4th Edition

CURRENT Diagnosis & Treatment

Family Medicine

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CURRENT Diagnosis & Treatment: Family Medicine

FOURTH EDITION

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We would like to dedicate this book
to all family physicians who deliver care in austere environments,
especially our colleagues in uniform, and the families that support them.

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Section V. Therapeutics, Genetics, & Prevention

Section VI. Psychosocial Disorders

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Preface

Current Diagnosis & Treatment: Family Medicine is the fourth edition of this single-source reference for house staff and practicing family physicians who provide comprehensive and continuous care of individuals of both sexes throughout the lifespan. The text is organized according to the developmental lifespan, beginning with childhood and adolescence, encompassing a focus on the reproductive years, and progressing through adulthood and the mature, senior years.

OUTSTANDING FEATURES

- Evidence-based recommendations
- Culturally related aspects of each condition
- Conservative and pharmacologic therapies
- Complementary and alternative therapies when relevant
- Suggestions for collaborations with other healthcare providers
- Attention to the mental and behavioral health of patients as solitary as well as comorbid conditions
- Recognition of impact of illness on the family
- Patient education information
- End-of-life issues

INTENDED AUDIENCE

Primary care trainees and practicing physicians will find this text a useful resource for common conditions seen in ambulatory practice. Detailed information in tabular and text format provides a ready reference for selecting diagnostic procedures and recommending treatments. Advanced practice nurses and physician's assistants will also find the approach provided here a practical and complete first resource for both diagnosed and undifferentiated conditions, and an aid in continuing management.

Unlike smaller medical manuals that focus on urgent, one-time approaches to a particular presenting complaint or condition, this text was envisioned as a resource for clinicians who practice continuity of care and have established a longitudinal, therapeutic relationship with their patients. Consequently, recommendations are made for immediate as well as subsequent clinical encounters.

ACKNOWLEDGMENTS

We wish to thank our many contributing authors for their diligence in creating complete, practical, and readable discussions of the many conditions seen on a daily basis in the average family medicine and primary care practice. Furthermore, the vision and support of our editors at McGraw-Hill for creating this resource for primary care have been outstanding and critical to its completion.

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1

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ESSENTIALS OF WELL-CHILD CARE

Providing a comprehensive patient-centered medical home for children and assisting in the progressive transition to adulthood are integral components of family medicine. The provision of well-child care through a series of periodic examinations forms the foundation for the family physician to build lasting relationships with the entire family, a critical distinction between the family physician and other medical specialists.

Enhanced nutrition, mandated safety standards, and expanded schedules for immunizations have significantly improved the health of US children, but serious childhood health problems persist. Inadequate prenatal care leading to poor birth outcomes, poor management of developmental delay, childhood obesity, lack of proper oral health, and learning disabilities are some examples of ongoing issues.

A key reference guide for childhood health promotion is the third edition (currently in revision) of *Bright Futures: Guidelines for Health Supervision of Infants, Children, and Adolescents*, funded by the US Department of Health and Human Services. The guidelines give providers a comprehensive system of care that addresses basic concerns of child rearing such as nutrition, parenting, safety, and infectious disease prevention with focused attention on evidence-based health components and interventions.

One widely accepted schedule for routine well-child visits (**Table 1-1**) is available in *Bright Futures* (http://brightfutures.aap.org/clinical_practice.html) (currently in revision). Seven visits are suggested during the first year, followed by an additional four visits by 2 years of age, and yearly visits until adulthood, coinciding with critical junctures during growth and development. Table 1-1 provides a structured framework for anticipatory guidance, exam features, and developmental screening recommendations at appropriate intervals.

The most important components of a preventive well-child visit include the following: (1) developmental/behavioral assessment; (2) physical examination, including measurement of growth; (3) screening tests and procedures; and (4) anticipatory guidance. The specific goal of each visit is to assess each component, identify concerns about a child's development and intervene with early treatment, if available, or monitor closely for changes. Another essential, recognized component is adherence to the most recent schedule of recommended immunizations from the Advisory Committee on Immunization Practices (of the US Public Health Service) and the Centers for Disease Control and Prevention (ACIP/CDC) (see Chapter 7).

The overall purpose of well visits is to engage the caregivers to partner with the physician to optimize the physical, emotional, and developmental health of the child. Family physicians need to comfortably identify common normal variants as well as abnormal findings that may require referral. Parents should be encouraged to use these dedicated well visits to raise questions, share observations, and advocate for their child, as they know their child best. Parents should be advised to bring in a list of questions during each visit and maintain their own records, especially for immunizations and growth, for each child.

Supplemental preventive health visits may be required if the child is adopted or living with surrogate parents; is at high risk for medical disorders as suggested by the conditions observed during pregnancy, delivery, neonatal history, growth pattern, or physical examination; or exhibits psychological disorders, or if the family is socially or economically disadvantaged or if the parents request or require additional education or guidance.

General Considerations

Well-child care ideally begins in the preconception period. Family physicians have the opportunity to provide preconception counseling to any woman, especially one who presents for gynecological examination before pregnancy.

Table 1–1. Proposed schedule of routine well-care visits.

American Academy of Pediatrics
DEDICATED TO THE HEALTH OF ALL CHILDREN™

Recommendations for Preventive Pediatric Health Care

Bright Futures/American Academy of Pediatrics

Bright Futures.

Each child and family is unique; therefore, these Recommendations for Preventive Pediatric Health Care are designed for the care of children who are receiving competent parenting, have no manifestations of any important health problems, and are growing and developing in satisfactory fashion. Additional visits may become necessary if circumstances suggest variations from normal.

Developmental, psychosocial, and chronic disease issues for children and adolescents may require frequent counseling and treatment visits separate from preventive care visits.

These guidelines represent a consensus by the American Academy of Pediatrics (AAP) and Bright Futures. The AAP continues to emphasize the great importance of continuity of care in comprehensive health supervision and the need to avoid fragmentation of care.

Refer to the specific guidance by age as listed in *Bright Futures* guidelines (Hagan JF, Shaw JS, Duncan PM, eds. *Bright Futures Guidelines for Health Supervision of Infants, Children and Adolescents*. 3rd ed. Elk Grove Village, IL: American Academy of Pediatrics; 2008).

	INFANCY							EARLY CHILDHOOD							MIDDLE CHILDHOOD						ADOLESCENCE									
AGE[1]	Prenatal[2]	Newborn[3]	3-5 d[4]	By 1 mo	2 mo	4 mo	6 mo	9 mo	12 mo	15 mo	18 mo	24 mo	30 mo	3 y	4 y	5 y	6 y	7 y	8 y	9 y	10 y	11 y	12 y	13 y	14 y	15 y	16 y	17 y	18 y	19 y	20 y	21 y
HISTORY																																
Initial/Interval	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●
MEASUREMENTS																																
Length/Height and Weight		●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●
Head Circumference		●	●	●	●	●	●	●	●	●	●	●																				
Weight for Length		●	●	●	●	●	●	●	●	●	●																					
Body Mass Index[5]												●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●
Blood Pressure[6]		★	★	★	★	★	★	★	★	★	★	★	★	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●
SENSORY SCREENING																																
Vision		★	★	★	★	★	★	★	★	★	★	★	★	●[7]	●	●	●	★	●	★	●	★	●	★	★	★	★	★	★	★	★	★
Hearing		●[8]	★	★	★	★	★	★	★	★	★	★	★	★	●	●	●	★	●	★	●	★	★	★	★	★	★	★	★	★	★	★	★
DEVELOPMENTAL/BEHAVIORAL ASSESSMENT																																
Developmental Screening[9]								●			●		●																			
Autism Screening[10]											●	●																				
Developmental Surveillance		●	●	●	●	●	●		●	●		●		●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●
Psychosocial/Behavioral Assessment		●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●
Alcohol and Drug Use Assessment[11]																						★	★	★	★	★	★	★	★	★	★	★
Depression Screening[12]																						★	★	★	★	★	★	★	★	★	★	★
PHYSICAL EXAMINATION[13]		●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●
PROCEDURES[14]																																
Newborn Blood Screening[15]		←———	●	———→																												
Critical Congenital Heart Defect Screening[16]		●																														
Immunization[17]		●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●
Hematocrit or Hemoglobin[18]						★			●	★	★	★	★	★	★	★	★	★	★	★	★	★	★	★	★	★	★	★	★	★	★	★
Lead Screening[19]							★	★	● or ★[20]		★	● or ★[20]		★	★	★	★															
Tuberculosis Testing[21]				★			★		★			★		★	★	★	★	★	★	★	★	★	★	★	★	★	★	★	★	★	★	★
Dyslipidemia Screening[22]												★			★		★		★	←—	●	→—	★	★	★	★	★	★	←———	●	———→	
STI/HIV Screening[23]																						★	★	★	★	★	←—	●	———→	★	★	★
Cervical Dysplasia Screening[24]																																●
ORAL HEALTH[25]							★	★	● or ★		● or ★	● or ★	● or ★	●			●															
ANTICIPATORY GUIDANCE	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●

