunger, discomfort, fear of separation or pain, and feelings of loss of control should be directly addressed. Recognize that the ED is a strange and threatening environment, and, whenever possible, isolate children from the sights and sounds of other patient care experiences that may heighten their own anxiety. Most importantly, be honest with children regarding expectations for their experience so that trust can be established.

COMMUNICATE WITH THE FAMILY

Assess and treat the child in the context of his or her family, avoiding separation whenever possible. ED policy should encourage parental accompaniment of children to the clinical area, for minor complaints as well as resuscitations where parental presence can be particularly important. It is best to recognize that there are two patients, child and parent(s), each with expectations that must be addressed. Caregivers have essential historical information and, in the case of infants and toddlers, are physically necessary to the performance of a meaningful physical assessment. At all ages, children watch their parents for cues with respect to how to respond to the medical staff. Parents who understand and accept the sequence of events involved in emergency care become allies in enlisting their child's cooperation. Whenever possible, encourage parents to remain present during procedures and to maintain visual and physical contact with the child from a sitting position. Appropriate exceptions include parental discomfort and critical illness. Finally, because parents are intimately familiar with their child's range of verbal and nonverbal behavior, the examiner must take the phrase "this is not my child" as a valid parental concern. Reliance on parental knowledge is particularly applicable to the assessment of a child with developmental delay.

ASSESS BY MEANS OF OBSERVATION

Make every effort to gain information about a young child before direct interaction. Infants and young children communicate a normal level of consciousness through age-appropriate motor and social responses to their environment. Observe the child's behavior from a distance, preferably without his or her awareness. This can often be done while obtaining the history from the caretakers. Observation time can be extended by administering antipyretic therapy and satisfying hunger. Nonemergent, uncomfortable examination components and procedures should be performed last.

OBTAIN MEANINGFUL VITAL SIGNS

Normal ranges for heart rate, respiratory rate, and blood pressure vary significantly with age and must be interpreted in the context of a child's activity at the time (**Table 109.1-1**). Anxiety, pain, fever, and crying will increase all values, and these states should be documented if present. Optimal vital signs are obtained with minimal manipulation of the child (e.g., respiratory rate taken by observing abdominal movements, and heart rate auscultated through clothing). If fever is a concern, obtain temperature rectally in infants, toddlers, and uncooperative children, because the oral, axillary, and tympanic routes are less reliable. Temperature measured by the oral route is likely to be feasible and accurate in children by 4 to 5 years of age. Blood pressure should be measured on previously well children who are 5 years of age and older (school age), children with chronic disease associated with hypertension (e.g., renal disease), and all children who are critically ill. Weight is a pediatric vital sign because of dosing considerations and the importance of growth as an indicator of chronic disease in children. Appropriate scales and growth charts should be available. For resuscitation purposes, bedside estimates of weight are frequently inaccurate, and length-based resuscitation resources [e.g., Broselow® tapes (Armstrong Medical Industries, Inc., Lincolnshire, IL)] are recommended.

GROWTH AND DEVELOPMENTAL STAGES

Developmental stages are described with associated age ranges, but these are best viewed as a sequence of events with significant individual variation in rate of progression. For purposes of facilitating patient care in the ED, two aspects of each developmental stage must be considered. *Physical aspects* include growth and physiologic parameters unique to a given developmental stage. *Neurologic aspects* include motor, language, and social/psychological milestones that impact on both patient assessment and responses to acute illness or injury. These milestones and their related strategies are summarized in **Table 109.1-2**.

EARLY INFANCY (0 TO 6 MONTHS OLD)

Physical Aspects Rapid growth rate is a characteristic feature of young infants, for whom the major work is eating. After a 5% to 10% weight

TABLE 109.1-1 Pediatric Vital Signs (Awake and Resting)

Age	Heart Rate, Upper Limit (beats/min)	Respiratory Rate, Upper Limit (breaths/min)	Blood Pressure,* Lower Limit (mm Hg)	Weight,† (kg)
0–1 mo	180	60	60/40	3–4
2–12 mo	160	50	70/45	5–10
12–24 mo	140	40	75/50	10–12
2–6 y	120	30	80/55	13–25
6–12 y	110	20	90/60	25–40
>12 y	100	20	90/60	40–60

