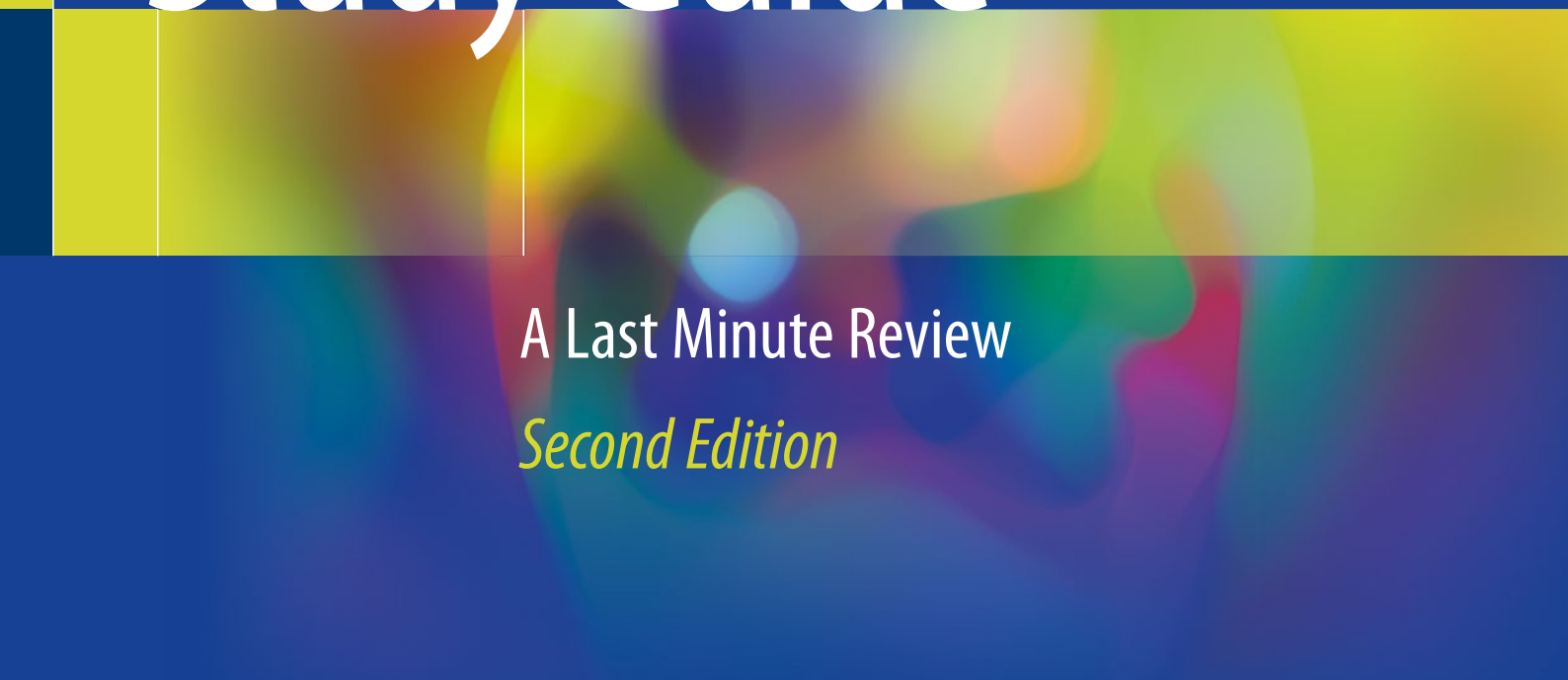
Osama I. Naga
Editor

Pediatric Board Study Guide



A Last Minute Review

Second Edition

Springer

Pediatric Board Study Guide

Osama I. Naga
Editor

Pediatric Board Study Guide

A Last Minute Review

Second Edition

Springer

Editor
Osama I. Naga, MD
Department of Pediatrics
Paul L. Foster School of Medicine
Texas Tech University Health Sciences Center
El Paso, TX
USA

ISBN 978-3-030-21266-7 ISBN 978-3-030-21267-4 (eBook)
https://doi.org/10.1007/978-3-030-21267-4

This Springer imprint is published by the registered company Springer Nature Switzerland AG
The registered company address is: Gewerbestrasse 11, 6330 Cham, Switzerland

I owe my deepest gratitude to the contributors whose expertise helped bring this pediatric resource to life.

To all the pediatricians who keep on learning for the sake of the children!

Preface

The *Pediatric Board Study Guide: A Last Minute Review* provides the core material needed to pass the General Pediatrics Certifying Examination by the American Board of Pediatrics (ABP) and to meet the requirements required for the ABP Maintenance of Certification. This book contains a total of 33 chapters; the first 31 chapters discuss all aspects of pediatric medicine and are all updated according to the most recent content specifications provided by the ABP. Chapter 32 reviews common pediatric radiology cases, while Chapter 33, the final chapter, consists of high-yield last minute review cases.

The second edition is notably more comprehensive and detailed than the first. Improvements over the previous edition include more illustrations and added chapters. Each chapter has been either written or reviewed by an expert in that specific field from a top academic institution in the United States. New chapters include Sports Medicine, Nutrition, Fluids and Electrolytes, Ethics, Patient Safety and Quality Improvement, and Pharmacology. Finally, to make the chapters even more incisive, "Pearls and Pitfalls" have been added at the end of each chapter.

The 80 clinical case scenarios in the Radiology Review (Chap. 32), with its distinct images and radiological findings, should not only improve exam performance but also help the general pediatrician to identify common radiological findings.

The final chapter, Last Minute Review, has been expanded in this new edition. These high-yield cases are arranged in the same sequence as the book chapters and placed in a way that allows the reader to discriminate among diseases and conditions, helping the test taker to distinguish between similar presenting cases on the exam. The final chapter allows the reader to review in the shortest time possible more than 1700 critical facts for the pediatric board exam, making it the ideal resource for the week prior to the exam.

This book is of particular interest to pediatricians, fellows, pediatric subspecialists preparing for the board examination or certification maintenance, pediatric residents preparing for the in-service exam, daily rounds, and real-life clinical encounters.

About the ABP board-certifying exam

- The board exam is offered once a year, usually in October.
- The exam consists of four sections.
- There is a total of 330–350 multiple-choice questions with normally five answer choices for each question.
- There are currently four sections with each section lasting 105 minutes. There is a 15-minute break between the first two sections.
- After the second section, there is a 60-minute lunch break.
- There is another 15-minute break between section 3 and section 4
- The exam is scored from 0 to 300 with 180 being a passing score.

How to study for the ABP board-certifying exam

- Read the text of the *Pediatric Board Study Guide: A Last Minute Review* thoroughly multiple times throughout your residency.
- Chapters can be read sequentially or can be read in conjunction with a rotation.

- For example, a resident doing a 1-month pediatric cardiology rotation could usefully read in Chap. 19, Cardiology.
- After finishing a chapter, turn to Chap. 33 to review the Last Minute Review cases for that particular specialty.
- Make sure to study the most recent self-assessment curricula of the Pediatric Review and Education Program (PREP): https://shop.aap.org/professional-education/self-assessments.
- Simulate the test-taking experience by answering timed questions.
- Read the critiques/explanations after each question, including the PREP Pearls at the end of each question.
- Read the new articles in *Pediatrics in Review* and answer their CME questions.
- Two to three months before the exam, read the *Pediatric Board Study Guide* one more time.
- One week before the exam, read for one final time Chap. 33, the Last Minute Review.
- Rest at least 24 hours before the exam.

The day of the exam

- Have a good breakfast.
- Arrive early to the testing center.
- Make sure to have all the documents with you (ID, exam ticket, etc.).
- Make sure to dress appropriately; sometimes the testing room may be cold.
- During the exam, make sure to answer all questions. Do not leave any question unanswered even if you do not know the answer. There is no penalty for guessing.
- Pace yourself: once the time has expired in a section, you cannot go back.

El Paso, TX, USA Osama Naga

Contents

Editor

Osama I. Naga, MD Department of Pediatrics, Paul L. Foster School of Medicine, Texas Tech University Health Sciences Center, El Paso, TX, USA

Contributors

Amr Abdelgawad, MD, MBA Department of Orthopaedic Surgery and Rehabilitation, Texas Tech University Health Sciences Center, El Paso, TX, USA

Marwa Abdou, MD Department of Pediatrics, Texas Tech University Health Sciences Center, El Paso, TX, USA

Jessica Addison, MD, MS Division of Adolescent/Young Adult Medicine, Department of Pediatrics, Boston Children's Hospital, Harvard Medical School, Boston, MA, USA

Mohamed Hamdy Ataalla, MD Department of Child and Adolescent Psychiatry, Texas Tech University Health Sciences Center, El Paso, TX, USA

Robert D. Baker, MD, PhD Department of Pediatrics, Jacobs School of Medicine and Biomedical Sciences, University at Buffalo, State University of New York, Amherst, NY, USA

Susan S. Baker, MD, PhD Jacobs School of Medicine and Biomedical Sciences, University at Buffalo, State University of New York, Buffalo, NY, USA

Amanda G. Brown, MD Division of Rheumatology, Department of Pediatrics, Baylor College of Medicine, Houston, TX, USA

Catherine J. Chen, MD Department of Urology, University of Texas Southwestern Medical Center, Dallas, TX, USA

Megan Craddock, MD Department of Dermatology and Pediatrics, Texas Children's Hospital, Baylor College of Medicine, Houston, TX, USA

Ellen Fraint, MD Division of Pediatric Hematology, Oncology, Marrow and Blood Cell Transplantation, Department of Pediatrics, Children's Hospital at Montefiore, Bronx, NY, USA

Mamta Fuloria, MD Division of Neonatology, Department of Pediatrics, The Children's Hospital at Montefiore, Albert Einstein College of Medicine, Bronx, NY, USA

Maria I. Garcia Lloret, MD, MSc Division of Pediatric Allergy/Immunology and Rheumatology, Department of Pediatrics, UCLA School of Medicine, Los Angeles, CA, USA

Michael George, MD Department of Radiology, Boston Children's Hospital, Harvard Medical School, Boston, MA, USA

Beatrice Goilav, MD Pediatric Nephrology, Children's Hospital at Montefiore, Albert Einstein College of Medicine, Bronx, NY, USA

Ivet Hartonian, MD, MS Pediatric Neurology, Department of Pediatrics, Adventist Health White Memorial, Los Angeles, CA, USA

Allison Hill, MD Division of Cardiology, Department of Pediatrics, Children's Hospital of Los Angeles, USC Keck School of Medicine, Los Angeles, CA, USA

Micah A. Jacobs, MD, MPH Department of Urology, University of Texas Southwestern Medical Center, Dallas, TX, USA

Wendy G. Kim, MD Department of Radiology, Boston Children's Hospital, Harvard Medical School, Boston, MA, USA

Sitratullah O. Kukoyi-Maiyegun, MD Department of Pediatrics, Paul L. Foster School of Medicine, Texas Tech University Health Science Center, El Paso, TX, USA

Grace Kung, MD Division of Cardiology, Department of Pediatrics, Children's Hospital of Los Angeles, USC Keck School of Medicine, Los Angeles, CA, USA

Caroline Y. Kuo, MD Division of Pediatric Allergy/Immunology and Rheumatology, Department of Pediatrics, UCLA School of Medicine, Los Angeles, CA, USA

William Blaine Lapin, MD Division of Rheumatology, Department of Pediatrics, Baylor College of Medicine, Houston, TX, USA

Matthew B. Laurens, MD, MPH Division of Infectious Diseases and Tropical Pediatrics, Department of Pediatrics, Center for Vaccine Development and Global Health, University of Maryland School of Medicine, Baltimore, MD, USA

Jason T. Lerner, MD Pediatric Neurology, Department of Pediatrics, UCLA Mattel Children's Hospital, Los Angeles, CA, USA

Tanya Martínez-Fernández, MD Division Respiratory Medicine, Department of Pediatrics, University of Texas Southwestern Medical Center/Children's Medical Center Dallas, Dallas, TX, USA

Jennifer McConnell, MD Division of Pediatric Emergency Medicine, Department of Pediatrics, UT Southwestern Medical Center, Dallas, TX, USA

Kara D. Meister, MD Department of Otolaryngology-Head & Neck Surgery, Pediatrics Division, Lucile Packard Children's Hospital, Stanford University, Stanford, CA, USA

Anna H. Messner, MD, FACS, FAAP Professor of Otolaryngology/Head & Neck Surgery, Baylor College of Medicine, Texas Children's Hospital, Houston, TX, USA

Kyle E. Miller, MC(FS) USN, MD Department of Ophthalmology, Naval Medical Center Portsmouth, Portsmouth, VA, USA

Scott Moerdler, MD Pediatric Hematology/Oncology Program, Department of Pediatrics, Rutgers Cancer Institute of New Jersey, Robert Wood Johnson Medical School, Rutgers University, New Brunswick, NJ, USA

Kerry Morrone, MD Division of Pediatric Hematology, Oncology, Marrow and Blood Cell Transplantation, Department of Pediatrics, Children's Hospital at Montefiore, Bronx, NY, USA

Amr Morsi, MD Division of Endocrinology, Department of Pediatrics, UPMC Children's Hospital of Pittsburgh, Pittsburgh, PA, USA

Daniel Murphy, MD, CAQ-Sports Medicine Department of Family and Community Medicine, Paul L. Foster School of Medicine, Texas Tech University Health Center, El Paso, TX, USA

Osama I. Naga, MD Department of Pediatrics, Paul L. Foster School of Medicine, Texas Tech University Health Sciences Center, El Paso, TX, USA

Jo-Ann O. Nesiama, MD, MS Division of Pediatric Emergency Medicine, Department of Pediatrics, UT Southwestern Medical Center, Dallas, TX, USA

Violeta Radenovich, MD, MPH Children's Eye Center of El Paso, Pediatric Ophthalmology, Texas Tech University Health Science Center, El Paso, TX, USA

Nora E. Rahmani, MD Division of Pediatric Hematology, Oncology, Marrow and Blood Cell Transplantation, Department of Pediatrics, Children's Hospital at Montefiore, Bronx, NY, USA

Andrea A. Ramirez, MD Division of Rheumatology, Department of Pediatrics, Baylor College of Medicine, Houston, TX, USA

Jennifer L. Rammel, MD Division of Rheumatology, Department of Pediatrics, Baylor College of Medicine, Houston, TX, USA

Yadira Rivera-Sánchez, MD Division Respiratory Medicine, Department of Pediatrics, University of Texas Southwestern Medical Center/Children's Medical Center Dallas, Dallas, TX, USA

Shira L. Robbins, MD, FAAO, FAAP Department of Ophthalmology, Ratner Children's Eye Center, University of California San Diego, La Jolla, CA, USA

Jennifer Ruth, MD Department of Dermatology and Pediatrics, Dell Children's Medical Group, Austin, TX, USA

Preeti Sharma, MD Division Respiratory Medicine, Department of Pediatrics, University of Texas Southwestern Medical Center/Children's Medical Center Dallas, Dallas, TX, USA

Arpan A. Sinha, MBBS, MD Jimmy Everest Center of Pediatric Hematology and Oncology, Department of Pediatrics, The University of Oklahoma Health Sciences Center, Oklahoma City, OK, USA

Benjamin Steinman, DO Department of Pediatrics, The Children's Hospital at SUNY Downstate, SUNY Downstate Medical Center, Brooklyn, NY, USA