1. If a child comes under care for the first time at any point on the schedule, or if any items are not accomplished at the suggested age, the schedule should be brought up to date at the earliest possible time.
2. A prenatal visit is recommended for parents who are at high risk, for first-time parents, and for those who request a conference. The prenatal visit should include anticipatory guidance, pertinent medical history, and a discussion of benefits of breastfeeding and planned method of feeding, per the 2008 AAP statement "The Prenatal Visit" (http://pediatrics.aappublications.org/content/124/4/1227.full).
3. Every infant should have a newborn evaluation after birth, and breastfeeding should be encouraged (and instruction and support should be offered).
4. Every infant should have an evaluation within 3 to 5 days of birth and within 48 to 72 hours after discharge from the hospital to include evaluation for feeding and jaundice. Breastfeeding infants should receive formal breastfeeding evaluation, and their mothers should receive encouragement and instruction, as recommended in the 2012 AAP statement "Breastfeeding and the Use of Human Milk" (http://pediatrics.aappublications.org/content/129/3/e827.full). Newborn infants discharged less than 48 hours after delivery must be examined within 48 hours of discharge, per the 2010 AAP statement "Hospital Stay for Healthy Term Newborns" (http://pediatrics.aappublications.org/content/125/2/405.full).
5. Screen, per the 2007 AAP statement "Expert Committee Recommendations Regarding the Prevention, Assessment, and Treatment of Child and Adolescent Overweight and Obesity: Summary Report" (http://pediatrics.aappublications.org/content/120/Supplement_4/S164.full).
6. Blood pressure measurement in infants and children with specific risk conditions should be performed at visits before age 3 years.
7. If the patient is uncooperative, rescreen within 6 months, per the 2007 AAP statement "Eye Examination in Infants, Children, and Young Adults by Pediatricians" (http://pediatrics.aappublications.org/content/111/4/902.abstract).
8. All newborns should be screened, per the AAP statement "Year 2007 Position Statement: Principles and Guidelines for Early Hearing Detection and Intervention Programs" (http://pediatrics.aappublications.org/content/120/4/898.full).
9. See 2006 AAP statement "Identifying Infants and Young Children With Developmental Disorders in the Medical Home: An Algorithm for Developmental Surveillance and Screening" (http://pediatrics.aappublications.org/content/118/1/405.full).
10. Screening should occur per the 2007 AAP statement "Identification and Evaluation of Children with Autism Spectrum Disorders" (http://pediatrics.aappublications.org/content/120/5/1183.full).
11. A recommended screening tool is available at (http://www.ceasar-boston.org/CRAFFT/index.php).
12. Recommended screening using the Patient Health Questionnaire (PHQ-2 or other tools available in the GLAD-PC toolkit and at (http://www.aap.org/en-us/advocacy-and-policy/aap-health-initiatives/Mental-Health/Documents/MH_ScreeningChart.pdf).
13. At each visit, age-appropriate physical examination is essential, with infant totally unclothed and older children undressed and suitably draped. See 2011 AAP statement "Use of Chaperones During the Physical Examination of the Pediatric Patient" (http://pediatrics.aappublications.org/content/127/5/991.full).
14. These may be modified, depending on entry point into schedule and individual need.
15. The Recommended Uniform Newborn Screening Panel (http://www.hrsa.gov/advisorycommittees/mchbadvisory/heritabledisorders/recommendedpanel/uniformscreeningpanel.pdf), as determined by The Secretary's Advisory Committee on Heritable Disorders in Newborns and Children, and state newborn screening laws/regulations (http://genes-r-us.uthscsa.edu/sites/genes-r-us/files/nbsdisorders.pdf), establish the criteria for and coverage of newborn screening procedures and programs. Follow-up must be provided, as appropriate, by the pediatrician.
16. Screening for critical congenital heart disease using pulse oximetry should be performed in newborns, after 24 hours of age, before discharge from the hospital, per the 2011 AAP statement "Endorsement of Health and Human Services Recommendation for Pulse Oximetry Screening for Critical Congenital Heart Disease" (http://pediatrics.aappublications.org/content/129/1/190.full).
17. Schedules, per the AAP Committee on Infectious Diseases, are available at (http://redbook.aappublications.org/site/resources/2ecschedules.xhtml). Every visit should be an opportunity to update and complete a child's immunizations.
18. See 2010 AAP statement "Diagnosis and Prevention of Iron Deficiency and Iron-Deficiency Anemia in Infants and Young Children (0-3 Years of Age)" (http://pediatrics.aappublications.org/content/126/5/1040.full).
19. For children at risk of lead exposure, see the 2012 CDC Advisory Committee on Childhood Lead Poisoning Prevention statement "Low Level Lead Exposure Harms Children: A Renewed Call for Primary Prevention" (http://www.cdc.gov/nceh/lead/ACCLPP/Final_Document_030712.pdf).
20. Perform risk assessments or screenings as appropriate, based on universal screening requirements for patients with Medicaid or in high prevalence areas.
21. Tuberculosis testing per recommendations of the Committee on Infectious Diseases, published in the current edition of *AAP Red Book: Report of the Committee on Infectious Diseases*. Testing should be performed on recognition of high-risk factors.
22. See AAP-endorsed 2011 guidelines from the National Heart Blood and Lung Institute, "Integrated Guidelines for Cardiovascular Health and Risk Reduction in Children and Adolescents" (http://www.nhlbi.nih.gov/guidelines/cvd_ped/index.htm).
23. Adolescents should be screened for sexually transmitted infections (STIs) per recommendations in the current edition of the *AAP Red Book: Report of the Committee on Infectious Diseases*. Additionally, all adolescents should be screened for HIV according to the AAP statement (http://pediatrics.aappublications.org/content/126/5/1023.full) once between the ages of 16 and 18, making every effort to preserve confidentiality of the adolescent. Those at increased risk of HIV infection, including those who are sexually active, participate in injection drug use, or are being tested for other STIs, should be tested for HIV and reassessed annually.
24. See USPSTF recommendations (http://www.uspreventiveservicestaskforce.org/uspstf/uspscerv.htm). Indications for pelvic examinations prior to age 21 are noted in the 2010 AAP statement "Gynecologic Examination for Adolescents in the Pediatric Office Setting" (http://pediatrics.aappublications.org/content/126/2/583.full).
25. Refer to a dental home, if available. If not available, perform a risk assessment (http://www2.aap.org/oralhealth/docs/RiskAssessmentTool.pdf). If primary water source is deficient in fluoride, consider oral fluoride supplementation. For those at high risk, consider application of fluoride varnish for caries prevention. See 2008 AAP statement "Preventive Oral Health Intervention for Pediatricians" (http://pediatrics.aappublications.org/content/122/6/1387.full) and 2006 AAP statement "Oral Health Risk Assessment Timing and Establishment of the Dental Home" (http://pediatrics.aappublications.org/content/117/5/1113.full).

KEY ● = to be performed ★ = risk assessment to be performed with appropriate action to follow, if positive ←—● —→ = range during which a service may be provided

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Prospective parents should be counseled about appropriate nutrition, including 0.4 mg of folic acid supplementation daily for all women of childbearing age. Prior to conception, referral for genetic screening and counseling should be offered on the basis of age, ethnic background, or family history. Prescription drug and supplement use should be reviewed. Exposure to cigarette smoke, alcohol, illicit drugs, or chemicals such as pesticides should be strongly discouraged. Clinicians should verify and complete immunization against hepatitis B, pertussis, tetanus, rubella, and varicella, and discuss prevention of infection from toxoplasmosis (often transmitted by contact with kittens), cytomegalovirus, and parvovirus B19.

Medical problems such as diabetes, epilepsy, depression, or hypertension warrant special management prior to conception, especially since medications may need to be changed before pregnancy. The "prenatal" visit provides an opportunity to discuss cultural, occupational, and financial issues related to pregnancy; to gather information about preparations for the child's arrival; to discuss plans for feeding and child care; and to screen for domestic violence. The prenatal visit is a good opportunity to promote breastfeeding, emphasizing the health benefits for both mother and infant. A social history should include the family structure (caregivers, siblings, etc) and socioeconomic status. Familiarity with the family's background enables the physician to dedicate visits with the newborn infant to providing parents with specific guidance about child care.