*May be estimated by:
Systolic blood pressure (5th percentile) = 70 + [2 × (age in years)]

†May be estimated by:
12 mo; weight (kg) = 4 + (age in months/2)
1–12 y; weight (kg) = 10 + [2 × (age in years)]

TABLE 109.1-2 Developmental Stages and ED Assessment Strategy

Stage	Milestone	Strategy
Early infancy (0–6 mo)	Motor: lifts head, reaches	Observation
	Verbal: cooing	Examine in parent's arms
	Social: responsive smile	Direct approach
Late infancy (6–18 mo)	Motor: reaches/obtains, sits, walks	Observation
	Verbal: jargon, few words	Examine in parent's arms
	Social: stranger anxiety/dependence	Indirect approach
Toddler (18–36 mo)	Motor: walks well, scribbles	Observation
	Verbal: speaks in phrases	Indirect approach
	Social: stranger anxiety/autonomy	
Preschool (3–5 y)	Motor: runs well, colors	Indirect or direct approach
	Verbal: speaks in sentences	Explain briefly just before procedures
	Social: magical thinking	
School age (5–12 y)	Motor: schoolwork, sports	Direct approach
	Verbal: concrete reasoning	Explain in detail before procedures
	Social: task oriented	
Adolescence (12–17 y)	Motor: adult	Direct approach
	Verbal: abstract reasoning	Confidentiality
	Social: autonomy, rebellion	Treat as adult

loss over the first 3 days of life, term infants regain birth weight by 10 to 14 days of age. A 20- to 30-gram/day weight gain is the best overall sign of health. **Normal infants double their birth weight by 5 months of age.** Young infants have a high surface area to body mass ratio with a proportionally large head, resulting in a high rate of heat loss and risk of hypothermia. The normal anterior fontanelle is slightly depressed when a child is upright. Young infants are obligate nose breathers and may experience partial airway obstruction with abnormal positioning or viral upper respiratory tract infections. Normal neonates may exhibit periodic breathing, or 5- to 10-second pauses followed by tachypnea, due to immature central control of respiration. Both cardiac output and minute ventilation are relatively rate dependent in early infancy. **A heart rate >180 beats/min and a respiratory rate >60 breaths/min should be considered abnormal.** Blood pressure is well maintained by compensatory mechanisms at this age, with hypotension a very late finding in shock. The pulmonary vascular bed dilates over the first 6 weeks of life, so that congenital heart lesions resulting in a left-to-right shunt (e.g., a ventricular septal defect) will present after this age. Finally, the primary series of immunizations, including diphtheria-tetanus-acellular pertussis (DTaP), *Haemophilus influenzae* type b conjugate and pneumococcal conjugate vaccines, inactivated poliovirus, rotavirus, and hepatitis B vaccines, are completed by 6 months of age (**Table 109.1-3**).

Neurologic Aspects Motor development is the major indicator of neurologic health and proceeds in a cephalocaudal fashion. Neonates demonstrate involuntary "primitive" reflexes, such as the suck, grasp, and Moro (startle) responses, which may be elicited to demonstrate muscle tone and should always be symmetric. By 1 month of age, infants can lift their heads, follow a moving object, and demonstrate a social smile. By 4 months, head control is steady, the child will reach for and grasp objects with the whole hand, a cooing response may be elicited, and rolling over has begun. During this period, normal infants learn trust from their parents and will respond positively to a gentle examiner. This is the period of least parental confidence, and many ED visits are made because of lack of knowledge and a need for reassurance.

Age-Specific Approach Assessment is optimally made by direct interaction using a pleasant, confident tone of voice and smiling face directed toward the infant. Observe muscle tone, spontaneous activity, eye contact, responsive smile, and recognition of parents. Examine the infant in the parent's lap, using brightly colored or pleasant-sounding objects to elicit a motor response. Feeding the infant or eliciting the sucking reflex with a finger will often result in greater cooperation. Optimal examination is done in order of least to most invasive interactions (i.e., observation, auscultation, and palpation), being careful to avoid uncomfortable procedures such as ear and throat examination until the child's level of consciousness is established. Parental confidence should be directly reinforced. Young infants should be carefully monitored during procedures involving conscious sedation or abnormal positioning, because of the risk of airway compromise. Finally, the motor abilities of young infants result in a limited potential for self-inflicted accidental injury. Whenever an injury is developmentally inconsistent with the stated mechanism, the potential for child abuse must be investigated.