Jennifer Su, MD Division of Cardiology, Department of Pediatrics, Children's Hospital of Los Angeles, USC Keck School of Medicine, Los Angeles, CA, USA

Adit Tal, MD Division of Pediatric Hematology, Oncology, Marrow and Blood Cell Transplantation, Department of Pediatrics, Children's Hospital at Montefiore, Bronx, NY, USA

Hina J. Talib, MD Division of Adolescent Medicine, Department of Pediatrics, Children's Hospital at Montefiore, Bronx, NY, USA

M. Hossein Tcharmtchi, MD Department of Pediatrics, Section of Critical Care, Baylor College of Medicine, Texas Children's Hospital, Houston, TX, USA

Vijay S. Tonk, PhD Department of Pediatrics, Texas Tech University Health Sciences Center, Lubbock, TX, USA

Manpreet K. Virk, MD Department of Pediatrics, Section of Critical Care, Baylor College of Medicine, Texas Children's Hospital, Houston, TX, USA

Dawn M. Wahezi, MD, MS Pediatric Rheumatology, Children's Hospital at Montefiore, Bronx, NY, USA

Golder N. Wilson, MD, PhD Department of Pediatrics, Texas Tech University Health Sciences Center and KinderGenome Medical Genetics, Dallas, TX, USA

Kenneth Yen, MD, MS Division of Pediatric Emergency Medicine, Department of Pediatrics, UT Southwestern Medical Center, Dallas, TX, USA

Jong W. Yoo, MD Pediatric Neurology, Department of Pediatrics, UCLA Mattel Children's Hospital, Los Angeles, CA, USA

Mohamed A. Zebda, DO, MPH Department of Pediatrics, Paul L. Foster School of Medicine, Texas Tech University Health Sciences Center, Galveston, TX, USA

General Pediatrics

1

Osama I. Naga

GROWTH

Background

- Growth is affected by maternal nutrition and uterine size
- Genetic growth potential is inherited from parents and also depends on nutrition throughout childhood
- Growth is affected by growth hormone, thyroid hormone, insulin, and sex hormones, all of which have varying influence at different stages of growth
- Deviation from normally expected patterns of growth often can be the first indication of an underlying disorder
- Carefully documented growth charts serve as powerful tools for monitoring the overall health and well-being of patients
- Key to diagnosing abnormal growth is the understanding of normal growth, which can be classified into 4 primary areas: fetal, postnatal/infant, childhood, and pubertal

Weight

- Healthy term infants may lose up to 10% of birth weight within the first 10 days after birth
- Newborns quickly regain this weight by 2 weeks of age
- 0–3 months: weight gain is approximately 30 g/day
- 3–6 months: weight gain is approximately 15 g/day
- 6–12 months: weight gain is approximately 10 g/day
- Birth weight is expected to double by 5–6 months

Height [1]

- The height of a newborn increases by 50% or by 25.4 cm (10 in.) in the 1st year
- The height of a newborn doubles within 3–4 years
- After 2 years the height increases by an average 5–6 cm/year
- There is a range of pubertal peak growth velocities of around 7–12 cm per year in boys and 6–10.5 cm per year in girls

Measurements [2]

- The length or supine height should be measured in infants and toddlers < 2 years
- Standing heights should be used if age > 3 years
- For children between 2 and 3 years of age, it is best to measure both supine length and standing height and compare the 2 measurements
- Plot gestational age rather than chronological age for preterm infants
- Specific growth charts are available for special populations, e.g., trisomy 21, Turner syndrome, Klinefelter syndrome, and achondroplasia

O. I. Naga (✉)
Department of Pediatrics, Paul L. Foster School of Medicine, Texas Tech University Health Sciences Center, El Paso, TX, USA
e-mail: osama.naga@ttuhsc.edu

O. I. Naga (ed.), *Pediatric Board Study Guide*, https://doi.org/10.1007/978-3-030-21267-4_1

Head circumference

- Head circumference will increase by 12.7 cm (5 in.) in the 1st year

Growth curve reading

- Shifts across 2 or more percentile lines may indicate an abnormality in growth
- Weight loss is one of the first signs of malabsorption and of cases of malnourishment or neglect
- Primary linear growth problems often have some congenital, genetic, or endocrine abnormalities (see also Chap. 12 Endocrinology)
- Genetic channeling: downward percentile crossing of a large baby born to short parents or upward percentile crossing of a small baby born to tall parents typically accomplished by 9–12 months

Macrocephaly

Definition

- Head circumference 2 standard deviations above the mean

Causes

- Benign familial macrocephaly with enlargement of subarachnoid space
- Hydrocephalus
- Intracranial hemorrhage or mass
- Genetic causes e.g., Soto syndrome, or "cerebral gigantism"

Benign familial macrocephaly (Table 1.1)

- Most common cause (50%)
- Autosomal dominant; usually seen in one or both parents
- Document parental head size
- Reassure parents and child if child's head size is congruent with familial sizes
- Periodic monitoring of the head size
- Periodic monitoring of physical growth and neurological development
- If the child's head size is not congruent with familial sizes:
  - Full history, including prenatal, birth, past medical, and family
  - Head ultrasound is the study of choice if anterior fontanelle is still open
  - Skull radiography
  - Brain magnetic resonance imaging (MRI) if the anterior fontanelle is closed

Table 1.1 Difference between benign familial macrocephaly and hydrocephalus

Benign familial macrocephaly	Hydrocephalus
Family history of macrocephaly	History of prematurity, IVH, trauma, or CNS infection
Normal growth and development	Spasticity, gait disturbance, cognitive deterioration, hypertonia
No signs of increased ICP	Bulging AF, ocular globes deviate downward (sun-setting sign), headaches, vomiting, irritability
Reassurance	Referral to neurosurgeon

CNS Central nervous system, *IVH* Intraventricular hemorrhage, *ICP* Intracranial pressure, *AF* Anterior fontanelle

Hydrocephalus (see Table 1.1)

- Referral to a pediatric neurosurgeon

Microcephaly (See Also Chap. 16 Neurology)

Definition

- Head circumference 2 standard deviations below the mean

Causes

- Congenital infections, e.g., TORCH (Toxoplasmosis, Others, Rubella, Cytomegalovirus [CMV]), Herpes simplex), Zika virus
- Maternal deprivation (folate deficiency, malnutrition, hypothyroidism)
- Maternal hyperphenylalaninemia
- Toxic or metabolic disorders
- Genetic conditions, e.g., trisomy 21, Cornelia de Lange syndrome
- Acquired or postnatal onset of microcephaly, e.g., hypoxic-ischemic encephalopathy

Plagiocephaly (Fig. 1.1) [3]

Background

- Deformational flattening from lack of changes in head positions is the most common cause of asymmetric head shape

Causes

- Positional or supine sleeping is the most common cause of plagiocephaly
- Causes of persistent head tilt, e.g., congenital muscular torticollis, ocular torticollis, Klippel-Feil syndrome (See also Chap. 13 Orthopedics.)
- Craniosynostosis

Craniosynostosis (See Also Chap. 4 Genetic Disorders)

Primary craniosynostosis

- One or more sutures fuse prematurely while the brain still increasing in size
- If one suture is involved, it is usually isolated
- If more than one suture is involved, it is commonly associated with genetic disorders
- Asymmetric skull (head growth is limited in the plane perpendicular to the fused suture)
- Bony ridging overlying the fused suture
- Commonly associated with an increase in head size asymmetrically
- Scaphocephaly (elongated head) is the most common type of craniosynostosis, due to early fusion of the sagittal suture; ridging of the sagittal suture is palpable

Secondary craniosynostosis

- Primary failure of brain growth leads to early fusion of sutures and microcephaly

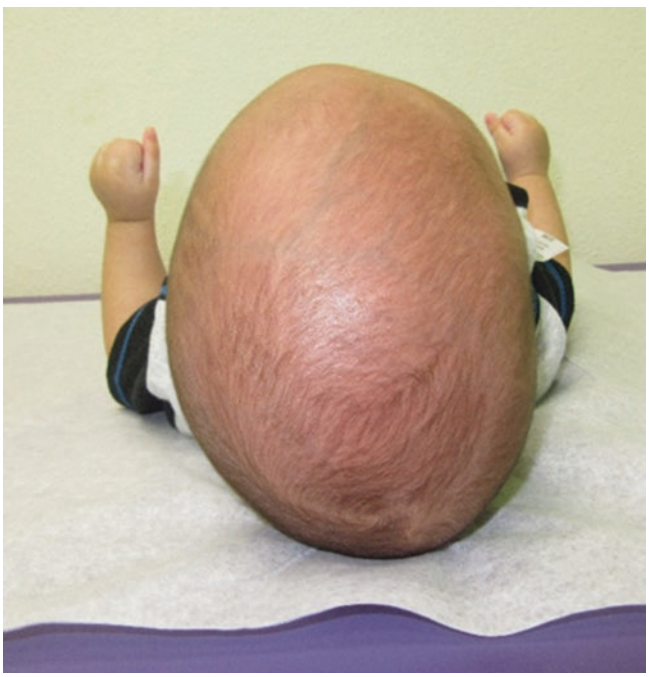


Fig. 1.1 A 5-month-old-boy with deformational plagiocephaly, flattening on the left side, and ipsilateral frontal bossing

Deformational plagiocephaly (Fig. 1.2, Table 1.2)

- Anterior displacement of the occiput and the frontal region on the same side (parallelogram)
- Ear position is more anterior on the side of flattening in positional plagiocephaly
- Supine sleeping recommendations ("baby on back") have increased the prevalence of posterior plagiocephaly

Diagnosis

- Neonatal examination to exclude syndromes with cranial and brain anomalies
- Careful examination alone can make the diagnosis
- Referral to a pediatric neurosurgeon if craniosynostosis is clinically suspected
- Plain skull radiography or CT scan can confirm the diagnosis of craniosynostosis if the diagnosis is not clear
- Cranial CT scan with 3-dimensional reconstruction is not required to make the diagnosis of craniosynostosis in most cases

Treatment

- Deformational plagiocephaly
  - Observation; usually resolves spontaneously
  - The helmet may be beneficial in severe cases of deformational plagiocephaly

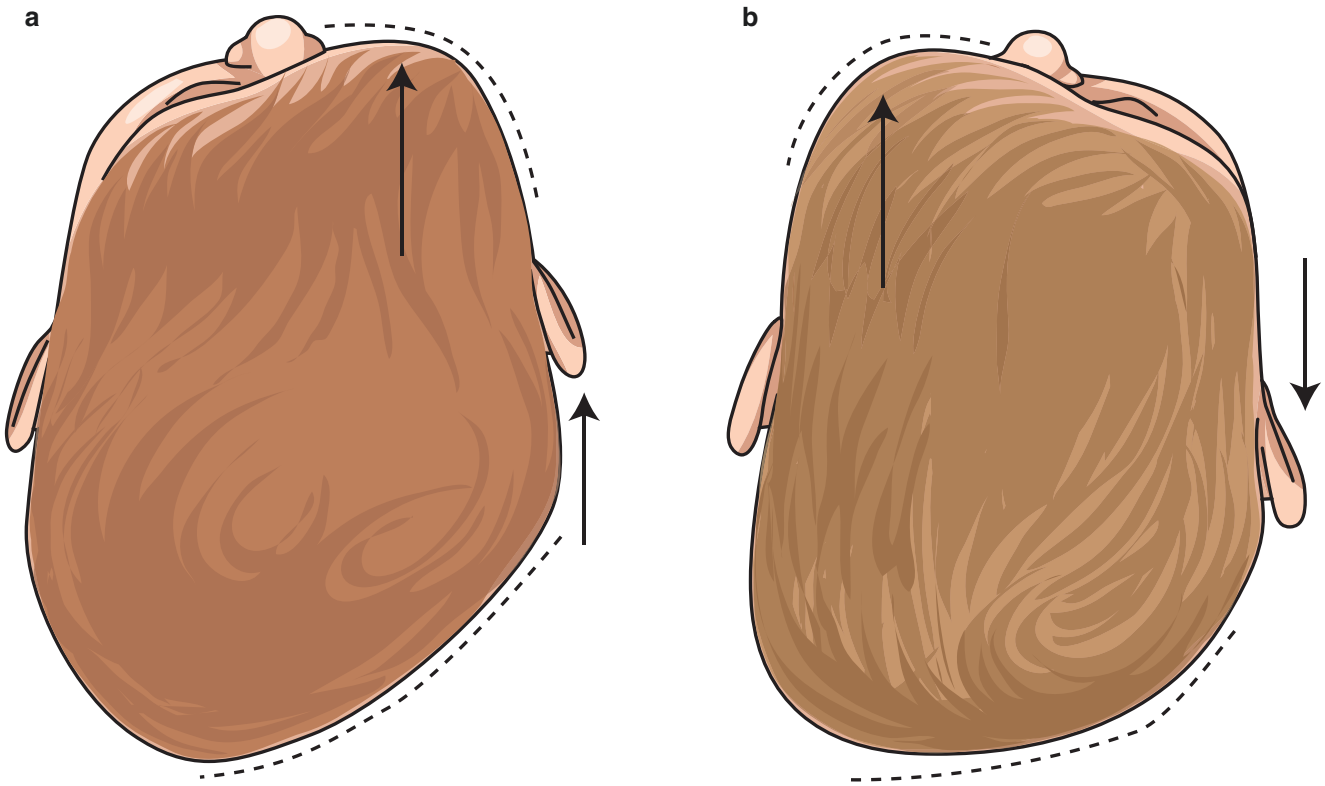


Fig. 1.2 **(a)** Deformational plagiocephaly; **(b)** Unilambdoid synostosis

Table 1.2 Difference between deformational plagiocephaly and plagiocephaly due to unilambdoid synostosis

Deformational plagiocephaly	Plagiocephaly due to unilambdoid synostosis
Parallelogram-shaped head	Trapezoid-shaped head
Occipital flattening on one side	Occipital flattening on one side
Frontal bossing on the same side	Frontal bossing on the contralateral side
Anterior displacement of the ear on the same side	Posterior displacement of the ear on the same side
Palpable suture, no palpable ridging	Absence of suture or palpable ridging of fused lambdoid suture

  - Treatment of underlying causes, e.g., congenital muscular torticollis or other causes of head tilt
  - Emphasis on floor ("tummy") time, occupational/physical therapy
- Craniosynostosis
  - Surgery, usually between 6 and 12 months

DEVELOPMENTAL MILESTONES [4, 5]

The American Academy of Pediatrics (AAP) recommends that clinicians screen children for general development using standardized, validated tools at 9, 18, and 30 months and for autism at 18 and 24 months or at any point when a caregiver or the clinician has a concern

Tools for screening

- Denver Developmental Screening Test
- Ages & Stages Questionnaires (ASQs)
- Modified Checklist for Autism in Toddlers (M-CHAT)

Newborn

Gross motor

- Lies in flexed position

- Turns head from side to side; head sags on ventral suspension

Social/communication
- Visual preference for human face

Visual
- Able to fixate face on light in line of vision; "doll's-eye" movement of eyes on turning the body
- Responds to visual threats by blinking
- Visual acuity is 20/400

Reflex
- Moro, stepping, placing, and grasp reflexes are all active

1 Month

Gross motor
- Legs more extended
- Head lifted momentarily to plane of body on ventral suspension
- Chin up in the prone position
- Turns head in the supine position

Fine motor
- Hands fisted near the face
- Sucks well

Social/communication/problem-solving
- Begins to smile
- Gazes at black-white objects
- Watches person; follows moving object
- Body movements following the sound of others