Once the child is born, the prenatal and neonatal records should be reviewed for gestational age at birth; any abnormal maternal obstetric laboratory tests; maternal illnesses such as diabetes, preeclampsia, depression, or infections that occurred during pregnancy; maternal use of drugs or exposure to teratogens; date of birth; mode of delivery; Apgar scores at 1 and 5 minutes; and birth weight, length, and head circumference. Repeated screening of parents during well-child visits for depression and tobacco use with an offer of counseling and treatment can have profound benefits for the child.

COMPONENTS OF PREVENTIVE WELL-CHILD CARE

Developmental/Behavioral Assessment

Young children who experience toxic stress such as maltreatment, neglect, poverty, or a depressed parent are at increased risk for later life health problems such as asthma, heart disease, cancer, and depression. During the prenatal and early childhood years, the neuroendocrine-immune network creates end-organ setpoints that lead to these disorders. Because well-timed adjustments to the child's environment can reduce the risk for later disease, the clinician should attempt to uncover toxic stressors at each preventive health visit.

Table 1–2. Developmental "red flags."[a]

Age (months)	Clinical Observation
2	Not turning toward sights or sounds
4–5	No social smiling or cooing
6–7	Not reaching for objects
8–9	No reciprocating emotions or expressions
9–12	No imitative sound exchange with caregivers
18	No signs of complex problem-solving interactions (following 2-step directions)
18–24	Not using words to get needs met
36–48	No signs of using logic with caregivers No pretend play with toys

[a]Serious emotional difficulties in parents or family members at any time warrant full evaluation.

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Watching a newborn develop from a dependent being into a communicative child with a unique personality is an amazing process that caregivers and clinicians can actively promote. Early identification of developmental disorders is critical for the well-being of children and their families. Unfortunately, primary care physicians fail to identify and appropriately refer many developmental problems, even though screening tools are available. Because the period of most active development occurs during the first 3 years, clinicians must assess and document developmental surveillance for every preventive care visit and preferably at every other office visit as well regardless of purpose. **Table 1-2** lists some developmental "red flags."

Surveillance includes asking parents if they have any concerns about their child's development, taking a developmental history, observing the child, identifying any risk factors for developmental delay, and accurately tracking the findings and progress. If the family shows concerns, reassurance and reexamination is appropriate if the child is at low risk.

As a result of concerns identified during surveillance and specifically at the 9-, 18-, and 30-month visits, a formal developmental screening tool should be administered to uncover problems such as those listed in **Table 1-3.** These visits occur when parents and clinicians can readily observe strides in the different developmental domains: fine and gross motor skills, language and communication, problem solving/adaptive behavior, and personal-social skills. Developmental tests screen children who are apparently normal, confirm or refute any concerns, and serve to monitor children at high risk for developmental delay. Each test approaches the task of identifying children in a different

Table 1–3. Prevalence of developmental disorders.

Disorder	Cases per 1000
Attention deficit/hyperactivity disorder	75–150
Learning disabilities	75
Behavioral disorders	60–130
Mental retardation	25
Autism spectrum disorders	2–11
Cerebral palsy	2–3
Hearing impairment	0.8–2
Visual impairment	0.3–0.6

Data from Levy SE, Hyman SL. Pediatric assessment of the child with developmental delay. *Pediatr Clin North Am.* 1993;40:465 and CDC. Prevalence of autism spectrum disorders—autism and developmental disabilities monitoring network, 14 sites, United States, 2002. *MMWR* (*Morbidity and Mortality Weekly Report*). 2007; 6:1–40.

way; no screening tool is universally deemed appropriate for all populations and all ages. A report in the United States during 2006–2008 found that about one in six children had a developmental disability.

Table 1-4 lists several useful developmental screening tests. The historical gold standard Denver Developmental Screening Test–revised requires trained personnel about 20–30 minutes of office time to administer. Proper use is not widespread in practice. The Parents' Evaluation of Developmental Status, the Ages and Stages Questionnaire, and the Child Development Review-Parent Questionnaire are all parent-completed tools that take less than 15 minutes to complete and are easily used in a busy clinical practice but are unfortunately proprietary. Shortened, customized lists of developmental milestones should not replace the use of validated developmental assessment tools, a list of which is available from the National Early Childhood Technical Assistance Center (NECTAC).

If the screening tool results are concerning, the physician should inform the parents and schedule the child for further developmental or medical evaluation or referral to subspecialists such as neurodevelopmental pediatricians, pediatric psychiatrists, speech-language pathologists, and physical and occupational therapists. In approximately one-fourth of all cases, an etiology is identified through medical testing, such as genetic evaluation, serum metabolite studies, and brain imaging.

If screening results are within normal limits, the physician has an opportunity to focus on optimizing the child's potential. Parents can be encouraged to read to their children

Table 1–4. Developmental screening tools.

Test	Age	Time (minutes)	Source
Office Administered			
Denver II	0–6 years	30	www.denverii.com
Battelle Developmental Inventory Screening Tool (BDI-ST)	0–8 years	15	www.riverpub.com
Brigance Screens-II	0–90 months	15	www.curriculumassociates.com
Bayley Infant Neuro-developmental Screen (BINS)	3–24 months	10	www.harcourtassessment.com
Parent Administered			
Ages & Stages Questionnaires (ASQ)	4–60 months (every 4 months)	15	www.brookespublishing.com
Parents' Evaluation of Development Status (PEDS)	0–8 years	< 5	www.pedstest.com
Child Development Inventory (CDI)	1.5–6 years	45	www.childdevrev.com
Language and Cognitive Screening			
Early Language Milestone (ELM)	0–3 years	5–10	www.proedinc.com
Capute Scales (Cognitive Adaptive Test/Clinical Linguistic Auditory Milestone Scale [CAT/CLAMS])	3–36 months	15–20	www.brookespublishing.com
Modified Checklist for Autism in Toddlers	16–48 months	5–10	www.firstsigns.com

Data from Mackrides PS, Ryherd SJ. Screening for developmental delay. *Am Fam Physician* 2011; 84(5):544–549.

on a regular basis, sing and play music, limit television and other media device use altogether in toddlers and to no more than 2 hours daily for older children, and directly engage in age-appropriate stimulating activities such as exercise or game playing. Clinicians should encourage the parents and patients to report on positive behaviors and activities at every visit.

At both the 18- and 24-month visits, clinicians should formally screen for autism spectrum disorders (ASDs). Increasing public awareness and concern about ASD has made this recommendation key. The Modified Checklist for Autism in Toddlers (M-ChAT) is a widely used, validated autism-specific screening tool. Autistic disorder is a pervasive developmental disorder resulting in various social, language, and/or sensorimotor deficits with an incidence as high as 1 in 88 children. Early diagnosis and intervention may help many autistic persons achieve some degree of independent living. The differential diagnosis includes other psychiatric and developmental disorders; profound hearing loss; metabolic disorders, such as lead poisoning; and genetic disorders, such as fragile X syndrome and tuberous sclerosis. MMR (measles-mumps-rubella) vaccine does not cause autism, but failure to take folic acid during pregnancy is linked to an increased risk.

The school years offer an excellent opportunity to evaluate the child's development through grades, standardized test results, and athletic or extracurricular activities. Participation in activities outside the home and school also help gauge the child's development. For example, a critical event during adolescence is learning to drive a motor vehicle.

Physical Examination

A general principle for well-child examinations (newborn to 4 years old) is to perform maneuvers from least to most invasive. Clinicians should first make observations about the child-parent(s) interaction, obtain an interval history, and then perform a direct examination of the child. Some parts of the examination are best accomplished when the infant is quiet so they may be performed "out of order." Although most communication about the child's health is between the physician and the parent(s), clinicians should attempt to communicate directly with the patient to gauge whether he or she is developmentally appropriate and to develop familiarity directly with that patient.