TABLE 109.1-3 Recommended Schedule of Immunizations

Vaccine	DTaP/Tdap	Hib	PCV	MCV4	IPV	Rota	MMR	HepB	Influenza	HepA	VZV
Age											
Birth								HepB			
2 mo	DTaP	Hib	PCV		IPV	Rota		HepB*			
4 mo	DTaP	Hib	PCV		IPV	Rota					
6 mo	DTaP	Hib	PCV		IPV†	Rota		HepB†	TIV‡		
12–15 mo		Hib	PCV				MMR			HepA	VZV#
15–18 mo	DTaP									HepA§	
4–6 y	DTaP				IPV		MMR		LAIV‡		VZV
11–12 y	Tdap			MCV4							

Abbreviations: DTaP = diphtheria-tetanus-acellular pertussis; HepA = hepatitis A vaccine; HepB = hepatitis B (live); Hib = *Haemophilus influenzae* type b conjugate; IPV = inactivated polio vaccine; LAIV = live attenuated influenza vaccine; MCV4 = meningococcal conjugate vaccine; MMR = measles-mumps-rubella; PCV = pneumococcal conjugate vaccine; Rota = rotavirus vaccine (live); TIV = trivalent inactivated influenza vaccine; Tdap = tetanus-diphtheria-acellular pertussis; VZV = varicella-zoster virus (live).

*Second dose of HepB may be given at 1 or 2 mo.

†Third dose of IPV and HepB may be given at any time from 6–18 mo.

‡Influenza vaccine given yearly, TIV from ages 6–59 mo (two doses given at least 4 wk apart first time given if <9 y old), LAIV from ages 2 y and older (if no underlying medical problems predisposing to influenza complications).

#VZV may be given at any time from 12–18 mo.

§Second dose of HepA given at least 6 mo after first.

LATE INFANCY (6 TO 18 MONTHS OLD)

Physical Aspects Normal infants triple their birth weight by 1 year of age, but the rate of growth slows during this period. The primary teeth begin to erupt by 6 months of age, with an average rate of acquisition of one per month, although there is considerable variability in teething. Head size, center of gravity, and surface area to mass ratio remain large in comparison with adults. The anterior fontanelle is closed by 18 months of age. Influenza vaccination with trivalent inactivated virus is begun at 6 months and readministered annually. The 2009 H1N1 vaccine is administered to children 6 months and older. Children 10 years of age and younger are given two doses four weeks apart. Children younger than two years of age should be given the injectable H1N1 vaccine, while those two years age and older may be given the nasal spray vaccine. In subsequent years the H1N1 vaccine will likely be included with the seasonal influenza vaccine. The measles-mumps-rubella vaccination is given at 12 to 15 months of age, and the hepatitis A and varicella vaccines are given at 12 to 18 months of age. The DTaP, *Haemophilus influenzae* type b, and pneumococcal conjugate vaccine boosters are given during this same period (**Table 109.1-3**).

Neurologic Aspects The normal infant sits with minimal support, transfers objects from hand to hand, and babbles by 6 months. By 9 months of age, the infant is crawling, pulling to a standing position, and verbalizing with nonspecific jargon. By 12 months, the infant has a mature pincer-type grasp, begins to walk, and acquires specific words. The developmental combination of mobility and grasp results in increasing risk of toxic and foreign-body ingestion. Between 9 and 12 months, a strong sense of "stranger anxiety," related to fear of separation from parents, is acquired and complicates every aspect of physical assessment. So, the failure of an older infant or toddler to recognize and preferentially respond to parents suggests significant disease.