Language
- Startles to voice or sound

2 Months

Gross motor
- Raises head slightly farther in prone position
- Head sustained in plane of body on ventral suspension
- Begins to push up when lying on tummy
- Head lags when pulled to sitting position

Fine motor
- Hands unfisted 50% of the time
- Retains an object or finger if placed in the hand
- Brings hands to mouth, sucks on hand, and may hold hands together

Social/communication/problem solving
- Follows moving object 180°
- Able to fixate on the face and follow it briefly
- Tries to look at parents
- Stares momentarily where object disappeared
- Smiles on social contact; listen to voice and coos
- Turns toward sounds

Language
- Coos and makes gurgling sounds
- Begins to act bored (crying, fussy)

3 Months

Gross motor
- Lifts head and chest with arms in prone position
- May roll to the side

Fine motor
- Brings hands together in the midline and to the mouth
- Inspects their own fingers
- Bats at objects or toys

Social/communication/problem solving
- Follows parents across the room
- Expression of dislike for a taste or a loud sound
- Regards hands and toys

Language
- Regards and vocalizes to parents when talking
- Chuckles

4 Months

Gross motor

- Holds head steady and no head lag when pulled from lying down to sitting position (Fig. 1.3)
- May be able to roll over from front to back
- Pushes tummy, with elbows lifting the head and chest (Fig. 1.4)

Fig. 1.3 Holds head steady and no head lag when pulled from lying down to sitting position

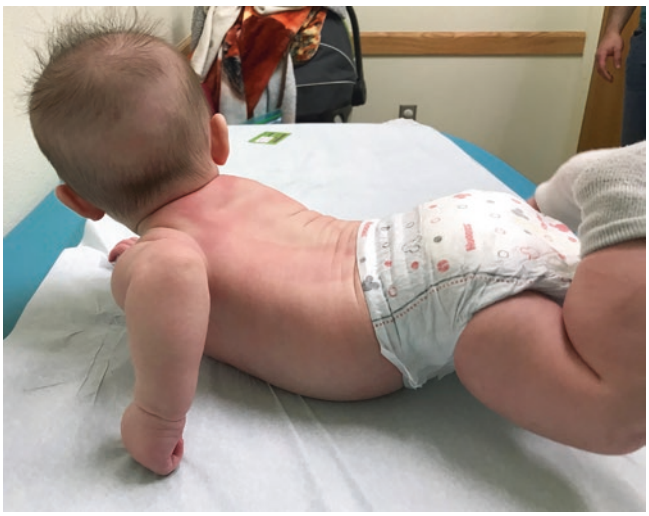


Fig. 1.4 Developmental milestone at 4 months: Pushes tummy, with elbows lifting the head and chest

- Pushes down on legs when feet are on a hard surface

Fine motor

- Brings hands to mouth
- Uses hands and eyes together, such as seeing a toy and reaching for it
- Shakes rattle

Social/communication/problem solving

- Responds to affection
- Begins to babble
- Laughs out loud
- Excited at sight of a bottle
- Recognizes familiar people and things at a distance
- Likes to play with people and might cry when playing stops

Language

- Vocalizes when alone

Reflexes

- Asymmetric tonic reflex is gone
- Palmar grasp is gone

6 Months

Gross motor

- Begins to sit with minimal support
- Rolls over from back to front and front to back
- Supports weight on legs and might bounce

Fine motor

- Transfers objects from one hand to another
- Brings objects or food to the mouth
- Places hands on the bottle
- Bangs and shakes toys
- Rakes pellets
- Removes cloth on face

Social/communication/problem-solving

- Stranger anxiety
- Responds to own name
- Responds to sounds by making sounds showing joy and displeasure

Language
- Monosyllabic babble
- Looks at self in mirror and smiles

7 Months

Gross motor
- Sits steady without support (Fig. 1.5)
- Bounces when held upright
- Puts arms out to the side for balance

Fine motor
- Radial palmar grasp

Social/communication/problem-solving
- Explores different aspects of toy and observes toy block in each hand
- Finds partially hidden toys or objects
- Looks from object to parents and back when wanting help
- Looks at familial objects or toys
- Attends to sounds and music
- Prefers mother
- Inhibits to "no"

Language
- More vowels and more variety of sounds

9 Months

Gross motor
- Can get into sitting position from lying down
- Pulls to stand
- Begins to crawl (Fig. 1.6)
- Bears walk with all limbs straight

Fine motor
- Radial-digital grasps of a block
- Bangs 2 blocks together
- Bites and chews cookie
- Inspects and rings a bell
- Pulls string to obtain a ring

Social/communication/problem-solving
- Separation anxiety
- Recognizes familiar people
- May be afraid of strangers

Fig. 1.5 Developmental milestone at 7 months: Sits steady without support

Fig. 1.6 Developmental milestone at 9 months: Begins to crawl

- Uses sound to get attention
- Plays peek-a-boo
- Orients to name well

Language

- Says "mamama" and "bababa" nonspecific
- Copies sounds and gestures of others

12 Months

Gross motor

- Walks with one hand held
- Pulls up to stand, walks holding on to furniture ("cruising")
- May stand alone and make a few steps without holding (Fig. 1.7)

Fine motor

- Fine pincer grasps of pellet
- Holds crayon and scribbles after demonstration
- Attempts tower of 2 blocks
- Finger feeds part of a meal
- Takes off a hat
- Puts out arm or leg to help with dressing
- Rattles spoon in a cup
- Puts a toy in a container, takes it out of the container

Social/communication/problem-solving

- Shows parents object to share interest
- Follows one-step command with a gesture
- Looks at the right picture or thing when it is named
- Points to get desired object (proto-imperative pointing) and to share interest
- Uses several gestures when vocalizing (e.g., waving, reaching)

Language

- Says a few words, including "mama," "dada," and exclamations like "uh-oh!"

Fig. 1.7 Developmental milestone at 12 months: May stand alone and make a few steps without holding

14 Months

Gross motor

- Walks well
- Stands without pulling

Fine motor
- Imitates back and forth scribbling
- May add the third block to a 2-block tower
- Puts round peg in and out of a hole
- Removes socks and shoes
- Chews well
- Puts a spoon in the mouth upside down
- Dumps pellet out of a bottle after a demonstration

Social/communication/problem-solving
- Points at an object to express interest (proto-declarative pointing)
- Purposeful exploration of toys through trial and error
- Follows one-step commands without gesture

Language
- Names one object

15 Months

Gross motor
- Stoops to pick up an object from the floor
- Runs stiff-legged
- Climbs on furniture and may be able to creep upstairs

Fine motor
- Builds 3- to 4-block tower
- Places 10 blocks in a cup
- Drinks from a cup
- Releases pellet into a bottle
- Eats with a spoon with some spilling
- Places circle in a single-shape puzzle
- Turns pages in a book

Social/communication/problem-solving
- Hugs parents in reciprocation
- Shows empathy (may cry when someone else is crying)
- Recognizes without demonstration that a toy requires activation, then hands it to an adult if it cannot operate
- Points to one body part
- Gets an object from another room upon demand

Language
- Uses 3–5 words
- Mature jargoning with real words

18 Months

Gross motor
- Runs well
- Creeps downstairs
- Gets onto a chair without assistance

Fine motor
- Throws a ball while standing
- Makes 4-block tower
- Imitates vertical stroke
- Can help undress him/herself
- Eats with a spoon
- Matches pairs of objects

Social/communication/problem-solving
- Normal M-CHAT
- Plays simple pretend, such as feeding a doll
- Begins to have temper tantrum and shows shame when does wrong
- Points to 2 of 3 objects when named and 3 body parts
- Points to familiar people with the name
- Understands “mine”

Language
- Uses 10–25 words
- Imitates animal sounds
- Names object in one picture on demand

24 Months

Gross motor
- Walks upstairs and downstairs holding rail
- Kicks a ball
- Throws ball overhand
- Stands on tiptoes

Fine motor
- Makes a single line of blocks
- In drawing, imitates horizontal line
- Begins to sort shapes and colors
- Opens door using the knob
- Takes off clothes without buttons
- Pulls off pants
- Builds a tower of 6 blocks
- Parallel play

Social/communication/problem-solving
- Begins to mask emotions for social etiquette
- Follows 2-step instructions or commands such as "Sit on your chair and eat your food"
- Points to 5–10 objects in pictures

Language
- Uses 2-word sentence
- Uses 50 or more words
- 50% intelligible speech

3 Years

Gross motor
- Walks up and down stairs, 1 foot on each step, no rails
- Climbs well
- Pedals a tricycle (3-wheeled bike)
- Balances on 1 foot for 3 seconds

Fine motor
- Copies a circle with pencil or crayon
- Can work toys with buttons, levers, and moving parts
- Screws and unscrews jar lids and turns door handle
- Understands what "2" means
- Imitates bridge of blocks
- Independent eating
- Puts on shoes without laces and able to unbutton clothing
- Draws man with 2 to 3 parts

Social/communication/problem-solving
- Understands long/short, big/small, more/less
- Knows own gender and age
- Follows 3-step instructions or commands
- Fears imaginary things

Language
- Uses words to describe what someone else is thinking ("Dad thought I was crying")
- Names body parts with function
- Uses 3-word sentences
- Says words like "I," "me," "we," and "you" and some plurals ("cars", "dogs," "cats")
- Names body parts by use
- 75% intelligible speech

4 Years

Gross motor
- Balances on 1 foot for 8 seconds
- Hops and stands on 1 foot up to 2 seconds

Fine motor
- Throws ball overhand more than 3 yards
- Catches a bounced ball most of the time
- Copies a square
- Goes to the toilet alone
- Wipes after a bowel movement
- Draws man with 4 to 6 parts

Social/communication/problem solving
- Group play
- Follows 3-steps commands and instructions
- Tells story and accurately counts 4 pennies

Language
- Knows some basic rules of grammar, such as correctly using "he," "she," "his," "her"
- 100% intelligible speech

5 Years

Gross motor
- Walks downstairs with rail, alternating feet
- Skips

Fine motor
- Copies a triangle
- Cuts with scissors
- Builds stairs with blocks from model
- Dresses and undresses

Social/communication/problem-solving
- Apologizes for mistakes
- Draws man with 8 to 10 parts
- Names 10 colors and counts to 10, counts 10 pennies correctly

Language
- Knows right from left
- Asks questions about the meanings of words and responds to questions
- Repeats 6 to 8 words in sentences

6 Years

Gross motor
- Tandem gait (heel-to-toe walks)

Fine motor
- Builds stairs from memory
- Copies a diamond shape
- Writes first and the last name

Social/communication/problem-solving
- Has a best friend of same gender
- Looks both ways at street when crossing
- Draws man with 12–14 parts
- Able to do simple additions and subtractions

Language
- Knows days of the week
- Able to describe events in sequence

Key Points to Developmental Milestones

Primitive reflexes
- Moro is absent around 3–4 months of age
- Palmar grasp absent around 2–3 months of age
- Parachute starts around 6–9 months of age

Following objects
- 1 month: Follows to the midline
- 2 months: Follows past midline
- 3 months: Follows 180°
- 4 months: Circular tracking 360°

Speech intelligibility
- 50% intelligible at 2 years
- 75% intelligible at 3 years
- 100% intelligible at 4 years

Language: receptive
- 1 month
  - Startles to voice or sound
- 2 months
  - Alerts to voice or sound
- 4 months
  - Orients head to the direction of a voice or sound
- 8 months
  - Responds to parents
- 9 months
  - Orients attentively to his or her name
- 10 months
  - Waves “bye-bye” in return
- 12 months
  - Follows one-step command with a gesture
- 14 months
  - Follows one-step command without a gesture

Language: expressive
- Coos
  - 2 months (2–4 months)
- Laughs out loud
  - 4 months
- Babbles
  - 6 months
- “Mama” or “dada” nonspecific
  - 9 months
- “Mama” and “dada” specific, plus a few words
  - 12 months
- Vocabulary of 10–25 words
  - 18 months
- Two-word sentences
  - 2 years (18–24 months)

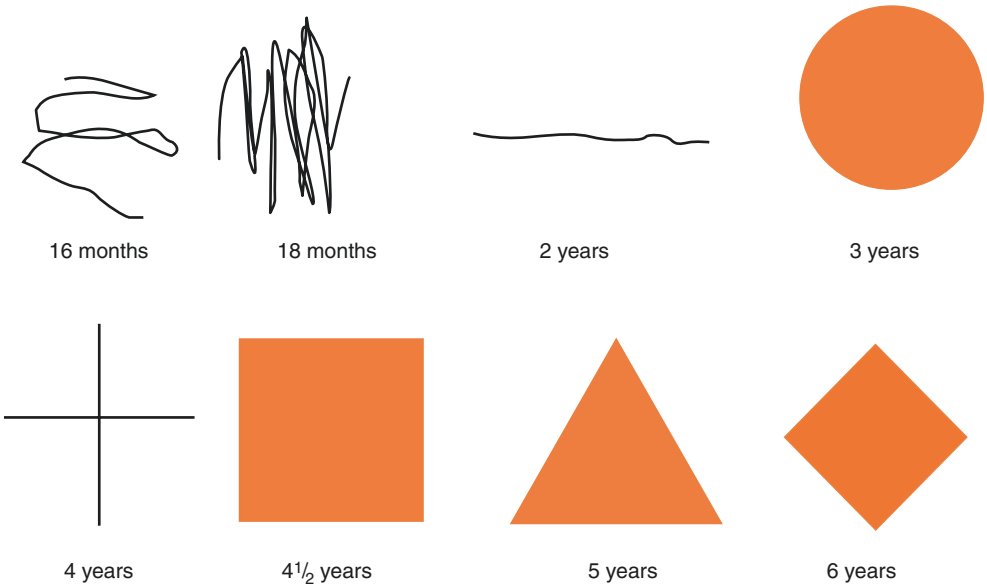


Fig. 1.8 Fine motor developmental milestones and ability to draw at different ages

- Three-word sentences
  - 3 years (2–3 year)
- Four-word sentences
  - 4 years (3–4 year)

Drawing (Fig. 1.8)

- Scribbles spontaneously
  - 16 months
- Imitates vertical lines
  - 18 months
- Imitates horizontal lines
  - 2 years
- Circle
  - 3 years
- Cross
  - 4 years
- Square
  - 4.5 years
- Triangle
  - 5 years
- Diamond
  - 6 years

Social skills

- Reciprocal smiling
  - 2 months
- Follows the person who is moving across the room
  - 3 months
- Smiles spontaneously at a pleasurable sight/sound
  - 4 months
- Recognizes caregiver socially
  - 5 months
- Stranger anxiety
  - 6 months
- Separation anxiety; gaze follows caregiver's pointing to object, "Oh, look!"
  - 9 months
- Waves "bye-bye" in return
  - 10 months
- Shows objects to parents to share interests
  - 12 months
- Parallel play
  - 2 years
- Reduction in separation anxiety
  - 28 months
- Cooperative play
  - 3–4 years
- Ties shoelaces
  - 5 years
- Distinguishes fantasy from reality
  - 6 years

Block play (Fig. 1.9)