A physical examination of the newborn should include the following:

- **General observation**: evidence of birth trauma, dysmorphic features, respiratory rate, skin discolorations, or rashes
- **Head, ears, eyes, nose, and throat (HEENT) examination**: mobile sutures, open fontanelles, head shape, ears, bilateral retinal red reflexes, clarity of lens, nasal patency, absence of cleft palate or lip, and palpation of clavicles to rule out fracture
- **Cardiovascular examination**: cardiac murmurs, peripheral pulses, capillary refill, and cyanosis
- **Pulmonary examination**: use of accessory muscles and auscultation of breath sounds
- **Abdominal examination**: masses, distention, and the presence of bowel sounds
- **Extremity examination**: number and abnormalities of digits, and screening for congenital dislocation of the hips using Ortolani and Barlow maneuvers
- **Genitourinary examination**: genitalia and anus
- **Neurologic examination**: presence of newborn reflexes (eg, rooting, grasping, sucking, stepping, and Moro reflex), resting muscle tone

To track the child's physical and developmental progress, a comprehensive interval history and physical examination is important at each encounter, even if the parents do not report concerns. The child's weight (without clothes or shoes), height, and head circumference (until 3 years of age) are measured and plotted on standard CDC growth charts at each visit. A child's rate of growth will usually follow one percentile (25th, 50th, etc) from birth through school age. A child can appropriately cross percentiles upward (eg, a premature infant who then "catches up") or inappropriately (eg, a child who becomes obese). Any child who drops more than two percentiles over any period of time should be evaluated for failure to thrive (see Chapter 2).

By 15 months of age, children experience stranger anxiety and are much less likely to be cooperative. Clinicians can minimize the child's adverse reactions by approaching the child slowly and performing the examination while the child is in the parent's arms, progressing from least to most invasive tasks. Touching the child's shoe or accompanying stuffed animal first and then gradually moving up to the chest while distracting the child with a toy or otoscope light is often helpful. After the first year of life, the pace of the infant's growth begins to plateau. At the 15- to 18-month visit, the infant most likely will be mobile and may want to stand during the examination. To engage the child, the clinician can ask where to do the examination or which body part to examine first.

Beginning at 2 years of age, the body mass index (BMI) is plotted; at age 3 years the child's blood pressure is measured. Eye examination for strabismus (also known as "cross-eye"; measured by the cover/uncover test) allows early treatment to prevent amblyopia. By age 3 or 4 years, documentation of visual acuity should be attempted. Hearing, now tested at birth, is informally evaluated until the age of 4 years, when audiometry should be attempted. At least 75% of speech in 3-year-olds should be intelligible. Speech delay should trigger referral. Physicians need to assess gait, spinal alignment, and injuries, looking particularly for signs of child abuse or neglect. **Table 1-5** highlights the important components of

Table 1–5. Highlights of physical examination by age.

Age of Child	Essential Components of Examination
2 weeks	Presence of bilateral red reflex Auscultation of heart for murmurs Palpation of abdomen for masses Ortolani/Barlow maneuvers for hip dislocation Assessment of overall muscle tone Reattainment of birth weight
2 months	Observation of anatomic abnormalities or congenital malformations (effects of birth trauma resolved by this point) Auscultation of heart for murmurs
4–6 months	Complete musculoskeletal examination (neck control, evidence of torticollis) Extremity evaluation (eg, metatarsus adductus) Vision assessment (conjugate gaze, symmetric light reflex, visual tracking of an object to 180°) Bilateral descent of testes Assessment for labial adhesions
9 months	Pattern and degree of tooth eruption Assessment of muscle tone Presence of bilateral pincer grasp Observation of crawling behavior
12 months	Range of motion of the hips, rotation, and leg alignment Bilateral descent of testes
15–18 months	Cover test for strabismus Signs of dental caries Gait assessment Any evidence of injuries

the physical examination at each age. The examiner should comment on the child's psychological and intellectual development, particularly during adolescence, when mood and affect evaluations should be recorded.

Screening Laboratory Tests

Every state requires newborns to undergo serologic screening for inborn errors of metabolism (**Table 1-6**), preferably at age 2–3 days. Funded by the Department of Health and Human Services (DHSS), Baby's First Test (www.babysfirst-test.org) is an unbiased website that provides information for providers about the mandated screening requirements in each state. Examples of commonly screened conditions are hypothyroidism, phenylketonuria, maple syrup urine disease, congenital adrenal hyperplasia, and cystic fibrosis. Most institutions routinely screen newborns for hearing loss [US Preventive Services Task Force (USPSTF) recommendation for universal screening level B]. The USPSTF assigned a level I (insufficient evidence) to universal screening of newborns for risk of chronic bilirubin encephalopathy with a transcutaneous bilirubin.

Table 1–6. Commonly screened components of newborn screening panels.[a]

Diseases Screened	Incidence of Disease in Live Births
Congenital hypothyroidism	1:4000
Duchenne muscular dystrophy	1:4500
Congenital adrenal hyperplasia	1:10,000–1:18,000
Phenylketonuria	1:14,000
Galactosemia	1:30,000
Cystic fibrosis	1:44,000–1:80,000 (depending on population)
Biotinidase deficiency	1:60,000

[a]Screening panel requirements vary in each state.
Data from Kaye CI and Committee on Genetics. *Newborn Screening Fact Sheets.* (technical report; available at www.pediatrics.org/cgi/content/full/118/3/1304). See also *Baby's First Test* (http:// babysfirst-test.org/) for complete listing of disease tests by state.

The American Academy of Pediatrics (AAP) recommends screening for anemia with fingerstick hemoglobin or hematocrit at age 12 months. Although the USPSTF assigned a level I to screening for iron deficiency, it did recommend iron dietary supplementation for age 6–12 months. Because of the high prevalence of iron deficiency anemia in toddlers (about 9%), repeat screenings may be necessary in high-risk situations. Measurement of hemoglobin or hematocrit alone detects only those patients with iron levels low enough to become anemic, so dietary intake of iron should be assessed. Pregnant adolescents should be screened for anemia. A positive screening test at any age is an indication for a therapeutic trial of iron. Thalassemia minor is the major differential consideration. A sickle cell screen is indicated in all African American children.

The AAP recommends universal lead screening at ages 12 and 24 months. If the child is considered to be at high risk, annual lead screening begins at age 6 months. Risk factors include exposure to chipping or peeling paint in buildings built before 1950, frequent contact with an adult with significant lead exposure, having a sibling under treatment for a high lead level, and location of the home near an industrial setting likely to release lead fumes. Although many agencies require a one-time universal lead screening at 1 year of age because high-risk factors are often absent in children with lead poisoning, the USPSTF recommends against screening children at average risk and assigns a level I to screening for high-risk children.

Tuberculosis (TB) screening using a purified protein derivative (PPD) is offered on recognition of high-risk factors at any age. Routine testing of children without risk factors is not indicated. Children require testing if they have had contact with persons with confirmed or suspected cases of infectious TB, have emigrated from endemic countries (Asia or the Middle East), or have any clinical or radiographic findings suggestive of TB. Human immunodeficiency virus (HIV)-infected children require annual PPD tests. Children at risk for HIV due to exposure to high-risk adults (HIV-positive, homeless, institutionalized, etc) are retested every 2–3 years. Children without specific risk factors for TB but who live in high-prevalence communities may be tested at ages 1 year, 4–6 years, and 11–12 years.

The AAP recommends universal dyslipidemia screening at ages 10 and 20 years. A cholesterol level may be obtained after age 2 years if the child has a notable family history. The National Cholesterol Education Program (NCEP) recommends screening in a child with a parent who has a total cholesterol of ≥240 mg/dL or a parent or grandparent with the onset of cardiovascular disease before age 55 years. Clinical evaluation and management of the child are to be initiated if the low-density lipoprotein (LDL) cholesterol level is ≥130 mg/dL. The USPSTF assigns a level I to cholesterol screening during childhood.

The AAP recommends an HIV test for all 20-year-olds.

Anticipatory Guidance

A. Nutrition

All mothers should be strongly encouraged to breastfeed their infants. A widely accepted goal is exclusive breastfeeding for at least the first 6 months of life. Vitamin D supplement (400 U/d) is indicated for breastfed children. Parents who choose to bottle-feed their newborn have several choices in formulas, but should avoid cow's milk, because of risks like anemia. Commercial formulas are typically fortified with iron and vitamin D, and some contain fatty acids such as docosahexaenoic acid (DHA) and arachidonic acid (ARA) which are not as yet proven to promote nervous system development. Soy-based or lactose-free formulas can be used for infants intolerant of cow's milk formulas.

An appropriate weight gain is 1 oz/d during the first 6 months of life and 0.5 oz/d during the next 6 months. This weight gain requires a daily caloric intake of ~120 kcal/kg during the first 6 months and 100 kcal/kg thereafter. Breast milk and most formulas contain 20 cal/oz. Initially, newborns should be fed on demand or in some cases as for twins on a partial schedule. Caregivers need to be questioned about the amount and duration of the child's feedings and vitamin D and fluoride intake at every visit.