Age-Specific Approach Assessment of an older infant and toddler begins with observation, preferably without the child's awareness of the examiner's presence. The child should be undressed to obtain a meaningful respiratory rate and to observe the work of breathing. Spontaneous motor activity, such as sitting and pulling up, and purposeful responses to parental overtures, such as reaching for objects and smiling, are indicators of a normal level of consciousness. The child should see the examiner approach gradually and engage his or her caretakers first. An entire examination requiring any degree of cooperation is best performed while the child is held on the parent's lap or shoulder so that perception of separation is avoided. As for younger infants, the examination proceeds from least to most invasive interactions. Procedures in this age group require adequate anxiolysis, sedation, analgesia, and physical restraint. Although parental restraint is acceptable for nonpainful examination procedures, parents should not be asked to immobilize their child for invasive procedures. Caretakers should be encouraged to remain present to reassure their child during procedures if it is their desire to do so. The high level of anxiety at this age frequently results in persistently uncooperative behavior despite adequate analgesia. Sedation for procedures may require a significantly higher per-kilogram dose of anxiolytic/analgesic drug to achieve the desired effect.

TODDLER (18 TO 36 MONTHS OLD)

Physical Aspects Decelerating growth rate and decreased appetite are seen during this period, although the head approaches its adult size. The 20 primary teeth are in place by 36 months, and dental caries are common. High center of gravity, mobility, and curiosity lead to increasing risk for head and orthopedic injuries. A toddler's open growth plates are far more likely to sustain physeal fracture than ligamentous injury. Traction injuries to the arm will frequently result in subluxation of the annular ligament of the radial head (i.e., "nursemaid's elbow").

Neurologic Aspects By 18 months of age, most children can walk well, feed themselves, follow simple commands, and use four to six words to indicate their desires. Stranger anxiety peaks at this age but remains important throughout the toddler period. By 24 months, most children can run, climb stairs, and speak with three-word phrases, although only 50% of speech is intelligible to nonfamily members. Toddlers understand far more than their spontaneous speech would indicate and learn by imitating the behavior of their family members. When given an opportunity to draw, a toddler will scribble with a brief attention span. Parents consistently underestimate the mobility and problem-solving ability of a toddler, resulting in a peak risk for falls and ingestions at this age.

Age-Specific Approach An examination strategy of indirect observation followed by direct interaction in the safety of the parent's arms should be followed, as described for older infants. The examiner should encourage the parent to have the toddler walk and follow commands as an important component of the assessment for acute systemic or neurologic disease. Allow the child a favorite object, such as a doll or blanket, for comfort during the examination. Talk to the child in simple language about what you will do and offer to let the child touch or hold the examination instruments to gain their trust. Older toddlers may indicate the site of pain specifically, but many will be unable to communicate localized pain or tenderness. As described above in Early Infancy (0–6 months), Age-Specific Approach, perform the physical assessment in order of least to most invasive examination components. As for older infants, anxiolysis, sedation, analgesia, and restraint is routinely indicated for painful procedures, and a higher per-kilogram dose of anxiolytic/analgesic drug may be required. Because of the likelihood of physeal fracture, a young child with tenderness over the growth plate after injury should be immobilized with a splint, even if x-ray films are negative.

PRESCHOOL AGE (3 TO 5 YEARS OLD)

Physical Aspects Growth rate slows significantly during this period, and appetite decreases further. Children develop a more lean body habitus. The incidence of injuries increases with increasing activity. Depending on state law involving age, weight, and/or height, the preschool and early school age child may no longer be restrained in a car seat, and is at risk for defined injury complexes from improperly fitting lap and shoulder belts. DTaP, inactivated polio vaccine, and measles-mumps-rubella vaccine boosters are given shortly before beginning school, between the ages of 4 and 6 years old. Annual influenza vaccination is continued, using live, activated influenza virus beginning at 2 years of age (**Table 109.1-3**).

Neurologic Aspects Preschool children develop progressive autonomy in terms of mobility and self-care. Attraction to books, drawing, and coloring is common. Expressive language skills expand rapidly, and children this age are often able to identify site(s) of specific complaint. However, a strong sense of fear of pain remains, and the level of anxiety is high in the ED. Preschool children live in the present and have a limited sense of time and history, so that prior symptoms are frequently forgotten. Self-centered "magical" reasoning is the rule, so that many preschool children believe that medical care is punishment for misbehavior. This is occasionally reinforced by parents who state they will "have the doctor give you a shot," a comment that should be discouraged.