- Passes blocks
  - More than 6 months

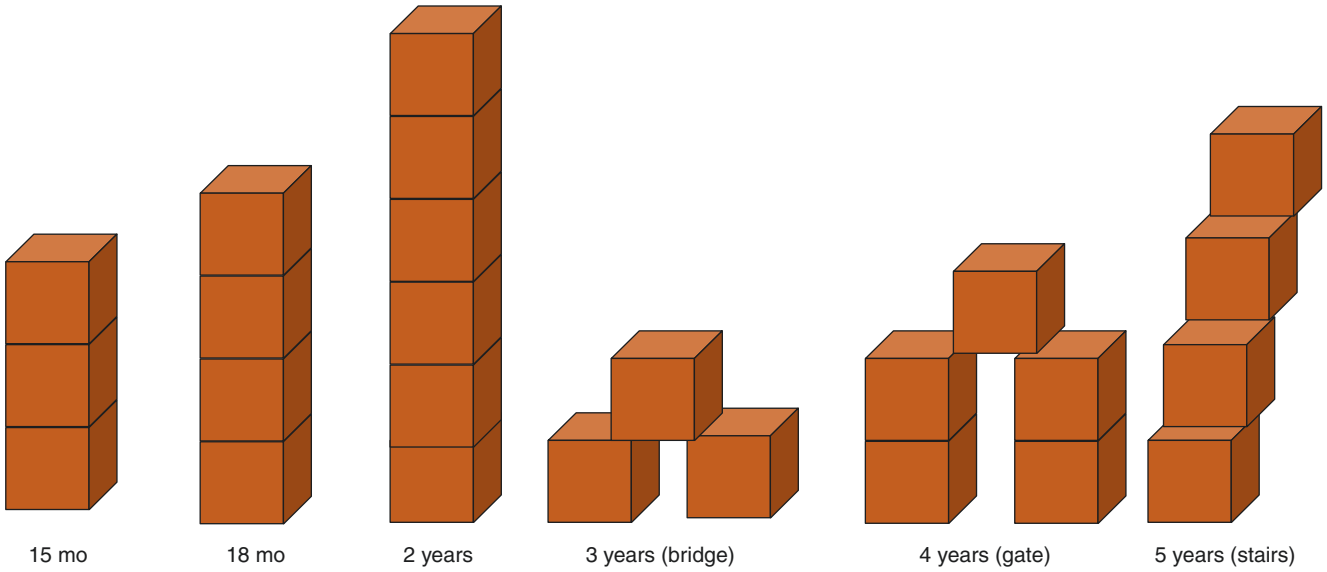


Fig. 1.9 Fine motor skills and ability to use blocks at different ages

- Bangs blocks
  - 9 months
- Block in a cup
  - 12 months
- Tower 3 blocks
  - 15 months
- Tower 4 blocks
  - 18 months
- Tower 6 blocks
  - 24 months
- Builds bridge with blocks
  - 3 years
- Builds gate with blocks
  - 4 years
- Builds stairs from model
  - 5 years

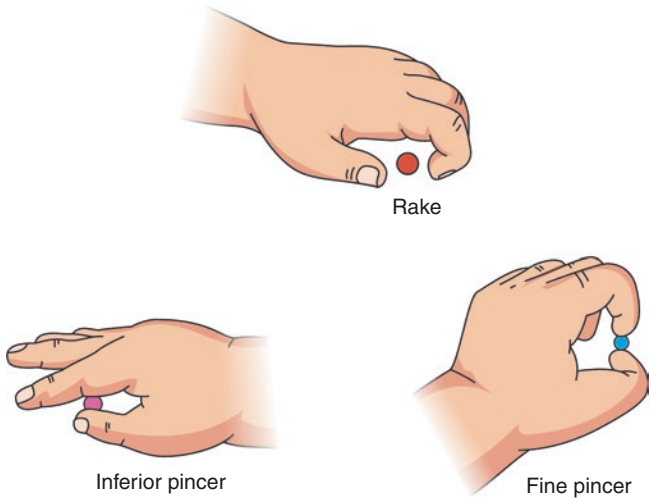


Fig. 1.10 Fine motor skills of catching an object at different ages

Catching objects (Fig. 1.10)

- Rakes
  - 5–6 months
- Radial-palmar grasp of pellet
  - 7–8 months
- Inferior pincer grasp of pellet
  - 10 months
- Fine pincer grasp of pellet
  - 12 months

Walking and running

- Independent steps
  - 12 months
- Walks well
  - 14 months
- Runs stiff-legged
  - 15 months
- Runs well
  - 18 months
- Kicks ball without demonstration
  - 2 years
- Skips and walks backward heel-toe
  - 5 years
- Heel to toe walks (tandem gait)
  - 6 years

Climbing stairs

- Creeps upstairs
  - 15 months
- Creeps downstairs
  - 18 months
- Walks downstairs holding rail, both feet on each step
  - 2 years
- Goes up stairs, alternating feet, no rail
  - 3 years
- Walks downstairs with rail, alternating feet
  - 5 years

Developmental red flags (Tables 1.3 and 1.4) [4]

Table 1.3 Developmental red flags for motor skills by age [4]

Age	Motor red flags
Newborn	Hypotonia and feeding difficulty
2 months	Unable to hold head up when pushing up when on tummy
4 months	Unable to hold head steady Unable to bring things to the mouth Persistent fisting (a predictor of neurological dysfunction)
6 months	Unable to pass an object from one hand to another and does not try to reach an object Floppy like a rag doll
9 months	Unable to sit, not rolling
12 months	Unable to stand or bear weight on legs when supported Unable to crawl
15 months	Unable to do pincer grasps
18 months	Unable to walk
24 months	Unable to walk well
36 months	Unable to climb stairs well and frequent falling
4 years	Unable to jump in place
5 years	Unable to draw pictures, a cross, or a square Poor balance
6–12 years	Unable to skip or hop on one foot Unable to write name
All ages	Loss of skills they once had

Table 1.4 Developmental red flags for language and social skills by age [4]

Age	Language and social red flags
Newborn	Does not respond to loud sounds
2 months	Does not alert to voice, lack of looking at faces Does not watch things as they move
4 months	Does not coo or make sounds Does not smile at people
6 months	Does not turn toward sounds; no smiling, laughing, or expression
9 months	Does not babble (“mama,” “baba,” “dada”)
12 months	Does not respond to name Does not understand “no” Indifferent or resistant attachment to the caregiver Does not look where caregiver points
15 months	Does not use words “mama,” “papa,” “dada” Does not point to the desired object
18 months	Does not gain new words Does not have at least 6 words Does not point to show things to other or share interest
24 months	Unable to use two-word phrases (e.g., “drink water”) Unable to follow simple instructions Unable to imitate actions or words Unable to maintain eye contact
36 months	Unable to use a three-word sentence Unable to pretend, play, or make-believe
4 years	Unable to speak clearly Unable to answer simple questions Unable to use pronouns (“I”, “me”, “you”, “he”, and “she”) correctly Ignores other children or does not respond to people outside the family
5 years	Unable to use plurals or past tense properly Unable to recognize shapes, letters, colors Unable to brush teeth, use toilet, wash and dry hands, or get undressed without help Unable to distinguish between reality and fantasy Shows extreme behavior (unusually fearful, aggressive, shy, or sad)
6–12 years	Unable retell or summarize a story Unable to name friends Unable to recognize the feelings of others
All ages	Loss of skills they once had

IMMUNIZATION [6, 7] (TABLE 1.5)

Responding to parents who refuse immunization for their children

- Listen to parents and address all their concerns about vaccines
- Explain all risks and benefits of the vaccinations:
  - Unimmunized, delay in vaccination, and use of alternative immunization schedules have caused a resurgence of many infectious diseases due to the loss of herd immunity, which puts many communities at risk
  - Vaccines are very safe, but they are not risk-free, nor are they 100% effective
  - Compare the risks of vaccines to the risks of diseases they protect against, some of which can cause death or permanent disability
- Refer parents to reputable sources and database about vaccines
- Discuss risks and benefits in each subsequent visit along with proper documentation
- Unimmunized children may be prevented from attending schools during outbreaks of vaccine-preventable diseases
- Advise parents to inform health-care providers that their child is not immunized during acute illness (e.g., emergency room visit)
- Have parents sign vaccine refusal form in every subsequent well visit
- Continued refusal after adequate discussion should be respected unless the child is put at significant risk of serious harm, e.g., refuses rabies vaccines after the child was bitten by a stray dog
- In general, the pediatrician should not refuse a child care because caregivers reject vaccines unless a strong sense of distrust develops that impacts the child's overall care

Table 1.5 Immunization schedule summary

Immunization schedule	Vaccine
Birth	HepB
2 months	DTap, IPV, HepB, Hib, PCV, RV
4 months	DTap, IPV, HIB, PCV, RV
6 months	DTap, IPV, HepB, Hib[a], PCV, RV[b], Influenza[c]
12 months	MMR, Varicella, Hib, PCV, HepA
15–18 months	DTap
18 months	HepA (1st and 2nd dose must be 6 months apart)
4–6 years	MMR, Varicella, DTap, IPV
11–12 years	Tdap, MCV4 HPV (2-dose series 6–12 months apart)[d]
16 years	Second dose of MCV4
High risk	PPSV23 2–18 years MCV4 2–10 years Meningococcal B (10 years and older)

DTaP Diphtheria and tetanus toxoids and acellular pertussis vaccine, *DTP* Diphtheria, pertussis, and tetanus, *HepA* Hepatitis A, *HepB* Hepatitis B, *Hib Haemophilus influenzae* type b (Hib) conjugate, *HPV* Human papillomavirus vaccine, *IPV* Inactivated poliovirus vaccine, *MCV4* Meningococcal conjugate ACWY vaccine, *MMR* Measles, mumps, and rubella, *PCV* Pneumococcal conjugate vaccine, *PPSV23* Pneumococcal polysaccharide vaccine, *Tdap* Tetanus and diphtheria toxoids and acellular pertussis vaccine, *RV* Rotavirus vaccine

[a]Hib dose at 6 months is not required if using PedvaxHIB (Merck)

[b]Dose at 6 months is not required if using Rotarix (GSK)

[c]Influenza every year beginning at 6 months

[d]3 doses of HPV for persons initiating vaccination at age 15 years or older

Recommended immunization schedule for children and adolescents ages 18 years or younger, United States, 2018 (US Department of Health and Human Services, Centers for Disease Control and Prevention) https://www.cdc.gov/vaccines/schedules/hcp/imz/child-adolescent.html

Hepatitis B Vaccine (HepB)

First dose of HepB is at birth

- Birth dose (monovalent HepB vaccine only)

Doses following birth dose

- Administer the second dose 1–2 months after the first dose (minimum interval of 4 weeks)
- Administration of four doses of HepB is permissible if the combination is used after birth dose

- The final third or fourth dose in the HepB series should not be administered before 6 months of age

Mother is HBsAg-negative

- One dose within 24 h of birth for medically stable infants ≥ 2000 g. For infants < 2000 g, administer one dose at chronological age 1 month or hospital discharge.

Mother is HBsAg-positive

- Give one dose HepB vaccine and 0.5 mL of hepatitis B immune globulin (HBIG) (at separate anatomic sites) within 12 h of birth, regardless of birth weight.
- Test for HBsAg and anti-HBs at age 9–12 months. If HepB series is delayed, test 1–2 months after final dose.

Mother's HBsAg status is unknown:

- Give HepB vaccine within 12 h of birth, regardless of birth weight.
- For infants < 2000 g, give 0.5 mL of HBIG in addition to HepB vaccine within 12 h of birth
- Give 3 additional doses of vaccine (total of 4 doses) beginning at age 1 month
- Determine mother's HBsAg status as soon as possible. If mother is HBsAg-positive, give 0.5 mL of HBIG to infants ≥ 2000 g as soon as possible, but no later than 7 days of age.

Catch-up vaccination

- An unvaccinated person should complete a three-dose series

Rotavirus Vaccine (Two Available in the USA)

Minimum age is 6 weeks

- If Rotarix (RV1; GlaxoSmithKline [GSK]) is used, administer a two-dose series at 2 and 4 months of age
- If RotaTeq (RV5; Merck & Co.) is used, administer a 3-dose series at age 2, 4, and 6 months
- If any dose in the series was RotaTeq or vaccine product is unknown for any dose in the series, a total of 3 doses of RV vaccine should be administered

Catch-up vaccination

- The maximum age for the first dose in the series is 14 weeks, 6 days
- Vaccination should not be initiated in infants of age 15 weeks, 0 days, or older
- The maximum age for the final dose is 8 months, 0 days

DTaP/Tdap

DTaP (diphtheria and tetanus toxoids and acellular pertussis vaccine)

Administration

- Minimum age 6 weeks (exception, DTaP-IPV [Kinrix, GSK; Quadracel, Sanofi Pasteur], 4 years)
- *Not* given to children 7 years and older
- Five-dose series DTaP vaccine at ages 2, 4, 6, 15–18 months, and 4–6 years
- The fourth dose may be administered as early as 12 months, if at least 6 months have elapsed since dose 3

Catch-up vaccination

- The fifth dose of DTaP vaccine is not necessary if the fourth dose was administered at age 4 years or older

Tdap (tetanus and diphtheria toxoids and acellular pertussis vaccine)

- Similar to DTaP but contain a smaller amount of pertussis antigen
- Minimum age: 10 years for both Boostrix (GSK) and Adacel (Sanofi Pasteur)

Administration
- Administer one dose of Tdap vaccine to all adolescents aged 11–12 years

Catch-up vaccination
- A child 7 years and older who is not fully immunized with DTaP vaccine should receive Tdap vaccine as one dose in the catch-up series; if additional doses needed, use tetanus and diphtheria vaccine, adult/adolescent formulation (Td).
- For children between 7 and 10 years who receive a dose of Tdap as part of the catch-up series, an adolescent Tdap vaccine dose at age 11–12 years should *not* be administered. Td should be administered instead, 10 years after Tdap dose.

DTaP inadvertently given after 7th birthday
- Child age 7–10 years: DTaP may count as part of catch-up series. Routine Tdap dose at 11–12 should be administered
- Adolescent age 11–18 years: Count dose of DTaP as the adolescent Tdap booster.