Healthy snacks and regular family mealtimes may help reduce the risk of obesity. Fruit juice is best avoided altogether; water is preferred for hydration. Ideal calorie intake is somewhat independent of weight but does change according to activity level. Children age 1 year should take in about 900 kcal/d; age 2–3 years, 1000; age 4–8 years, 1200 for girls and 1400 for boys; age 9–13 years, 1600 for girls and 1800 for boys; and age 14–18, 1800 for girls and 2200 for boys.

Solid foods such as cereals or pureed baby foods are introduced at 4–6 months of age when the infant can support her or his head and the tongue extrusion reflex has extinguished. Delaying introduction of solid foods until this time appears to limit the incidence of food sensitivities. The child can also continue breast- or bottle-feeding, limited to 30 oz/d, because the solids now provide additional calories. Around 1 year of age, when the infant can drink from a cup, bottle-feeding should be discontinued to protect teeth from caries. No specified optimum age exists for weaning a child from breastfeeding. After weaning, ingestion of whole or 2% cow's milk may promote nervous system development.

Older infants can tolerate soft adult foods such as yogurt and mashed potatoes. A well-developed pincer grasp allows children to self-feed finger foods. With the eruption of primary teeth at 8–12 months of age, children may try foods such as soft rice or pastas.

With toddlers, mealtimes can be a source of both pleasure and anxiety as children become "finicky." The normal child may exhibit specific food preferences or be disinterested in eating. An appropriate growth rate and normal developmental milestones should reassure frustrated parents. Coping strategies include offering small portions of preferred items first and offering limited food choices. Eating as a family gives toddlers a role model for healthy eating and appropriate social behaviors during mealtimes.

B. Elimination

Regular patterns for voiding and defecation provide reassurance that the child is developing normally. Newborn infants should void within 24 hours of birth. An infant urinates approximately 6–8 times a day. Parents may count diapers in the first few weeks to confirm adequate feeding. The older child usually voids 4–6 times daily. Changes in voiding frequency reflect the child's hydration status, especially when the child is ill.

Routine circumcision of male infants is not currently recommended, so parents who are considering circumcision require additional guidance. Although a circumcised boy has a decreased incidence of urinary tract infections [odds ratio (OR) 3–5] and a decreased risk of phimosis and squamous cell carcinoma of the penis, some clinicians raise concerns about bleeding, infection, pain of the procedure, or damage to the genitalia (incidence of 0.2–0.6%). Therefore, the decision about circumcision is based on the parents' personal preferences and cultural influences. When done, the procedure is usually performed after the second day of life, on a physiologically stable infant. Contraindications include ambiguous

genitalia, hypospadias, HIV, and any overriding medical conditions. The denuded mucosa of the phallus appears raw for the first week postprocedure, exuding a small amount of serosanguineous drainage on the diaper. Infection occurs in <1% of cases. Mild soap and water washes are the best method of cleansing the area. By the 2-week checkup, the phallus should be completely healed with a scar below the corona radiata. The parents should note whether the infant's urinary stream is straight and forceful.

Newborns are expected to pass black, tarry meconium stools within the first 24 hours of life. Failure to pass stool in that period necessitates a workup for Hirschsprung disease (aganglionic colon) or imperforate anus. Later the consistency of the stool is usually semisolid and soft, with a yellow-green seedy appearance. Breastfed infants typically defecate after each feeding or at least 2 times a day. Bottle-fed infants generally have a lower frequency of stooling. Occasionally, some infants may have only one stool every 2 or 3 days without discomfort. If the child seems to be grunting forcefully with defecation or is passing extremely hard stools, treatment with lubricants such as, glycerin is recommended. Any appearance of blood in the stools is abnormal and warrants investigation. Anal fissure is common.

With the introduction of solid foods and maturation of intestinal function, stool becomes more solid and malodorous. Treatment of mild to moderate constipation may include the use of Karo syrup mixed in with feedings (1–2 tsp in 2 oz of milk) or psyllium seed or mineral oil (15–30 mL) for older children. Older children and adolescents should ingest high-fiber foods such as fruits and vegetables and drink water to reduce the risk of constipation. Children who are severely constipated may require referral.

C. Sleep Patterns

An important issue for new parents is the development of proper sleeping habits for their child. Newborns and children experience different stages of sleep/wakefulness cycles, including deep, light, or rapid-eye-movement (REM) sleep; indeterminate state; wide-awake, alert state; fussy; and crying. On average, a baby experiences a cycle every 3–4 hours, and the new parents' first job is to learn their baby's unique style. Newborns sleep an average of 18–20 hours in each 24-hour period.

At first, feeding the baby whenever he or she wakes up is the most appropriate response. Because babies often have their days and nights "reversed," tiring nighttime awakenings are commonplace because of frequent feedings. When the baby is 3 or 4 weeks old, feedings can be delayed for a bit of play and interaction. The goal is to space out the baby's awake time to 3 or more hours between feedings and a long sleep at night.

By 2–3 months, the baby's pattern of sleeping and feeding should be more predictable and parents can institute some routines that allow the child to self-comfort. After feeding, rocking, and soothing, parents should be encouraged to lay the baby down in the crib when she or he is quiet but not asleep. A soothing, consistent bedtime ritual allows babies to learn to settle down by themselves and lays the foundation for other independent behaviors in the future.

All newborn infants should be placed on their backs to sleep to reduce the risk of sudden infant death syndrome (SIDS). Risk factors include prone and side positions for infant sleep, smoke exposure, soft bedding and sleep surfaces, and overheating. Cosleeping (bed sharing) slightly increases the overall risk of SIDS, especially for infants less than 11 weeks old. The issue of cosleeping is often difficult to address as it is viewed as a common and necessary practice in some cultures. Evidence also suggests that pacifier use and room sharing (without bed sharing) are associated with decreased risk of SIDS. Although the cause of SIDS is unknown, immature cardiorespiratory autonomic control and failure of arousal responsiveness from sleep are important factors. With the "back to sleep" campaign, prone sleeping among all US infants has decreased to less than 20%, and the incidence of SIDS has decreased to 40%.

An unintended consequence of the supine sleep position has been increased incidence of positional head deformity or plagiocephaly. Providers need to recognize physical examination distinctions between this cosmetic deformity and the more significant concern of craniosynostosis. Parents should be counseled early about strategies to minimize plagiocephaly, including use of supervised prone positioning ("tummy time") and avoidance of prolonged car seat or rocker use. Early referral and treatment in severe cases typically results in satisfactory outcomes.

Sleep disorders are extremely common in young children and adolescents. Good sleep hygiene offers the best solution to these difficulties.

D. Oral Health

The poor state of oral health in many children is a continued major concern. Tooth decay remains one of the most common chronic diseases of childhood, even more common than asthma. Medically and developmentally compromised children and children from low-income families are at highest risk. Affected children remain at higher risk for cavities throughout their childhood and adulthood. To minimize early-childhood caries, children should not be put to sleep with a bottle or by breastfeeding. Parents should also be discouraged from inappropriately using the bottle or "sippy cup" as a pacifier. Dietary sugars along with cariogenic bacteria, most often acquired from the mother, who should never clean off a pacifier by inserting it into her own mouth, lead to accelerated decay in the toddler's primary teeth. Ingestion of water after feeding may help reduce cavities.

Current recommendations encourage establishing regular dental care around 6–9 months of age in high-risk children and at 1 year of age for all others. Children should

continue with regular biannual dental appointments thereafter. Primary prevention includes provision of a diet high in calcium and fluoride supplementation for those with an unfluoridated water supply (<0.6 ppm) from age 6 months through age 16 years. Once primary teeth erupt, parents should use a soft-bristled brush or washcloth with water to clean the teeth twice daily. A pea-sized amount of fluoride containing toothpaste is adequate. Infants should drink from a cup and be weaned from the bottle at around 12–14 months of age. Pacifiers and thumb sucking are best limited after teeth have erupted. All children need limits on the intake of high-sugar drinks and juices, especially between meals. Fluoride applications 2–6 times per year on erupted teeth markedly reduce the incidence of caries (http://www.ada.org/goto/fluoride).

E. Safety

Accidental injury and death are the major risks to a healthy child. Safety should be stressed at every well-child visit. Poison avoidance; choking hazards; and water, pet, gun, and automobile safety are critical areas to review. The Injury Prevention Program (TIPP) from the American Academy of Pediatrics provides an excellent framework for accident prevention.