Age-Specific Approach Many preschool children may be directly approached and examined in the traditional systematic fashion. However, some will require the indirect approach described for toddlers, and the nearby presence of a parent is typically essential for cooperation. The examiner should always talk directly with the preschooler to establish rapport and confirm the general complaint. Identification of recent positive experiences such as birthdays or favorite cartoon characters is frequently helpful in gaining cooperation. However, preschool children have a limited ability to verbalize sequences of events and time intervals, and thus should be expected to identify only their current complaint. Reliance on parental history should remain. Cooperation during the physical examination is likely, although less comfortable components are still best performed at the end. The performance of painful procedures requires a careful approach. It is always best to be honest regarding discomfort, but information should be given immediately before performing the procedure to minimize the effects of fantasy regarding pain and causality as well as delaying tactics. Comfort and distraction by the parent is fre-

quently effective for minor procedures; however, anxiolysis, sedation, analgesia, and restraint as for toddlers is typically necessary. Rewards such as verbal praise and a sticker for bravery often significantly enhance the memory of the experience for the child and family.

SCHOOL AGE (5 TO 12 YEARS OLD)

Physical Aspects The school years represent the slowest period of linear growth in childhood. Although the body habitus is typically slender, there is a rising incidence of the development of obesity during this period. The primary teeth are loosening, and the secondary teeth erupt. The lymphoid tissues, such as tonsils and adenoids, reach maximal dimensions relative to body size by 6 years of age. There is increased physical activity, including organized sports, during this period, and injuries become common.

Neurologic Aspects School-age children experience rapid language growth and maturing motor ability. Concrete reasoning ability emerges with an ability to understand cause and effect. The child is increasingly aware of his or her body and develops a sense of modesty. Task-oriented behavior is common, and school and sports activity are typically the central events of the child's life. School-age children are eager to please and often reluctant to express their fears of pain and death.

Age-Specific Approach The direct examination approach is typically successful for school-age children. Parental accompaniment and respect for modesty should be maintained. Historical information should be elicited from the child as well as the parent. An effort to inquire about school or extracurricular interests will enhance rapport. Change in school performance is a helpful indicator of chronic disease. Painful procedures are best preceded by explanations to both the parent and child, given well in advance, with honesty regarding discomfort. The child should be given some degree of choice in the manner in which the procedure is completed, such as a comfortable position, to minimize the sense of loss of control.

ADOLESCENCE (12 TO 17 YEARS OLD)

Physical Aspects The teenage years mark a second period of rapid growth, beginning at approximately age 10 years old in girls and age 12 years old in boys. Secondary sexual development begins shortly after beginning the growth spurt, with menarche starting between 10 and 16 years old in girls. Menstrual periods may be irregular for the first 1 to 2 years after onset of menarche, and physeal closure occurs an average of 2 years post-menarche. Sexual activity and drug use are common during adolescence, and many teens are parents themselves, complicating both the differential diagnosis and issues of maturity and reliability in carrying out the follow-up plan. The tetanus-diphtheria-activated pertussis booster and meningococcal conjugate vaccine are given at 12 to 15 years of age (**Table 109.1-3**). Although still not widely incorporated into practice, immunization with human papilloma virus is recommended for girls between 11 and 12 years of age.

Neurologic Aspects Abstract reasoning ability progressively develops during adolescence, paired with a self-centered world view and self-consciousness regarding appearance. Feelings of immortality and denial of the consequences of risky behavior are common. Loss of autonomy is the greatest fear of an adolescent, and mistrust of and rebellion toward authority is normal. Previously well-controlled chronic disease frequently becomes unstable as a result of these developmental issues. Psychiatric disease and suicidal behavior are increasingly recognized in this age group. The parents of teenagers are frequently angered by these changes and may project these feelings on the ED staff.

Age-Specific Approach The traditional history and physical examination with respect for modesty is effective in the assessment of adolescents. The examiner should communicate to the teenager that he or she will be treated "like an adult." Choices must be allowed, such as parental presence during the examination, with proper limit setting regarding cooperative behavior. The parent's concerns must be addressed individually and, if necessary, in private. Confidentiality should be stressed, particularly as the law requires with respect to pregnancy and sexually transmitted disease.

USEFUL WEB RESOURCES

American Academy of Pediatrics Immunization Guidelines for Children—http://www.cispimmunize.org/IZSchedule_childhood.pdf

American Academy of Pediatrics Immunization Guidelines for Adolescents—http://www.cispimmunize.org/IZSchedule_Adolescent.pdf