Absolute contraindication
- History of encephalopathy within 7 days of dosing

Relative contraindication
- History of fever > 40.5 °C (105 °F) within 48 h after prior dose
- Seizure within 3 days
- A shock-like condition within 2 days
- Persistent crying for more than 3 h within 2 days

Vaccination may be administered under these conditions
- Fever of < 105 °F (< 40.5 °C), fussiness, or mild drowsiness after a previous dose of DTaP
- Family history of seizures
- Family history of sudden infant death syndrome
- Family history of an adverse event after DTaP administration
- Stable neurologic conditions (e.g., cerebral palsy, well-controlled seizures, or developmental delay)

Haemophilus influenzae Type B (Hib) Conjugate

Vaccine
- Hib vaccine prevents invasive bacterial infections usually caused by *H. influenzae* type b

Routine vaccination of Hib
- Administer a 2- or 3-dose Hib vaccine primary series and a booster dose (dose 3 or 4, depending on vaccine used in primary series) at age 12–15 months to complete a full Hib vaccine series

Special situations
- Do not immunize immunocompetent children 5 years of age or older, even if they never had Hib vaccine
- Give one dose of Hib to unimmunized children 5 years of age or older with HIV, functional/anatomical asplenia
- Give one dose of Hib to unimmunized children who are going for elective splenectomy, preferably at least 14 days before the procedure
- Children who are going for hematopoietic stem cell transplant will need 3-dose series with doses 4 weeks apart, starting 6–12 months after successful transplant (regardless of Hib vaccination history)

Pneumococcal Vaccines

13-Valent pneumococcal conjugate vaccine (PCV13)

Routine vaccination
- Administer a 4-dose series of PCV13 vaccine at ages 2, 4, and 6 months, and at age 12–15 months

- PCV13 is recommended for all children younger than 5 years

Catch-up vaccination with PCV13

- Administer 1 dose of PCV13 to all healthy children aged 24–59 months who are not completely vaccinated for their age

23-Valent pneumococcal polysaccharide vaccine (PPSV23)

- Protects children older than 2 years of age against invasive disease caused by the 23 capsular serotypes contained in the vaccine

Special situations: high-risk conditions (Table 1.6)

- When both PCV13 and PPSV23 are indicated, administer PCV13 first
- PCV13 and PPSV23 should not be administered during same visit

Methods of vaccine administration (Table 1.7)

Inactivated Poliovirus Vaccine (IPV)

Routine vaccination

- Administer a 4-dose series of IPV at ages 2, 4, 6–18 months, and 4–6 years
- The final dose in the series should be administered on or after the fourth birthday and at least 6 months after the previous dose

Catch-up vaccination

- Minimum age is 6 weeks
- The minimum interval between dose 1 to dose 2 and dose 2 to dose 3 is 4 weeks, the minimum interval between dose 3 to dose 4 is 6 months
- The minimum age for final dose is 4 years

Oral Poliovirus Vaccine (OPV)

- Live oral vaccine
- No longer used in the USA

Contraindication

- Children with immunodeficiency
- Children who live with adult HIV-infected or immunocompromised

Table 1.7 Methods of vaccine administration

Method of vaccine administration	Vaccine
Oral	Rotavirus Oral polio vaccine (not used in the USA)
Subcutaneous	MMR Varicella IPV
Intramuscular	All other vaccines, including IPV

MMR Measles, mumps, and rubella, *IPV* Inactivated poliovirus vaccine

Table 1.6 PCV13 and PPSV23 administration to children with an underlying medical condition

Group and risks	PCV13	PPSV23 Dose#1	PPSV23 Dose #2
Healthy children < 5 years	Routine	None	None
Immunocompetent children and teens with underlying medical conditions, e.g., chronic heart disease, chronic lung disease, (including asthma treated with high-dose, oral corticosteroids), diabetes mellitus, cerebrospinal fluid leak; cochlear implant	1 dose 8 weeks before PPSV23[a]	Age 2 years and older: Administer 1 dose at least 8 weeks after any prior PCV13 dose	None
Children and teens with *immunocompromising* conditions, nephrotic syndrome, malignant neoplasms, functional or anatomic asplenia	1 dose 8 weeks before PPSV23[a]	Age 2 years and older: Administer 1 dose at least 8 weeks after any prior PCV13 dose	1 additional dose at least 5 years following the first PPSV23

PCV13 13-Valent pneumococcal conjugate vaccine, *PPSV23* 23-Valent pneumococcal polysaccharide vaccine

[a]Children 2–5 years with any incomplete series of PCV13; not having received all doses in either the recommended series or an age-appropriate catch-up series will need one PCV13 booster dose (if received 3 PCV13 doses series), and two PCV13 booster doses 8 weeks apart (if received < 3 PCV13 doses series), at least 8 weeks after any prior PCV13 dose

Influenza Vaccines

Minimum age

- 6 months: inactivated influenza vaccine (IIV)
- 2 years: live attenuated influenza vaccine (LAIV)
- 18 years: recombinant influenza vaccine (RIV)

Routine vaccination

- 1 dose any influenza vaccine appropriate for age and health status annually (2 doses separated by at least 4 weeks for children 6 months–8 years who did not receive at least 2 doses of influenza vaccine before July 1, 2018)

Special situations

- Egg allergy, hives only
  - Give any influenza vaccine appropriate for age and health status annually
- Egg allergy more severe than hives (e.g., angioedema, respiratory distress)
  - Give any influenza vaccine appropriate for age and health status annually in medical setting under supervision of health-care provider who can recognize and manage severe allergic conditions
- LAIV should **NOT** be used in the following conditions
  - History of severe allergic reaction to any component of the vaccine (excluding egg) or to a previous dose of any influenza vaccine
  - Children and adolescents receiving concomitant aspirin or salicylate-containing medications
  - Children age 2–4 years with a history of asthma or wheezing, those who are immunocompromised due to any cause (including immunosuppression caused by medications and HIV infection)
  - Anatomic and functional asplenia, cochlear implants, cerebrospinal fluid-oropharyngeal communication
  - Close contacts and caregivers of severely immunosuppressed persons who require a protected environment
  - Pregnancy
  - Persons who have received influenza antiviral medications within the previous 48 hours.

Measles, Mumps, and Rubella (MMR) Vaccine

Background

- MMR is a combination of 3 attenuated live viruses
- Not contraindicated in children with egg allergy

Routine vaccination

- Administer a 2-dose series of MMR vaccine at ages 12–15 months and 4–6 years

International travel to high-risk countries

- Age 6–11 months
  - Administer 1 dose of MMR vaccine before departure from the USA
  - If the child remains in the high-risk area, the second dose should be given at least 4 weeks later
  - The dose before age of 12 months does not count towards the routine MMR vaccine series
- Age 12 months and older
  - Administer 2 doses of MMR vaccine 4 weeks apart before departure from the USA

Catch-up vaccination

- Ensure that all school-aged children and adolescents have had 2 doses of MMR vaccine; the minimum interval between the 2 doses is 4 weeks
- May not be given within 4 weeks of other live vaccines, but it can be given together or in combination with varicella vaccine at the same time

Contraindication

- Anaphylactic reaction to neomycin or gelatin
- Pregnancy; however, it is not an indication for abortion
- Immunodeficiency, e.g., AIDS; however, HIV-infected children can receive MMR live vaccine if not immunodeficient

Vaccination may be administered under these conditions

- Positive tuberculin skin test
- Simultaneous tuberculin skin testing
- Breastfeeding
- Pregnancy of recipient's mother or other close or household contact
- A recipient is female of childbearing age
- Immunodeficient family member or household contact
- Asymptomatic or mildly symptomatic HIV infection
- Allergy to eggs

Varicella (VAR)

Background

- Live attenuated virus vaccine contains a small amount of neomycin and gelatin
- Two doses are recommended
- Minimum age is 12 months, second dose at 4–6 years
- The combination with MMR vaccine is now available (MMRV)

Routine vaccination

- Administer a 2-dose series of VAR vaccine at ages 12–15 months and 4–6 years
- The second dose may be given as early as 3 months after the first dose (a dose given after a 4-week interval may be counted)

Catch-up vaccination

- Ages 7–12 years: Routine interval 3 months (minimum interval, 4 weeks)
- Ages 13 years and older: Minimum interval 4 weeks

Contraindication

- Immunocompromised children
- Pregnant women

Vaccination may be administered under these conditions

- Pregnancy of a recipient's mother or other close or household contact
- Immunodeficient family member or household contact
- Asymptomatic or mildly symptomatic HIV infection
- Humoral immunodeficiency (e.g., agammaglobulinemia)
- Children with HIV or who live with an immunocompromised adult can take the vaccine
- The vaccine can be given to children who live with a pregnant woman.

Varicella Zoster Immune Globulin (VariZIG)

- Post-exposure to measles and varicella prophylaxis (Table 1.8)

Hepatitis A (HepA) Vaccine

Routine vaccination

- Initiate the 2-dose HepA vaccine series at 12–23 months; separate the 2 doses by 6–18 months
- Minimum age: 12 months for routine vaccination

Catch-up vaccination

- Anyone 2 years of age or older may receive HepA vaccine if desired. Minimum interval between doses is 6 months.

International traveling to countries with high or intermediate endemic hepatitis A

- Infants age 6–11 months: 1 dose before departure; revaccinate with 2 doses, separated by

Table 1.8 Post-exposure to measles and varicella prophylaxis

Exposure of individuals who have no evidence of immunity	Vaccine	Immunoglobulin
Measles	MMR vaccine within 72 hours of exposure MMR vaccine should be offered at any interval after exposure, as it may provide some protection MMR vaccination of infants 6–11 months if many measles cases appeared in infants < 12 months	Immunoglobulin can be given within 6 days of exposure to people at risk of severe illness or infants younger than 12 months; 6–11 months old, MMR vaccine can be given within 72 hours instead of immunoglobulin
Varicella	To healthy individuals with no history of immunization who are 12 months or older within 3–5 days after varicella or herpes zoster exposure	VariZIG within 10 days to the newborn infant whose mother had chickenpox (not zoster) within 5 days before delivery or within 48 hours after delivery To immunocompromised children

MMR Measles, mumps, and rubella, *VariZIG* Varicella zoster immune globulin

6–18 months, between 12 and 23 months of age
- Unvaccinated age 12 months and older: first dose as soon as travel considered

Post-exposure prophylaxis
- < 12 months: administer a single dose of Ig as soon as possible
- ≥ 12 months: administer a dose of single-antigen vaccine or Ig as soon as possible (the efficacy of Ig or vaccine when administered > 2 weeks after exposure has not been established)

Meningococcal Conjugate Vaccines

Background
- MCV4 or meningococcal conjugate vaccines (Men ACWY: Menactra, Sanofi Pasteur; Menveo, GSK), reduce morbidity and mortality from meningococcal disease caused by serotypes A, C, W, or Y (does not cover for B serotype)

Routine vaccination
- Administer a single dose of Menactra or Menveo vaccine at age 11–12 years, with a booster dose at age 16 years

Catch-up vaccination
- Age 13–15 years: 1 dose now and booster at age 16–18 years (minimum interval, 8 weeks)
- Age 16–18 years: 1 dose

Special situations
- Anatomic or functional asplenia (including sickle cell disease), HIV infection, persistent complement component deficiency, eculizumab use

Menveo
- Dose 1 at age 8 weeks: 4-dose series at 2, 4, 6, 12 months
- Dose 1 at age 7–23 months: 2-dose series (dose 2 at least 12 weeks after dose 1 and after the 1st birthday)
- Dose 1 at age 24 months or older: 2-dose series at least 8 weeks apart

Menactra
- Persistent complement component deficiency:
  - Age 9–23 months: 2 doses at least 12 weeks apart
  - Age 24 months or older: 2 doses at least 8 weeks apart
- Anatomic or functional asplenia, sickle cell disease, or HIV infection
  - Age 9–23 months: Not recommended

  - 24 months or older: 2 doses at least 8 weeks apart
  - Menactra must be administered at least 4 weeks after completion of PCV13 series.

Travel in countries with hyperendemic or epidemic meningococcal disease, including countries in the African meningitis belt or during the Hajj

- Children age less than 24 months:
  - Menveo (age 2–23 months):
    - Dose 1 at 8 weeks: 4-dose series at 2, 4, 6, 12 months
    - Dose 1 at 7–23 months: 2-dose series (dose 2 at least 12 weeks after dose 1 and after the 1st birthday)
  - Menactra (age 9–23 months):
    - Two-dose series (dose 2 at least 12 weeks after dose 1; dose 2 may be administered as early as 8 weeks after dose 1 in travelers)
- Children age 2 years or older: 1 dose of Menveo or Menactra

First-year college students who live in residential housing (if not previously vaccinated at age 16 years or older) or military recruits: 1 dose of Menveo or Menactra

Serogroup B meningococcal vaccines

- MenB vaccine may be administered based on individual clinical decision to *adolescents not at increased risk* age 16–23 years (preferred age 16–18 years): (Bexsero, GSK; Trumenba, Pfizer)
- Children 10 years or older who are at increased risk for serogroup B meningococcal infections should be vaccinated, e.g.:
  - Asplenia (functional or anatomic)
  - Persistent complement deficiency
  - Eculizumab use

Administration

- Bexsero: 2-dose series at least 1 month apart
- Trumenba: 3-dose series at 0, 1–2, and 6 months
- Bexsero and Trumenba are not interchangeable

Human Papillomavirus (HPV) Vaccines

Background

- Prevent cervical cancer, precancerous genital lesions, and genital warts due to HPV type 6, 11, 16, and 18
- 4vHPV (Gardasil, Merck & Co.) and 9vHPV (Gardasil 9)

Routine vaccination

- Administer a 2-dose series of HPV vaccine on a schedule of 0 and 6–12 months to all adolescents aged 11 or 12 years
- The vaccination series can start at age 9 years

Catch-up vaccination

- For persons initiating vaccination at age 15 years or older, the recommended immunization schedule is 3 doses of HPV vaccine at 0, 1–2, and 6 months

Special situations

- History of sexual abuse or assault: Begin series at age 9 years
- Immunocompromised (including HIV) aged 9–26 years: 3-dose series at 0, 1–2, and 6 months

Vaccine content that may cause an allergic reaction (Table 1.9)

Common Adverse Reaction of Vaccines

- Low-grade fever
- Local reaction and tenderness

Table 1.9 Vaccine content that may cause an allergic reaction

Contents in the vaccine that may cause allergies	Type of vaccine
Egg	Influenza, yellow fever *Egg allergy is no longer a contraindication to influenza vaccine* "In severe egg allergies (e.g., angioedema, respiratory distress) influenza vaccine can be given under supervision of health care provider who can recognize and manage severe allergic conditions"
Gelatin, neomycin	MMR and varicella
Streptomycin, neomycin	IPV and OPV

MMR Measles, mumps, and rubella, *IPV* Inactivated poliovirus vaccine, *OPV* Oral poliovirus vaccine

Table 1.10 Contraindications to vaccinations

Vaccine	Contraindications
Any vaccine	Life-threatening allergic reaction after a previous dose
Live vaccines, e.g., MMR, varicella, rotavirus	Known severe immunodeficiency
Rotavirus	Personal history of intussusception (not family history)
DTP, DTaP, or Tdap	Encephalopathy not attributable to another identifiable cause, within 7 days of administration of the previous dose

MMR Measles, mumps, and rubella, *DTP* Diphtheria, pertussis, and tetanus, *DTaP* Diphtheria and tetanus toxoids and acellular pertussis vaccine, *Tdap* Tetanus and diphtheria toxoids and acellular pertussis vaccine

Contraindications to Vaccinations (Table 1.10)

General conditions commonly misperceived as contraindications (i.e., vaccination may be administered under these conditions)

- Mild acute illness with or without fever
- Mild-to-moderate local reaction (i.e., swelling, redness, soreness); low-grade or moderate fever after the previous dose
- Fever of < 105 °F (< 40.5 °C); fussiness or mild drowsiness after a previous dose of DTP/DTaP
- Current antimicrobial therapy
- A family history of seizures, autism, or developmental delay
- Preterm birth (HepB vaccine is an exception in certain circumstances)
- Recent exposure to an infectious disease
- History of penicillin allergy, other non-vaccine allergies, relatives with allergies, or receiving allergen extract immunotherapy
- Positive purified protein derivative (PPD) test

Special considerations

- If PPD not given with MMR on the same day, PPD test should wait for 4–6 weeks (MMR may alter result if not done on the same day)
- If the infant vomited the rotavirus vaccine, there is no need to re-administer the dose again; complete the series normally
- Family history of intussusception or anaphylaxis is not a contraindication to give rotavirus vaccine

PREVENTIVE MEDICINE [8]

Newborn Screening

- All 50 states in the USA screen for:
  - Congenital hypothyroidism
  - Phenylketonuria
- Some states screen for more diseases, e.g., metabolic and hemoglobinopathies

History (initial/interval), length/height, and weight

- From birth and at all child well visits

Head circumference measurements

- From birth and at all child well visits until 24 months of age or at any time if any concern about the head growth