Issues in Normal Development

Anticipatory guidance can be helpful to caregivers in preparation for normal growth and development and when their child exhibits variations from ideal behavior. *Bright Futures* provides extensive information about anticipatory guidance throughout childhood and adolescence. Important anticipatory guidance topics include safety, school readiness, school refusal, bullying, physical activity, media (TV, smartphones, etc) use, drug addiction, sexuality, and intellectual pursuits. Selected behavioral issues that are commonly encountered in young children include infantile colic, temper tantrums, and reluctant toilet training.

A. Infantile Colic

Colic is a term often used to describe an infant who is difficult to manage or fussy despite being otherwise healthy. Colic may be defined as 3 or more hours of uncontrollable crying or fussing at least 3 times a week for at least 3 weeks. Many parents complain of incessant crying well before 3 weeks have passed. Other symptoms include facial expressions of pain or discomfort, pulling up of the legs, passing flatus, fussiness with eating, and difficulty falling or staying asleep. Symptoms classically worsen during the evening hours. Because the diagnosis depends on parental report, the incidence of colic varies from 5% to 20%. It occurs equally in both sexes and peaks around 3–4 weeks of age.

The cause of colic is unknown, but organic pathology is present in <5% of cases. Possible etiologies include an immature digestive system sensitive to certain food proteins, an immature nervous system sensitive to external stimuli, or a mismatch of the infant's temperament and those of caregivers. Feeding method is probably unrelated. Clinicians can provide reassurance to caregivers by informing them that colicky children continue to eat and gain weight appropriately, despite the prolonged periods of crying, and that the syndrome is self-limited and usually dissipates by 3–4 months of age. Colic has no definite long-term consequences; therefore, the main problem for caregivers is to cope with anxiety over the crying child. A stressed caregiver who is unable to handle the situation is at risk for abusing a child.

No definitive treatment can be offered for colic. Little evidence supports the use of simethicone or acetaminophen drops. Switching to a hypoallergenic (soy) formula is effective when the child has other symptoms suggestive of cow's milk protein allergy. Breastfeeding mothers can attempt to make changes in their diets (eg, avoidance of cruciferous vegetables such as broccoli and cabbage) to see if the infant improves. Both clinicians and caregivers have proposed many "home remedies." Both reducing stimulation and movement such as a car ride or walk outdoors are recommended. Frequent burping, swaddling, massage, a crib vibrator, and background noise from household appliances or a white-noise generator are moderately effective. Rigorous study of these techniques is difficult, but clinicians can suggest any or all because the potential harm is minimal.

B. Temper Tantrums

A normal part of child development, temper tantrums encompass excessive crying, screaming, kicking, thrashing, head banging, breath-holding, breaking or throwing objects, and aggression. Between the ages of 1 and 3 years, a child's growing sense of independence is in conflict with physical limitations and parental controls and hampered because of limited vocabulary and inability to express feelings or experiences. This power struggle sets the stage for the expression of anger and frustration through a temper tantrum. Tantrums can follow minor frustrations or occur for no obvious reason, but are mostly self-limited. A child's tendency toward impulsivity or impatience or a delay in the development of motor skills or cognitive deficits and parental inconsistency—excessive restrictiveness, overindulgence, or overreaction—may increase the incidence of tantrums. Tantrums that produce a desired effect have an increased likelihood of recurrence.

As much as possible, parents should provide a predictable home environment. Consistency in routines and rules will help the child know what to expect. Parents should prepare the child for transitions from one activity to another, offer some simple choices to satisfy the child's growing need for control, acknowledge the child's wants during a tantrum, and act calmly when handling negative behaviors to avoid reinforcement. Physical (corporeal) punishment is not advised.

Most importantly, ignoring attention-seeking tantrums and not giving in to the demands of the tantrum will, in time, decrease the recurrence. Children who are disruptive enough to hurt themselves or others must be removed to a safe place and given time to calm down in a nonpunitive manner. Most children learn to work out their frustrations with their own set of problem-solving and coping skills, thus terminating tantrums. Persistence of tantrums beyond age 4 or 5 years requires further investigation and usually includes referral or group education and counseling.

C. Toilet Training

Some indicators of readiness for toilet use include an awareness of impending urination or defecation, prolonged involuntary dryness, and the ability to walk easily, to pull

Table 1–7. Medical problems commonly diagnosed in childhood.

Problem	Definition	Prevalence	Risk Factors	Assessment	Treatment
Developmental dysplasia of hips	Spectrum of abnormalities that cause hip instability, ranging from dislocation to inadequate development of acetabulum	8–25 cases per 1000 births	Female gender Breech delivery Family history Possibly birth weight >4 kg	Screening clinical examination at birth and well-child visits of marginal use Diagnosis: ultrasound in infants <6 months; radiographs >6 months	Abduction splints in infants <6 months; open or closed reduction more effective in those >6 months; optimal treatment remains controversial; consider orthopedic referral
Congenital heart disease	Major—large VSDs, severe valvular stenosis, cyanotic disease, large ASDs Minor—small VSDs, mild valvular stenosis, small ASDs	5–8 cases per 1000 newborns, 50% with major disease and 50% with minor disease	Maternal diabetes or connective tissue disease; congenital infections (CMV, HSV, rubella, etc); drugs taken during pregnancy; family history; Down syndrome	Major disease presents shortly after birth Minor disease can present with murmur, tachycardia, tachypnea, pallor, peripheral pulses; EKG, CXR, echocardiogram	Cardiology evaluation; medication; surgical treatment options
Cryptorchidism	Testicles are absent (agenesis, vascular compromise) or undescended	2–5% of full-term and 30% of premature male infants; prevalence varies geographically	Disorders of testosterone secretion; abdominal wall defects; trisomies	Increased risk of inguinal hernia, testicular torsion, infertility, and testicular cancer	Hormonal or surgical treatment, or both; can start at age 6 months; complete before age 2 years
Pyloric stenosis	Hypertrophic (elongated, thickened) pylorus, progresses to obstruction of gastric outlet	3 cases per 1000 live births	Male infants; first-born infants; unconjugated hyperbilirubinemia	Diagnosis by clinical examination, ultrasound, or upper GI series; electrolyte abnormalities (metabolic alkalosis)	Surgical repair; fluid, electrolyte resuscitation
Hypospadias	Ventral location of urethral meatus (anywhere from proximal glans to perineum)	~1 case per 250 male births	Advanced maternal age; maternal diabetes mellitus; Caucasian ethnicity; delivery before 37 weeks' gestation	Check for other abnormalities (cryptorchidism) and intersex conditions (congenital adrenal hyperplasia)	Circumcision contraindicated; urology referral, usually within 3–6 months
Strabismus	Anomaly of ocular alignment (one or both eyes, any direction)	~2–4% of population	Family history; low birth weight; retinopathy of prematurity; cataract	Clinical tests: corneal light reflex, red reflex, cover test, and cover/uncover test	Child should be referred to pediatric ophthalmologist for early treatment to reduce visual loss (amblyopia)

ASD, atrial septal defect; CMV, cytomegalovirus; CXR, chest x-ray; EKG, electrocardiogram; GI, gastrointestinal; HSV, herpes simplex virus; VSD, ventricular septal defect.

clothes on and off easily, to follow instructions, to identify body parts, and to initiate simple tasks. These indicators are not likely to be present until 18–30 months of age. Once the child becomes interested in bathroom activities or watching his or her parents use the toilet, parents should provide a potty chair. Parents can then initiate toilet training by taking the diaper off and seating the child on the potty at a time when she or he is likely to urinate or defecate. Routine sittings on the potty at specified times, such as after meals when the gastrocolic reflex is functional, may be helpful. The child who is straining or bending at the waist may be escorted to the bathroom for a toileting trial. If the child eliminates in the potty or toilet, praise or a small reward may reinforce that behavior. Stickers, storybooks, or added time with the parents can be used for motivation.

With repeated successes, transitional diapers or training pants may be used until full continence is achieved. The training process may take days to months, and caregivers can expect accidents. Accidents need to be dealt with plainly; the child should not be punished or made to feel guilty or forced to sit on the toilet for prolonged periods. Significant constipation can be treated medically, because it may present a barrier to training. About 80% of children achieve success at daytime continence by age 30 months.

As with many child-rearing issues, consistency and a nurturing environment give the child a sense of security. Training should not start too early or during times of family stress. Parents can be asked to describe specific scenarios, so concrete anticipatory guidance may be given to deal with any barriers. Toilet training, as with most behavior modification, has a higher chance of success if positive achievements are rewarded and failures are not emphasized.

Medical Concerns Outside Normal Development

Beyond the normal variations in child development, the family physician may need to identify and treat significant medical problems. Early diagnosis and referral lead to prevention of potentially serious sequelae and improved quality of life. Some of the major abnormalities detected in the young child (**Table 1-7**) underscore the importance of regular and thorough well-child-care visits with the family physician.