Newborn Bilirubin Screening

- Screening for hyperbilirubinemia is recommended for all term and late preterm infants
- Assessment of jaundice, risk factors for severe hyperbilirubinemia
- Measure total serum bilirubin or transcutaneous bilirubin before discharging any newborn from the newborn nursery

Blood Pressure Screening

- All children on yearly basis starting at 3 years of age
- Blood pressure measurements at visits before 3 years if coexisting medical conditions associated with hypertension

Pediatric cuff size (Fig. 1.11)

- Minimum bladder width
  - Bladder width should be at least 40% of mid arm circumference (MAC)
- Bladder length
  - Bladder length should encircle 80–100% of MAC, but no more than 100%

Normal blood pressure (BP)

- < 90th percentile for age and sex
- Children whose BP is > 90th percentile for age, sex, and height require further evaluation

Vision Screening

- Examination of eyes and visual system should begin in the nursery and continue throughout childhood and into adolescence
- Newborn infants should be examined using inspection and red reflex testing to detect structural ocular abnormalities such as cataract, corneal opacity, and ptosis before discharge from the newborn nursery
- Instrument-based screening should be attempted between 12 months and 3 years of age and at annual well child visits until visual acuity can be tested directly
- Visual acuity testing is now recommended for children beginning at 3 years of age (if cooperative), 4, 5, 6, 8, 10, 12, and 15 years

Screening tools

- Ophthalmoscope
- Photo-screening device
- Lea symbols, Allen figures, HOTV letters, Tumbling E, Snellen chart

Cover and uncover test

- The child should be looking at an object from a distance of 10 ft
- Movement in the uncovered eye when the opposite is covered or uncovered suggests potential strabismus

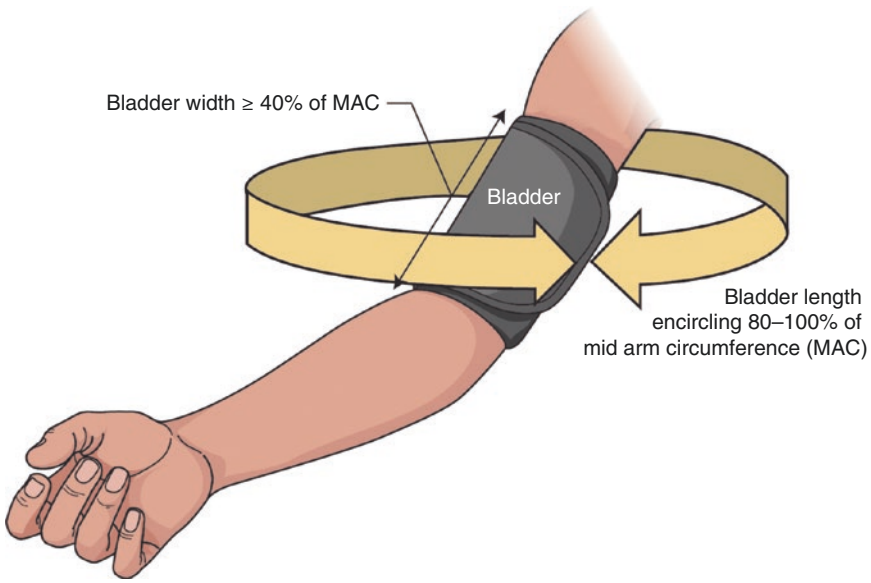


Fig. 1.11 Pediatric cuff size and accurate blood pressure measurement: Relative sizes of patient's mid arm circumference, cuff bladder width and length

Hearing Screening

Periodicity

- All newborns must receive newborn hearing screening before discharge from the newborn nursery or NICU
- At age of 3–5 days, confirm initial screen was completed, verify results, and follow-up as appropriate
- Formal hearing screening is recommended at age 4, 5, 6, 8, 10, and once between 11–14, 15–17, 18–21 years

Goal of screening

- Identify hearing loss of 35 dB or greater in 500–4000 Hz range

Indication for hearing screening in special situations

- Speech delay
- Parental expression of concern on hearing problem, language, or developmental delay
- History of bacterial meningitis
- Neonatal CMV infection
- Head trauma
- Syndromes associated with hearing loss, e.g., Alport syndrome
- Exposure to ototoxic medications

Developmental Screening

- Developmental screening at 9, 18, and 30 months of age

Autism screening

- AAP Bright Futures recommends autism screening at 18 and 24 months of age
- Repeat specific screening whenever parental concern raised
- Positive screening: If < 3 years of age, refer to early intervention (EI); if > 3 years of age, refer to the school district for further evaluation
- Screening tool at 18 and 24 months (See also Chap. 6 Mental and Behavioral Health.)
  - M-CHAT: Modified Checklist for Autism in Toddlers (https://www.autismspeaks.org/screen-your-child; Autism Speaks)

Lead Screening [9, 10]

Ages of screening

- All Medicaid-eligible children and those whose families receive any governmental assistance must be screened at age 1 and 2 years

Elevated blood lead level (BLL)

- There is no safe BLL
- Lead poisoning is diagnosed if the BLL is ≥ 5 mcg/dL (0.24 mmol/L)
- BLL for children 1–5 years old should be less than 2 mcg/dL
- An elevated capillary BLL should be confirmed with a venous sample

Risk factors for lead poisoning

- Living in or regularly visiting a house built before 1950 or remodeled before 1978
- Other sibling or family member with a high lead level
- Immigrant or adopted children
- Use of folk remedies
- Environment with high or unknown lead level
- Children eligible for Medicaid are at high risk

Effect of lead intoxication

- A decline in academic achievement, intelligence quotient (IQ) scores, attention-related behaviors with BLL < 10 mcg/dL
- Microcytic anemia
  - Concomitant iron deficiency anemia; increased lead absorption
- Abdominal colic
- Constipation
- Growth failure
- Dental caries
- Hearing loss

- Renal disease
- Neurotoxicity
- Seizures
- Encephalopathy
- Death

Management of lead poisoning, any detectable or elevated BLL (Table 1.11)

Iron Deficiency Anemia Screening

- AAP Bright Future recommends universal anemia screening with determination of hemoglobin concentration at 1 year of age

Screening of high-risk children

- Prematurity
- Low birth weight
- Early introduction of cow's milk
- Strict vegans
- Poverty
- Limited access to food
- Associated medical conditions

Urinalysis (UA) Screening

- No routine screening recommended by AAP Bright Futures at this time

Sexually Transmitted Diseases

- Recommendations for screening sexually active adolescents for sexually transmitted infections vary with age, sex, and sexual behavior.

HIV Screening

- The US Preventive Services Task Force recommends that clinicians screen for HIV infection in all adolescents once between 15 and 18 years of age
  - Younger adolescents who are at increased risk should also be screened
  - Risk factors, e.g., male-to-male sexual contact, injection drug use, heterosexual contact

Table 1.11 Management of lead poisoning, any detectable or elevated blood lead level (BLL)

BLL	Management	Re-testing venous BLL
Any detectable or elevated BLL	Education Environmental investigations	Periodic follow-up
BLL > 5 mcg/dL	Education Environmental investigations	In 6–12 months if the child is at high risk In 3–6 months if < 12 months old
BLL 5–14 mcg/dL	Refer to local health authorities CBC, CRP, and serum ferritin Iron-rich food and vitamin C	Re-test venous BLL within 1–3 months
BLL 15-44 mcg/dL	In addition to previous steps of BLL 5–14 mcg/dL, if pica for paint chips or mouthing behaviors, perform KUB; bowel decontamination if foreign bodies containing lead are visualized	Re-test venous BLL within 1–4 weeks
BLL > 44 mcg/dL	Perform chelation therapy	Re-test venous BLL within 48 h if no symptoms
BLL > 69 mcg/dL	Hospitalization and chelation therapy	Re-test venous BLL within 24 h if no symptoms
Symptomatic lead intoxication	Hospitalize for full investigations, decontamination, and chelation therapy. PICU admission if lead encephalopathy	Medical emergency Confirm with a stat BLL

CBC Complete blood count, *CRP* C-reactive protein, *KUB* Kidneys, ureters, and urinary bladder, abdominal radiograph, *PICU* pediatric ICU

Screening test for HIV

- Rapid HIV testing or HIV immunoassay
- The reactive test followed by confirmatory Western blot or immunofluorescent assay

Tobacco, Alcohol, And Substance Use

- Annual screening for tobacco, alcohol, and substance use, beginning at age 11 years

Depression Screening

- Universal screening for depression annually from age 12 to 21 years
- Screening for depression in children ≥ 10 years and adolescents at high risk of depression

Tuberculosis (TB) Screening

- The AAP/Bright Futures guidelines suggest tuberculosis risk assessment by 1 month of age; at ages 6, 12, and 24 months; and annually thereafter

Dyslipidemia

- Routine screening for dyslipidemia in all children once between 9 and 11 years and once between 17 and 21 years

Screening methods

- Non-fasting non-HDL-cholesterol
- Screen for dyslipidemia in a child between 2 and 8 years of age if parent has a total cholesterol of 240 mg/dL or higher: A fasting lipid profile should be obtained and then repeated after 2 weeks to 3 months (See also Chap. 19 Cardiology.)

Oral Health Screening

- Perform dental risk assessment at 6 and 9 months of age
- The AAP recommends repeat oral health assessment at 12, 18, 24, and 30 months and 3, 4, 5, and 6 years of age if the child has not yet established a dental home
- The AAP recommends the initial dental visit at 12 months of age

Fluoride supplementation

- Periodic application of fluoride varnish between 6 months and 5 years of age
- No fluoride should be given to an infant of less than 6 months
- If the fluoride in the water supply < 0.3 PPM begin supplementation at 6 months of age
- If fluoride in the water supply is > 0.6 PPM, no need for taking extra fluoride

Tooth care

- Once tooth erupts, it should be brushed twice daily with plain water
- Once the child reaches 2 years of age, brush teeth twice daily with a pea-sized amount of fluoride toothpaste
- Daily flossing

Prevention of bacterial transmission (*Streptococcus mutans* or *S. sobrinus*)

- Practice good oral hygiene and seek dental care
- Do not share utensils, cups, spoons, or toothbrushes with an infant
- Do not clean a pacifier by mouth before giving it to an infant

Risk group infants should be referred to a dentist as early as 6 months of age and no later than 6 months after the first tooth erupts or 12 months of age (whichever comes first) for the establishment of a dental home. Examples of risk group infants:

- Children with special health-care needs
- Children of mothers with a high caries rate

- Children with demonstrable caries, plaque, demineralization, and/or staining
- Children who sleep with a bottle or are breast-feed throughout the night
- Children in families of low socioeconomic status

Summary of Routine screening in Pediatrics (Table 1.12)

WELL CHILD VISITS

Well Visit Schedule

Infancy
- Newborn
- 3–5 days old
- 1, 2, 4, 6, and 9 months

Early childhood
- 12, 15, 18, 24, 30 months; 3 and 4 years

Middle childhood
- Yearly from 5 to 10 years

Adolescents
- Yearly from 11 to 21 years

Counseling during each well visit is very important
- Bath safety
- Sun exposure
- Fluoride supplementation
- Nutrition
- Immunization
- Common cold management

Age-appropriate anticipatory guidance, e.g.:
- Feeding the newborn
- Dental care when the first tooth appears
- Dental appointment at 12 months if pediatric dentist is available
- Limitations on screen time (TV, computer, phone)
- Encourage reading to the child, and by the child

Table 1.12 Routine screening in pediatrics

Screening	Ages to be performed	Special considerations
Length/height and weight	From birth and in each well visit	Repeat and confirm any abnormal reading
Head circumference	From birth until the age of 2 years	Repeat and confirm any abnormal reading or any time if any concern about head size
Blood pressure	3 years of age, then yearly after	Before 3 years of age visits if any risk factor of hypertension
Hearing	Newborn, 4, 5, 6, 8, 10, and once at 11–14, 15–17, 18–21 year	Any time if any risk factor
Vision	3, 4, 5, 6, 8, 10, 12, 15 year	Any time if any concern
Developmental screening	9, 18, and 30 months	Any time if any concern
Autism screening	18 and 24 months	Any time if any concern
Depression	12 years of age, then yearly after	Any time if any signs of depression
Maternal depression	1, 2, 4, and 6-month visits	Any time if any signs of depression
Bilirubin	Newborn	Any time if indicated
Anemia	12 months	Any time if indicated
Lead	12 and 24 months if Medicaid or high risk of prevalence area	Any time if any risk factor
Tuberculosis	Risk assessment at 1, 6, 12, and 24 months, and annually thereafter	Any time if any risk factor
Dyslipidemia	9–11, and once at 17–21 years	Any time if indicated
HIV	Once between 15 and18 years	Younger if increased risk of HIV infection
Oral health	Perform dental risk assessment at 6 and 9 months, fluoride varnish every 3-6 months between 6 months and 5 years of age	Refer to establish a dental home at 12 months of age
Anticipatory guidance	From birth and in each well visit	Any time if parents have a concern

- Helmet for bicycle
- Discussion about tobacco, alcohol, drug use, and sex at age of 11 and up

ENVIRONMENTAL SAFETY COUNSELING

Preventing Motor Vehicle Injuries in Children [11]

Children should be properly buckled up in a car seat, booster seat, or seat belt, whichever is appropriate for their age, height, and weight

- All children aged 12 years and under should be buckled in the back seat
- Airbags can kill young children riding in the front seat
- Never place a rear-facing car seat in front of an airbag

Rear-facing car seat

- Birth until 2–4 years of age
- Buckle children in a rear-facing car seat until they reach the maximum weight or height limit of their car seat
- Keep children rear-facing as long as possible

Forward-facing car seat

- After out-growing rear-facing car seat until at least 5 years of age

Booster seat

- After outgrowing the forward-facing car seat until seat belts fit properly
- The recommended height for proper seat belt fit is 57 in. (4 ft 9 in.) tall and 9–12 years of age

Seat belt

- Once seat belts fit properly without a booster seat
- Children no longer need to use a booster seat if the seat belts fit properly when the lap belt lays across the upper thighs (not the stomach) and the shoulder belt lays across the chest (not the neck)

Car seat or bed screen before discharging a pre-term baby from NICU [12]

- Indications for screening
  - Infants < 37 weeks gestation
  - At risk for obstructive apnea, bradycardia, or hypoxemia, including infants with hypotonia (e.g., Down syndrome), micrognathia (e.g., Pierre Robin sequence)
  - After cardiac surgery
- Infants "fail" the screen if they have
  - Oxygen desaturation below 90% or 93% for more than 10 s
  - Apnea greater than or equal to 20 s
  - Bradycardia less than or equal to 80 beats per minute

Preventing Drowning

- Enclose pools entirely with fence and least 4 ft high and self-closing gate
- Wear life jackets on boats and when playing near water
- Do not leave children unattended in baths
- Supervise closely (adults within one arm's reach of a child in or near water)

Preventing Fire and Burns

- Install a smoke detector on every level of the home and near sleeping areas
- Reduce water heater temperature to 120 °F
- Do not drink hot fluids near children
- Never leave the stove unattended

Preventing Gun Accidents

- If parents choose to keep a firearm in the home, the unloaded gun and ammunition must be kept in separate locked cabinets

Preventing Poisoning

- Keep all potential poisons in original containers and out of reach
- Keep all medications out of reach
- Place child-resistant caps on medications
- Install carbon monoxide detectors on every level of the home
- Keep the 24-h Poison Control number near the phone: 1-800-222-1222 (National Capital Poison Center).
- Online: webPoison Control. https://triage.webpoisoncontrol.org/#/exclusions

Preventing Threats to Breathing [13]

- Remove comforters, pillows, bumpers, and stuffed animals from crib
- The AAP recommends:
  - Hard candy and gum not be given to children younger than age 5 years
  - Raw vegetables and fruit be cut up into small pieces
  - Children should always be supervised while eating and that children be seated when eating—not running, walking, or lying down
  - Caregivers should be familiar with choking-related rescue maneuvers

Preventing Falls

- No baby walkers with wheels
- Baby walkers increase risk of falls and skull fracture

Preventing Bicycle Injuries [14]

- Children between the ages of 5 and 14 years are at the highest risk for bicycle injury
- Head injuries account for the majority of bicycle-related deaths and hospital admissions
- Children < 1 year should not ride in bicycle-mounted carriers or trailers
- Children < 3 years do not have the developmental skills necessary to ride a tricycle
- Children aged 4–5 usually can ride a bicycle with training wheels and foot-operated brakes; they should not ride in traffic and must always be supervised
- Children 6 years or older usually can ride a bicycle without training wheels and operate hand brakes
- Children should not be permitted to ride in traffic until they have demonstrated that they can control the bicycle, understand and follow the rules of the road, and exercise good judgment
- Reflectors are important to increase visibility in the dark; however, bicycling in the dark should be discouraged
- Use bicycle lanes and bicycle paths
- Keep children < 10 years off the road

Bicycle helmets

- Reduce the risk of head, brain, and severe brain injuries for bicyclists of all ages
- Should be encouraged for riders and passengers of all ages, on every occasion that they ride a bicycle
- Should fit properly and be worn in the proper position
- Only those that meet US Consumer Product Safety Commission standards should be used
- Helmets that have been involved in a crash should be discarded
- Helmets should be replaced every 5 years

Preventing Sunburn [15]

- Sunburn increases risk of melanoma at all ages

Sun avoidance

- Wear protective clothing
- Seek shade or reduce exposure to the sun between 10:00 AM–2:00 PM, when sunlight intensity is greatest, especially in the summer
- Protective clothing such as long sleeves and wide-brim hats should be worn while outdoors

Sunscreens

- Broad spectrum sunscreens with a sun protection factor (SPF) of at least 30 or higher on both cloudy and sunny days
- Sunscreen rated SPF 30 filters 97% of UVB rays while SPF 50 blocks 98%.
- Sunscreens should be applied 15–30 min before sun exposure to allow the formation of a protective film on the skin
- Reapply sunscreen every 2 h and after swimming or sweating

Infants younger than 6 months

- For infants younger than 6 months, the AAP recommends avoidance of sun exposure and the use of clothing (e.g., lightweight pants, long-sleeved shirts, brimmed hats)
- A minimal amount of sunscreen with an SPF of $\geq$ 15 may be applied to small areas (e.g., face, back of the hands) when adequate clothing and shade are not available

Artificial Ultraviolet Rays (Tanning)

- Artificial ultraviolet rays may cause sunburn, skin dryness, pruritus, and photokeratitis
- Long-term exposure may cause cataracts, skin aging, and cancer

Preventing Mosquito Bites [16]

Example of effective repellents

- DEET (N,N-diethyl-3-methylbenzamide) repels mosquitoes, ticks and other bugs; used on the skin only
- Permethrin products (repel mosquitoes and ticks and can be used on clothing)
- Picaridin (can be used on the skin or clothing)

DEET

- Repellents with 10–30% DEET should be safe and effective when used according to the directions on the product labels
- Repellents with 10% DEET concentration are effective for periods of approximately 2 h
- Repellents with 24% DEET concentration are effective for periods of approximately 4 h
- Higher concentrations provide longer durations of protection
- Protection is shortened by swimming, washing, rainfall, sweating, and wiping

Recommended age for repellents

- Children 2 months or older
- Children younger than 2 months of age should not use products with DEET

Adverse effects

- Dermatitis, allergic reactions, and rare neurotoxicity from excessive absorption through the skin
- Avoid using sunscreen products containing DEET because of possibility of reapplication and excessive absorption of DEET
- Once the child is indoors, wash off the skin with water to avoid excessive absorption

Complications of mosquito bites

- Urticarial reaction
- Large local reaction; itchy or even painful area of redness, warmth, swelling, and/or induration that ranges from 2 cm to more than 10 cm in diameter
- Malaria and West Nile virus infections in high-risk areas

- Bacterial cellulitis:
  - It is not common
  - Malaise, chills, fever, and toxicity may be present
  - The involved area is red, hot, swollen, and tender
  - May take days to develop versus minutes to hours in cases of local reaction
  - Without treatment, bacterial cellulitis will continue to get worse versus local reaction, which will improve with time

Prevention of large local reaction
- Mosquito avoidance
- Prophylaxis with an oral non-sedating H1 antihistamine

Treatment of large local reactions
- Antihistamines
- Ice in a wet washcloth for 20 min
- Topical hydrocortisone cream
- Systemic glucocorticoids in severe cases

CRYING INFANT

Infantile Colic

Background
- Colic begins during the 2nd week of life, peaks at 6 weeks, and resolves between 12 and 16 weeks
- Equally common in both breast- and bottle-fed infants
- Average crying per day: 2.2 h
- May cause parental anxiety and may increase the risk of postpartum depression

Normal physical findings
- Weight gain:
  - Infants with colic often have accelerated growth; failure to thrive should make one suspicious about the diagnosis of colic
  - Exclusion of organic causes, e.g., infection, occult fractures, or maternal drug effects
- Should respond to comforting
- Baby acts happy between bouts of crying

Differential diagnosis
- Gastrointestinal causes (e.g., gastroesophageal reflux disease [GERD], over- or underfeeding, milk protein allergy, early introduction of solids)
- Exposure to cigarette smoke and its metabolites
- Food allergy

Management of infantile colic [17]
- Parents need to be reassured that they have a healthy infant
- Effective swaddling, and decreased stimulation of the infant
- Hold and comfort, e.g., gentle rocking, dancing with the baby, wind-up swing, or vibrating chair
- Cautioning overtired and frustrated parents never to shake their infant and giving them permission to allow the infant to cry are essential components of any treatment plan and can decrease the risk of child abuse
- A breastfeeding mother should avoid caffeine
- Probiotics and/or simethicone may help (no data to support the routine use of these therapies)

Dietary changes may include the following
- Elimination of cow's milk protein in cases of suspected intolerance of the protein
- In infants with suspected cow's milk allergy, a protein hydrolysate formula is indicated
- Soy-based formulas are not recommended, because many infants who are allergic to cow's milk protein may also become intolerant of soy protein

PEARLS AND PITFALLS

- Crossing percentiles in the growth curve for any child must be investigated initially by repeating the measurement to ensure accuracy.
- Rotavirus vaccine is contraindicated in infants with personal history of intussusception or personal history of anaphylaxis to rotavirus vaccine.

- Family history of intussusception or anaphylaxis to rotavirus is not a contraindication to rotavirus vaccine.
- For any child with abnormal red reflex, or any parental concern about white pupil reflex, the most prudent action is to refer the patient for a complete ocular examination.
- Any new-onset strabismus is a red flag for ocular or intracranial structural abnormalities e.g., brain tumor.
- Screen all adolescents for HIV once between age 15 and 18 years.
- To prevent drowning, children should be supervised closely (adults within one arm's reach of a child in or near water).
- If parents choose to keep a firearm in the home, the unloaded gun and ammunition must be kept in separate locked cabinets.
- Hard candy and gum should not be given to children younger than age 5 years and raw vegetables and fruit should be cut into small pieces.
- Baby walkers with wheels increase risk of falls and skull fracture.
- Bicycle helmets reduce the risk of severe head and brain injuries for bicyclists of all ages.
- Broad-spectrum sunscreens with SPF 30 or higher should be regularly used when performing outdoor activities in sunny weather, especially in regions with high levels of insolation.
- Keep infants younger than 6 months away from the sun.
- To prevent mosquito bites, repellents with 10–30% DEET are recommended for children 2 months and older.
- Children younger than 2 months of age should not use products with DEET.
- Infantile colic is a self-limited condition that will spontaneously resolves between 12 and 16 weeks.
- Effective swaddling, gentle rocking, and decreased stimulation of the infant are helpful measures in the management of infantile colic.
- Simethicone, considered by many as a mainstay of colic treatment, is a safe but relatively ineffective remedy for the treatment of infantile colic.
- There is no safe blood lead level (BLL). Any detectable BLL must be managed and investigated further.
- Intake of milk above 16–24 oz is associated with increased risk of iron deficiency and subsequent anemia.
- Growing pains is a diagnosis of exclusion, requires that symptoms only occur at night, and that the patient has no limp, no joint swelling, or symptoms during the day.

References

1. Braun LR, Marino R. Disorders of growth and stature. Pediatr Rev. 2017;38(7):293–304.
2. Nicol L, Allen DB, Czernichow P, Zeitler P. Normal growth and growth disorders. In: Kappy MS, Allen DB, Geffner ME, editors. Pediatric practice endocrinology. New York: McGraw-Hill; 2010. p. 23–76.
3. Losee JE, Mason AC. Deformational plagiocephaly: diagnosis, prevention, and treatment. Clin Plast Surg. 2005;32(1):53–64, viii.
4. Scharf RJ, Scharf GJ, Strousup A. Developmental milestones. Pediatr Rev. 2016;37(1):25–37; quiz 38, 47.
5. Feigelman S. Growth, development, and behavior. In: Kliegman RM, Stanton BF, Schor NF, St. Geme III JW, Behrman RE, editors. Nelson textbook of pediatrics. 19th ed. Philadelphia: Elsevier Saunders; 2011. p. 26–32.
6. U.S. Department of Health and Human Services Centers for Disease Control and Prevention. Recommended immunization schedule for children and adolescents aged 18 years or younger—United States 2019. https://www.cdc.gov/vaccines/schedules/hcp/imz/child-adolescent.html. Accessed 16 Feb 2019.8.
7. U.S. Department of Health and Human Services. Centers for Disease Control and Prevention. Immunization schedules for health care professionals. 26 May 2016. https://www.

cdc.gov/vaccines/schedules/hcp/index.html. Accessed 29 Sep 2018.
8. Bright Futures/American Academy of Pediatrics. Recommendations for Preventive Pediatric Health Care (periodicity schedule). 2017. https://www.aap.org/en-us/Documents/periodicity_schedule.pdf. Accessed 23 Sep 2018.
9. Academy of Pediatrics. Committee on environmental health. Lead exposure in children: prevention, detection, and management. Pediatrics. 2005;116(4):1036–46.
10. Lowry JA. Childhood lead poisoning: Management. Post TW, editor. Waltham, MA: UpToDate Inc. http://www.uptodate.com. Accessed 14 Oct 2018.
11. U.S. Department of Health and Human Services. Centers for Disease Control and Prevention. Child passenger safety: get the facts. 11 2017. https://www.cdc.gov/motorvehiclesafety/child_passenger_safety/cps-factsheet.html. Accessed 29 Oct 2018.
12. Smith VC, Stewart J. Discharge planning for high-risk newborns. Post TW, editor. Waltham, MA: UpToDate Inc. http://www.uptodate.com. Accessed 14 Oct 2018.
13. Green SS. Ingested and aspirated foreign bodies. Pediatr Rev. 2015;36(10):430–6.
14. Gill AC. Bicycle injuries in children: Prevention. Post TW, editor. Waltham, MA: UpToDate Inc. http://www.uptodate.com. Accessed 14 Oct 2018.
15. Young AR, Tewari A. Sunburn. Post TW, editor. Waltham, MA: UpToDate Inc. http://www.uptodate.com. Accessed 14 Oct 2018.
16. Breisch NL. Post TW, editor. Prevention of arthropod and insect bites: repellents and other measures. Waltham: UpToDate Inc.. http://www.uptodate.com. (Accessed 14 Oct 2018
17. Cohen GM, Albertini LW. Colic. Pediatr Rev. 2012;33(7):332–3.

Suggested Reading

Kelly NR. Screening tests in children and adolescents. Post TW, editor. Waltham, MA: UpToDate Inc. http://www.uptodate.com. Accessed on 14 Oct 2018.

Olney AH. Macrocephaly syndromes. Semin Pediatr Neurol. 2007;14(3):128–35.

Neonatology

2

Mamta Fuloria

DEFINITIONS

Live birth

- Live birth occurs when a fetus, whatever its gestational age, exits the maternal body and subsequently shows any signs of life, such as voluntary movement, heartbeat, or pulsation of the umbilical cord, for however brief a time and regardless of whether the umbilical cord or placenta is intact

Gestational age (GA)

- The number of weeks in a pregnancy since the 1st day of the last menstrual period or the corresponding age of gestation as estimated by a more accurate method if available. Such methods include an early obstetric ultrasonography or by adding 14 days to a known duration since fertilization (in patients who have undergone in vitro fertilization)

Small for gestational age (SGA)

- Birth weight (BW) < 10th percentile for the given GA

Large for gestational age (LGA)

- BW > 90th percentile for the given GA

Low birth weight (LBW)

- BW < 2500 g regardless of the GA

Very low birth weight (VLBW)

- BW < 1500 g

Extreme low birth weight (ELBW)

- BW of less than 1000 g (2 lb., 3 oz)

Preterm

- An infant born at < 37 weeks GA

Term

- An infant born between the 37 0/7 and 41 6/7 weeks of gestation
  - Early term: Between 37 0/7 and 38 6/7 weeks of gestation
  - Full term: Between 39 0/7 and 40 6/7 weeks of gestation
  - Late term: Between 41 0/7 and 41 6/7 weeks of gestation

Post-term

- An infant born after 42 0/7 weeks of gestation

PRENATAL CARE

Routine Prenatal Laboratory Tests

- Urine for protein, glucose, and bacteriuria
- Complete blood count (CBC)
- Blood type and Rh
- Red blood cell (RBC) antibodies
- Hepatitis B surface antigen
- Rapid plasma reagin (RPR) or venereal disease research laboratory test (VDRL)

M. Fuloria (✉)
Division of Neonatology, Department of Pediatrics, The Children's Hospital at Montefiore, Albert Einstein College of Medicine, Bronx, NY, USA
e-mail: mfuloria@montefiore.org

O. I. Naga (ed.), *Pediatric Board Study Guide*, https://doi.org/10.1007/978-3-030-21267-4_2

Table 2.1 Significant fetal ultrasonographic anatomic findings and postnatal management

Prenatal US finding	Causes	Postnatal evaluation
Dilated cerebral ventricles	Hydrocephalus, Dandy-Walker cyst, agenesis of corpus callosum	Serial head US or MRI, evaluation for other system anomalies
Choroid plexus cyst	Trisomy 18; can be a normal variant	Karyotype if indicated, Head US or MRI scan, evaluation for other system anomalies
Nuchal pad thickening	Cystic hygroma, Turner syndrome, trisomy 18 or 21	Evaluation for other system malformation, karyotype if indicated
Dilated renal pelvis	Ureteropelvic junction obstruction, vesicoureteral reflux, posterior urethral valve, ectopic ureterocele	Renal ultrasound between day 5 and 7 and at 4–6 weeks of age; voiding cystourethrogram and prophylactic antibiotic if indicated