Media Use

Children should limit TV and computer use to no more than 2 hours per day. Parents must be aware of the content of viewed programs, videogames, and websites to reduce childhood exposure to violence and socially inappropriate content such as drug use. Safe use of handheld phones and computer devices should be routinely discussed with all parents and older children and adolescents.

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2 Failure to Thrive

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ESSENTIALS OF DIAGNOSIS

- Persistent weight loss over time.
- Growth failure associated with disordered behavior and development.
- Weight less than third percentile for age.
- Weight crosses two major percentiles downward over any period of time and continues to fall.
- Median weight for age of 76–90% (mild undernutrition), 61–75% (moderate undernutrition), or <61% (severe undernutrition).

General Considerations

Failure to thrive (FTT) is an old problem that continues to be an important entity for all practitioners who provide care to children. Growth is one of the essential tasks of childhood and is an indication of the child's general health. Growth failure may be the first symptom of serious organ dysfunction. Most frequently, however, growth failure represents inadequate caloric intake. Malnutrition during the critical period of brain growth in early childhood has been linked to delayed motor, cognitive, and social development. Developmental deficits may persist even after nutritional therapy has been instituted.

There is no unanimously established definition of FTT. Practitioners must also recognize the limitations of the different definitions of FTT. In a European study, 27% of well children met one criterion for FTT in the first year of life. This illustrates the poor predictive value of using a single measurement in diagnosis. Competing definitions of FTT include the following:

- **Persistent weight loss over time.** Children should steadily gain weight. Weight loss beyond the setting of an acute illness is pathological. However, the assessment and treatment for FTT need to be addressed *before* the child has had persistent weight loss.
- **Growth failure associated with disordered behavior and development.** This old definition is useful because it reminds the practitioner of the serious sequelae and important alarm features in children with undernutrition. Currently, FTT is more commonly defined by anthropometric guidelines alone.
- **Weight less than the third to fifth percentile for age.** This is a classic definition. However, this definition includes children with genetic short stature and whose weight transiently dips beneath the third percentile with an intercurrent illness.
- **Weight crosses two major percentiles downward over any period of time.** Thirty percent of normal children will drop two major percentiles within the first 2 years of life as their growth curve shifts to their genetic potential. These healthy children will continue to grow on the adjusted growth curve. Children with FTT do not attain a new curve, but continue to fall. The most accurate assessment for FTT is a calculation of the child's median weight for age. This quick calculation enables the clinician to assess the degree of undernutrition and plan an appropriate course of evaluation and intervention. The median weight for age should be determined using the most accurate growth chart for the area in which the child lives. The median should not be adjusted for race, ethnicity, or country of origin. Differences in growth are more likely due to inadequate nutrition in specific geographic or economically deprived populations. Determinations of nutritional status are as follows:
  - **Mild undernutrition:** 76–90% median weight for age. These children are in no immediate danger and may be safely observed over time (**Table 2-1**).

Table 2-1. Degree of undernutrition.

Percentage of Median Weight for Age (%)	Degree of Undernutrition	Recommendation
76–90	Mild	Observe as outpatient
61–75	Moderate	Urgent outpatient evaluation Close weight follow-up
>61	Severe	Hospitalization Nutrition support In-hospital evaluation

- **Moderate undernutrition:** 75% median weight for age. These children warrant immediate evaluation and intervention with close follow-up in an outpatient setting.
- **Severe malnutrition:** <61% median weight for age. These children may require hospitalization for evaluation and nutritional support.

Failure to thrive is one of the most common diagnoses of early childhood in the United States. It affects all socioeconomic groups, but children in poverty are more likely to be affected and more likely to suffer long-term sequelae. Ten percent of children in poverty meet criteria for FTT. As many as 30% of children presenting to emergency departments for unrelated complaints can be diagnosed with FTT. This group of children is of most concern. They are least likely to have good continuity of care and most likely to suffer additional developmental insults such as social isolation, tenuous housing situations, and neglect. Because FTT is most prevalent in at-risk populations that are least likely to have good continuity of care it is crucial to address growth parameters at every visit, both sick and well. Many children with FTT may not present for well-child visits. If that is the only visit at which the clinician considers growth, then many opportunities for meaningful intervention may be lost.

Pathogenesis

All FTT is caused by undernutrition. The mechanism varies. The child may have increased caloric requirements because of organic disease. The child may have inadequate intake because not enough food is made available, or there may be mechanical difficulty in eating. Also, adequate calories may be provided, but the child may be unable to utilize them either because the nutrients cannot be absorbed across the bowel wall or because of inborn errors of metabolism.

When diagnosing FTT it is essential to consider the etiology. Over the past decades FTT has been better understood as a mixed entity in which both organic disease and psychosocial factors influence each other. With this understanding, the old belief that a child who gains weight in the hospital has nonorganic FTT has been debunked.

A. Organic FTT

Organic causes are identified in 10% of children with FTT. In-hospital evaluations reveal an underlying organic etiology in about 30% of children. The data are misleading. More than two-thirds of these children are diagnosed with gastroesophageal reflux disease (GERD). The practitioner risks one of two errors in diagnosing GERD as the source of failure to thrive. Physiological reflux is found in at least 70% of infants. It may be a normal finding in an infant who is failing to thrive for other reasons. Further, undernutrition causes decreased lower esophageal segment (LES) tone, which may lead to reflux as an effect rather than a cause of FTT.

B. Nonorganic FTT

Nonorganic FTT, weight loss in which no physiological disease is identified, constitutes 80% of cases. Historically, the responsibility for this diagnosis fell on the caregiver. The caregiver was either unable to provide enough nutrition or emotionally unavailable to the infant. In either circumstance the result was unsuccessful feeding. Psychosocial stressors were thought to create a neuroendocrine milieu preventing growth even when calories were available. Increased cortisol and decreased insulin levels in undernourished children inhibit weight gain.

C. Mixed FTT

Most FTT is *mixed*. There is a transaction between both physiological and psychosocial factors that creates a vicious cycle of undernutrition. For example, a child with organic disease may initially have difficulty eating for purely physiological reasons. However, over time, the feedings become fraught with anxiety for both parents and child and are even less successful. The child senses the parents' anxiety and eats less and more fretfully than before. The parents, afraid to overtax the "fragile" child, may not give the child the time needed to eat. They may become frustrated that they are not easily able to accomplish this most basic and essential care for the child. Parents of an ill child may perceive that other aspects of care are more important than feeding, such as strict adherence to a medication or therapy regimen.

Children with organic disease underlying FTT often gain weight in the hospital when fed by emotionally uninvolved parties such as nurses, volunteers, or physicians. Weight gain in the hospital should not be mistaken for parental neglect in the home. The primary care provider should pay close attention to the psychosocial stressors on the feeding dyad.

Conversely, the child who seems to be failing to thrive for purely psychosocial reasons often has complicating organic

issues. The undernourished child is lethargic and irritable, especially at feeding times. Undernutrition decreases LES tone and may worsen reflux. The undernourished child is more difficult to feed and retains fewer calories. Poor nutrition adversely affects immunity. Children with FTT often have recurrent infections that increase their caloric requirements and decrease their ability to meet them.

The mixed model reminds the clinician that FTT is an interactive process involving physiologic and psychosocial elements and, more importantly, both caregiver and child. A fussy child may be more difficult for a particular parent to feed. A "good" or passive baby may not elicit enough feeding. Physical characteristics also affect parent-child relationships; organic disease may not only make feeding difficult but may engender a sense of failure or disappointment in the parent. It is crucial to remember that caregivers have unique relationships with each of their children. Therefore, a parent whose first child is diagnosed with FTT is not doomed to repeat the cycle with the second child. Conversely, an experienced caregiver who has fed previous children successfully may care for a child with FTT.

Prevention

Failure to thrive may be prevented by good communication between the primary care provider and the family. The practitioner should regularly assess feeding practices and growth and educate parents about appropriate age-specific diets. As a general rule, infants who are feeding successfully gain about:

- 30 g/d at 0–3 months
- 20 g/d at 3–6 months
- 15 g/d at 6–9 months
- 12 g/d at 9–12 months
- 8 g/d at 1–3 years

In addition, growth parameters need to be recorded at every visit, sick or well. Weight should be documented for all children. Recumbent length is measured for children younger than 2 years old. Height is measured for children older than 3 years old. Between the ages of 2 and 3 years either height or length may be recorded. Length measurements exceed heights by an average of 1 cm. With a good growth chart in hand, the primary care provider can monitor growth and intervene early if problems arise.