MRI magnetic resonance imaging, *US* ultrasonography

- Human immunodeficiency virus (HIV) screening
- Rubella antibodies
- Blood work for neural tube defects and chromosomal abnormalities, if indicated
- Ultrasound at 18–20 weeks, if indicated (Table 2.1)
- Glucose challenge and/or glucose tolerance tests between 24 and 28 weeks gestation (for diagnosing gestational diabetes)
- Vaginal and rectal culture for group B streptococcus (GBS) between 35 and 37 weeks gestation, and intrapartum antibiotics if indicated
- Education about nutrition, vitamins, and pregnancy course
- Prenatal care delayed until after the first trimester is associated with higher infant mortality rate

General neonatal risks

- Delayed prenatal care
- Maternal age: Teens and > 40 years of age
- Male infants have higher mortality rates than female infants
- Multiple births
- Placental bleeding – placenta previa, placental abruption
- Uterine abnormalities
- Premature rupture of membranes
- Preterm delivery
- Chorioamnionitis
- Maternal drug abuse, e.g., cocaine
- Bacterial vaginosis

Known risk factors for prematurity

- Placental bleeding
- Uterine abnormalities
- Use of drugs such as cocaine
- Smoking
- Alcohol intake
- Maternal chronic disease
- Premature rupture of membranes
- Prior history of preterm delivery
- Chorioamnionitis
- Bacterial vaginosis
- Preeclampsia or hypertension
- Maternal age: < 18 years and > 35 years

Factors associated with high mortality rate in preterm infants

- Younger GA
- Male sex
- 5 min Apgar < 4
- Persistent bradycardia at 5 min
- Hypothermia
- Intrauterine growth restriction

Umbilical Cord

- Umbilical cord has two arteries and one vein
- Single artery umbilical cord can be associated with other organ anomalies, e.g., heart and kidneys
- Umbilical cord length is about 55 cm; umbilical cord < 40 cm is short and can be associated with fetal complications, e.g., amniotic band and arthrogryposis
- Longer cord more than 55 cm may be associated with knots, prolapse, or may entwine the fetus

Placenta

- **Placenta accreta**: Develops when the chorionic villi attaches to the myometrium of the uterine wall rather than being restricted within the decidua basalis; may occur because of previous trauma, e.g., previous cesarean section, and curettage
- **Placenta increta**: Develops when the chorionic villi invades into the myometrium
- **Placenta percreta**: Develops when the chorionic villi invades through the myometrium, sometimes extending to nearby organs such as the bladder, resulting in serious bleeding
- **Placental abruption**:
  - Develops when the placenta separates from the wall of the uterus, either partially or completely, before birth of the infant
  - Hemorrhage into the decidua basalis occurs as the placenta separates from the uterus
  - Vaginal bleeding usually follows, although a concealed retroplacental hemorrhage is possible

Cesarean Section (C-section): Indications

- Previous C-section
- Fetal distress
- Dystocia
- Fetal malpresentation
- Placenta previa
- Placenta accreta, increta, and percreta
- Other

Fetal Distress

Definitions

- **Nonstress test** is the most common noninvasive test; it monitors fetal heart rate accelerations that follow fetal movement over time
- **Early deceleration** is associated with head compression during uterine contraction, resulting in vagal stimulation and slowing of the heart rate
- **Variable deceleration** is associated with compression of the umbilical cord
- **Late deceleration** is associated with uteroplacental insufficiency. Thus, maternal hypotension, uterine hyperstimulation, preeclampsia, or any other factor that reduces uterine blood flow and limits effective oxygenations of the fetus will result in late decelerations and decreased baseline variability.
  - Persistent late decelerations associated with decreased beat-to-beat variability is an ominous pattern
  - If late deceleration is not responding to oxygen supplementation, hydration, position change, and discontinuation of labor stimulation, prompt delivery is indicated
- **Contraction stress test** is performed to determine how well a fetus will tolerate uterine contractions during delivery. It is important for testing the wellbeing of fetus, e.g., in uteroplacental insufficiency, IUGR
  - Contraction stress test measures the heart rate in relation to uterine contraction by giving oxytocin or nipple stimulation
- **Biophysical profile test** assesses fetal heart rate, movement, breathing, muscle tone, and amniotic fluid volume. It does not assess fetal growth

Causes of abnormal alpha-fetoprotein (AFP) during pregnancy

- Increased AFP
  - Neural tube defect
    - Anencephaly
    - Spina bifida
  - Abdominal wall defects
    - Gastroschisis
    - Omphalocele
  - Cystic hygroma
  - Placental abnormalities
  - Renal abnormalities, e.g.:
    - Polycystic kidney or absent kidney
    - Urinary obstruction
  - Multiple pregnancy
- Decreased AFP
  - Incorrect GA calculation
  - Trisomy 21 (Down syndrome)
  - Trisomy 18 (Edward syndrome)

DELIVERY ROOM CARE [1]

Temperature control

- To minimize heat loss, the delivered infant is first placed in a warmed towel or blanket
- Raising the environmental (room) temperature to 26 °C (78.8 °F) will also help in reducing neonatal hypothermia
- Other methods of warming infants:
  - Swaddle after drying
  - "Skin-to-skin" contact with mother
  - Polyurethane bags or wraps in infants with BWs less than 1500 g
  - Warming pads

Initial management—Once the infant is born:

- Dry the infant
- Clear the airway of secretions
- Provide warmth; place under radiant warmer
- Neonatal resuscitation if indicated

Newborn resuscitation

- Pediatrician or provider skilled in neonatal resuscitation should be present and equipment should be prepared prior to the birth of high-risk infants
- Preterm infants very likely will need at least some resuscitation, and they may develop complications from resuscitation more often than term infants

Indications for resuscitation

- Apnea or poor respiratory effort
- Cyanosis
- Bradycardia
- Poor muscle tone

Resuscitation steps

- Initial care includes providing warmth to the infant, clearing the airway, and drying and stimulating the infant
- Apneic or gasping infant with a heart rate < 100 beats/min (bpm):
  - Positive pressure ventilation (PPV) provided by bag-mask ventilation is initiated at a rate of 40–60 breaths/min
  - Chest compressions are required if the infant's heart rate remains < 60 bpm despite adequate ventilation for 30 s. Chest compressions must always be accompanied by PPV using 100% oxygen
  - Pulse oximetry is used to continuously monitor heart rate and oxygen saturation (SpO2)
  - Intubation or use of a laryngeal mask airway is needed if PPV is ineffective or prolonged, or chest compressions are being performed
- If the heart rate remains < 60 bpm despite adequate ventilation and chest compressions:
  - Intravenous administration of epinephrine is indicated (epinephrine can also be given via the endotracheal tube if vascular access is not available)
  - Cannulation of the umbilical vein is the quickest means of obtaining intravenous (IV) access in the newborn
- For infants with labored breathing or persistent cyanosis, and a heart rate ≥ 100 bpm:
  - Ensure the airway is optimally positioned and cleared of secretions; pulse oximetry is used to monitor SpO2
  - Supplemental oxygen is provided to targeted preductal SpO2
- Infants who require resuscitation are at risk of developing post-resuscitative complications
- After successful resuscitation, they require placement in a setting in which close monitoring and ongoing appropriate care can be provided

Withholding resuscitation

- Resuscitation efforts may be discontinued after 10 min of resuscitation if the neonate has demonstrated no signs of life (no heartbeat or no respiratory effort for greater than 10 min)
- Resuscitation can be withheld if it is legally acceptable and there is complete agreement among parents and care providers that the neonatal outcome is dismal

NEWBORN NURSERY CARE

Eye prophylaxis

- Ophthalmic erythromycin 0.5% ointment within 1 h after delivery
- Prevent *Neisseria gonorrhoeae* ophthalmia neonatorum

Hepatitis B prophylaxis

- Universal vaccination of newborns regardless of maternal hepatitis B virus surface antigen (HBsAg) status is recommended
- The first dose of the hepatitis B vaccine (HBV) should be given within 24 h of delivery (See Chap. 1 General Pediatrics)

Vitamin K

- Vitamin K 1 mg intramuscular (IM) injection in the first few hours after delivery prevents hemorrhagic disease of the newborn

Umbilical cord care

- In developed countries where aseptic care is routine in clamping and cutting of the umbilical cord, additional topical care beyond dry cord care is not needed to prevent omphalitis

Newborn screening

- All states in the USA require newborn screening for metabolic and genetic disorders
- Blood is collected for an initial screen between 24 and 48 h of life. Some states also require a second screen, which is usually collected between 7 and 14 days of age

Critical congenital heart defects screening

- Pulse oximetry cardiac screening for all newborns before discharge

Hearing loss

- Universal newborn hearing screening is recommended to detect infants with hearing loss

Feeding

- Breastfed infants:
  - Should be fed as soon as possible after delivery, preferably in the delivery room
  - Should receive at least 8–12 feeds per day during the newborn hospitalization
  - Rooming-in, skin-to-skin contact, frequent demand feedings in the early postpartum period, and lactation support increase the rate of successful breastfeeding
- Formula-fed infants
  - Healthy infants who are fed formula should be offered standard 19–20 kcal/oz. (20 kcal per 30 mL) iron-containing infant formula
  - Feeding on demand, but the duration between feedings should not exceed 4 h
  - The volume of feedings should be at least 0.5–1 oz. (15–30 mL) per feed during the first few days of life
- Pasteurized human donor milk may be available in some nurseries for the healthy breastfed newborn who may require supplementation
- Weight loss—term infants may lose up to 10% of their BW in the first few days of life and typically regain their BW by 10–14 days

Hypoglycemia

- Glucose screening—healthy, asymptomatic term infants born after an uncomplicated pregnancy and delivery are at low risk for significant hypoglycemia. As a result, blood glucose measurement is not routinely performed in these neonates
- Per American Academy of Pediatrics (AAP) guidelines, glucose monitoring should be performed for newborns with the following risk factors:
  - Preterm infants (infants of GA < 37 weeks)
  - Large for gestational age (LGA)
  - Small for gestational age (SGA)
  - Infants of diabetic mothers (IDM)
  - Post-term infants (GA > 42 weeks)

Hyperbilirubinemia

- Visual assessment is not accurate for estimating the degree of hyperbilirubinemia
- Use transcutaneous bilirubin or total serum bilirubin measurement
- Infants should be routinely assessed every 8–12 h and at discharge for the presence of jaundice
- Assess pre-discharge bilirubin screen and risk factors together for prediction of development or worsening of hyperbilirubinemia after discharge

24 h discharge criteria

- Full-term healthy infants between 37 and 41 weeks
- Normal spontaneous vaginal delivery
- Clinical course and physical examination at discharge have not revealed abnormalities
- Stable state at least 12 h before discharge with normal vital signs
- At least two successful consecutive feedings
- The infant has urinated regularly and passed at least one stool spontaneously
- Infant blood tests are available and have been reviewed, such as cord or infant blood type and direct Coombs test results, as clinically indicated
- Not at high risk to develop subsequent hyperbilirubinemia
- Newborn metabolic and hearing screenings have been completed

Timing of the first well-child visit after hospital discharge

- For infants with a birth hospitalization less than 48 h
  - An early follow-up visit is recommended within 48 h of discharge
- For infants with a birth hospitalization greater than 48 h
  - An initial well-child visit within 3–5 days after discharge is reasonable
  - Infants at high risk of developing worsening hyperbilirubinemia and breastfed infants should be seen by their pediatrician within 48 h of discharge

MATERNAL CONDITIONS

Premature Rupture of Membranes

Background

- Premature rupture of membranes (PROM) refers to a patient who is beyond 37 weeks gestation and has presented with rupture of membranes (ROM) prior to the onset of labor
- Preterm premature rupture of membranes (PPROM) is ROM prior to 37 weeks gestation
- Spontaneous preterm rupture of the membranes (SPROM) is ROM after or with the onset of labor occurring prior to 37 weeks gestation
- Prolonged ROM is any ROM that persists for more than 24 h and prior to the onset of labor

PROM at term (> 37 weeks gestation): Management

- Evaluate the mother by speculum examination
- Check fetal heart rate (FHR)
- Identify fetal presentation
- Most patients (90%) enter spontaneous labor within 24 h when they experience ROM at term. However, most obstetricians induce labor at this point. Evidence supports the idea that induction of labor, as opposed to expectant management, decreases the risk of chorioamnionitis without increasing the cesarean delivery rate

Preterm premature rupture of membranes (PPROM):

Risks

- Prematurity is the principal risk to the fetus
- The risk of infection increases with the duration of PPROM

Expectant management

- The immature fetus may benefit from expectant management, even if for a short period, to allow for administration of steroids and antibiotics

Indications for delivery

- In certain circumstances (e.g., chorioamnionitis, advanced labor, fetal distress, and placental abruption with nonreassuring fetal surveillance), immediate delivery of the fetus with PPROM is indicated
- If fetal lung maturity has been documented by either amniocentesis or collection of vaginal fluid, delivery should be facilitated

Medications during expectant management

- 48 h course of IV ampicillin and erythromycin followed by 5 days of amoxicillin and erythromycin is recommended during expectant management
- In the absence of chorioamnionitis, some obstetricians give tocolysis, even with active contractions after the steroid therapy is started. The use of tocolysis should be considered only when a clear clinical benefit exists, such as in transport of the mother to a tertiary institution with a newborn intensive care unit (NICU)
- Magnesium sulfate given before anticipated early preterm birth reduces the risk of cerebral palsy in surviving infants

Chorioamnionitis

Background

- Inflammation of the fetal amnion and chorion membranes due to a bacterial infection

Clinical presentation

- Maternal fever (intrapartum temperature > 100.4 °F or > 37.8 °C) most frequently observed sign
- Significant maternal tachycardia (> 100 beats/min)
- Fetal tachycardia (> 160 beats/min)
- Purulent or foul-smelling amniotic fluid or vaginal discharge
- Uterine tenderness
- Maternal leukocytosis (total blood leukocyte count > 15,000 cells/μL in the absence of corticosteroid therapy)

Management

- Early delivery, supportive care, and antibiotic administration
- Pharmacotherapy for the mother includes:
  - Ampicillin and gentamicin
  - Clindamycin or metronidazole when endometritis is suspected
  - Vancomycin for penicillin-allergic patients
  - Penicillin G: Used exclusively for GBS intrapartum prophylaxis; if intraamniotic infection is suspected, antibiotic coverage should be broadened
- Pharmacotherapy for the neonate
  - Ampicillin and gentamicin
- Supportive care of the neonate with sepsis may include the following:
  - Warmth, monitoring of vital signs
  - Preparedness to perform a full resuscitation, including intubation and providing PPV
  - Treatment of hypovolemia, shock, and respiratory and/or metabolic acidosis
  - Surfactant replacement therapy
  - Glucose homeostasis
  - Assessment and treatment of thrombocytopenia and coagulopathy, if present

Preeclampsia

Defined as the presence of:

- Hypertension:
  - Systolic blood pressure (SBP) greater than or equal to 140 mm Hg or a diastolic blood pressure (DBP) greater than or equal to 90 mm Hg or higher, on two occasions at least 4 h apart in a previously normotensive patient, ***or***
  - SBP greater than or equal to 160 mm Hg or a DBP greater than or equal to 110 mm Hg or higher
- Proteinuria:
  - Proteinuria of ≥ 0.3 g in a 24-h urine specimen, a protein (mg/dL)/creatinine (mg/dL) ratio of ≥ 0.3, or a urine dipstick protein of 1+ (if a quantitative measurement is unavailable)