Clinicians should investigate the economic stresses on families to ensure adequate access to nutrition for the family.

Clinical Findings

A. Symptoms and Signs

The importance of a complete, long-term growth curve in making the diagnosis of FTT cannot be overemphasized. In acute undernutrition, the velocity of weight gain decreases while height velocity continues to be preserved. The result is a thin child of normal height. Chronic undernutrition manifests as "stunting"; both height and weight are affected. The child may appear proportionately small. Review of a growth curve may reveal that weight was initially affected and increase the suspicion for FTT. In interpreting growth charts, it is important to remember that healthy children may cross up to two major percentile lines up to 39% of the time between birth and 6 months of age and up to 15% of the time between 6 and 24 months of age. Children with length above the 50th percentile seldom have endocrine disease.

Children should be plotted on an appropriate growth curve. Growth curves are gender-specific and are available at the CDC website. Growth curves should not be used for specific countries of origin. Specific growth curves are available for children with genetic disorders such as trisomy 21 (Down syndrome) or Turner syndrome. However, these curves are not well validated. These curves draw from a small group of children, and the nutritional status of the participants was not assessed. These curves may be useful for the clinician in discussing an affected child's growth potential with the child's family.

B. History

1. General history—The clinician's most valuable tool in the diagnosis of FTT is the history. While taking the history, health care providers have the opportunity to establish themselves as the child's advocate and the parents' support. Care must be exercised to avoid establishing an adversarial relationship with the parents. It is useful to begin by asking the parents their perception of their child's health. Many parents do not recognize FTT until the clinician brings it to their attention.

The history and physical examination can uncover significant organ dysfunction contributing to growth failure. For example, the child who feeds poorly may have a physical impediment to caloric intake such as cleft palate or painful dental caries. Poor suck (ie, inadequate ability to suck) may also raise concerns for neurological disease. Recurrent upper or lower respiratory tract infections may suggest cystic fibrosis (CF), human immunodeficiency virus (HIV), or immunodeficiency. Sweating during feeding should prompt consideration of an underlying cardiac problem even in the absence of cyanosis. Chronic diarrhea can indicate malabsorption. Symptoms of chronic infection, eosinophilic disease, celiac disease, and pancreatic insufficiency should be elicited.

The health care provider must elicit more subtle aspects of past medical history as well, focusing particularly on developmental history and intercurrent illnesses. Delay in achievement of milestones should prompt a close neurologic examination. Inborn errors of metabolism and cerebral palsy can present with growth failure. A history of recurrent serious

illness and FTT may be the only indicators of inborn errors of metabolism. Recurrent febrile illness without a clear source may also indicate occult urinary tract infection. A history of snoring or sleep disturbances should prompt an evaluation for tonsillar and adenoidal hypertrophy, which has been identified as a cause of FTT.

Past medical history must include a complete perinatal history (**Table 2-2**). Children with lower birth weights and those with specific prenatal exposures are at higher risk for growth problems. Of all children with diagnosed FTT, 40% have birth weights below 2500 g; only 7% of all births are below 2500 g.

Table 2-2. History taking.

Questions	Differential
Perinatal Infection Movement	 Congenital infection Genetic disorders
Feeding behavior Diaphoresis Poor suck, swallow Length of feedings	 Cardiac problem Neurologic, mechanical (submucosal cleft)
Diet history Infant Breastfeeding: time of nursing, sensation of letdown, fullness of breasts Formula fed: assess how parents are mixing formula, feeding techniques Older children 24-hour diet history Prospective 72-hour diet diary Dysphagia	Inadequate milk production Inappropriate diet Inappropriate interaction to stimulate feeding Inappropriate caloric intake Eosinophilic or allergic disorder reflux
Growth history Onset in infancy Onset of FTT after addition of solids Onset after infancy, recent drop	Genetic disorder: CF, syndromic, metabolic, urinary tract anomalies Celiac, eosinophilic Inflammatory bowel disease, celiac
Stooling history Diarrhea Constipation	Malabsorption: celiac, inflammatory bowel disease, eosinophilic enteritis Maldigestion: pancreatic insufficiency Cystic fibrosis, undernutrition, celiac
Voiding history	Poor stream in boys: posterior urethral valves

Low birth weight may be caused by infection, drug exposure, or other maternal and placental factors. The child with symmetric growth retardation is of particular concern. Infants exposed *in utero* to rubella, cytomegalovirus (CMV), syphilis, toxoplasmosis, or malaria are at high risk for low birth weight, length, and head circumference. These measurements portend poor catchup growth potential. Short stature is often accompanied by developmental delay and mental retardation in these children.

Children with asymmetric intrauterine growth retardation (preserved head circumference) have better potential for catchup growth and appropriate development. Fetal growth is affected by both maternal factors and exposure to toxins. Drugs of abuse such as tobacco, cocaine, and heroin have been correlated with low birth weight. Placental insufficiency caused by hypertension, preeclampsia, collagen vascular disease, or diabetes may result in an undernourished baby with decreased birth weight. Finally, intrauterine physical factors may reduce fetal growth; uterine malformation, multiple gestation, and fibroids may all contribute to smaller babies.

Maternal HIV infection is also a significant risk factor for FTT. Most children born to HIV-positive mothers have normal birth weights and lengths. However, children who are infected frequently develop FTT within the first year of life.

Family history is essential. A family history of atopy, eczema, or asthma raises the suspicion of eosinophilic enteritides. A family history of autoimmune disease should heighten the concern for celiac disease. Metabolic diseases are generally recessive, and an absence of family history should not be regarded as reassuring.

An examination of the family's relationships with the child and one another can uncover valuable information. Children described as "difficult" or "unpredictable" by their mothers have been noted to be slow or poor feeders by independent observers. Maternal depression and history of abuse are strong risk factors for FTT; addressing these issues is integral to establishing a functional feeding relationship between parent and child. Finally, a thorough assessment of economic supports may reveal that nutritious foods are unobtainable or difficult to access. Social financial supports are often inadequate to meet children's needs. Tenuous housing or homelessness may make it impossible to keep appropriate foods readily available.

2. Feeding history—A careful feeding history is part of the history of present illness. It often sheds more light on the problem than a battery of laboratory tests. When assessing an infant, it is essential to know what formula the infant is taking, in what volume, and how frequently. Caregivers should describe the preparation of formula. Caregivers may be inadvertently mixing dilute formula. In calculating caloric intake, the practitioner should remember that breast milk and formula have 20 cal/oz. Baby foods range from 40 to

120 calories per jar. An 80-cal/4-oz jar is a good average to use when making calculations.

The examiner should ask how long it takes the baby to eat; slow eating may be associated with poor suck or decreased stamina secondary to organic dysfunction. Parental estimation of the infant's suck may also be helpful. Parents should be asked about regurgitation after eating. The clinician should also inquire about feeding techniques. Bottle propping may indicate a poor parent-child relationship or an overtaxed parent.

The breastfed baby merits special mention. The sequelae of unsuccessful breastfeeding are profound. Infants may present with severe dehydration. Parents rarely recognize that the infant is failing to thrive. Mothers are often discharged from the hospital before milk is in and may be unsure about what to expect when initially learning how to breastfeed. The neonatal period is the most critical period in the establishment of breastfeeding. The primary care provider should educate the breastfeeding mother prior to hospital discharge. Milk should be in by day 3 or 4. The neonate should feed at least 8 times in a 24-hour period and should not be sleeping through the night. A "good" baby (an infant who sleeps through the night) should raise concerns of possible dehydration. Breastfed babies should have at least six wet diapers a day. Whereas formula-fed infants may have many stool patterns, the successful breastfed neonate should have at least four yellow seedy stools a day. After 4 weeks of life, the stool pattern may change to once a day or less.

Breastfed babies should be seen within the first week of life to evaluate infant weight and feeding success. Weight loss is expected until day 5 of life. Infants should regain their birth weight by the end of the second week of life. Any weight loss greater than 8% should elicit close follow-up. Weight loss greater than 10–12% should prompt an evaluation for dehydration. Primary care providers should ask about the infant's suck and whether the mother feels that her breasts are emptied at the feeding. The successful infant should empty the mother's breast and be content at the end of the nursing session. When breastfed infants are not gaining weight, it may be useful to observe the breastfeeding or obtain consultation with a lactation specialist.

The evaluation of older children also requires a thorough diet history. An accurate diet history begins with a 24-hour diet recall. Parents should be asked to quantify the amount of each food that their child has eaten. The 24-hour recall acts as a template for a 72-hour diet diary, the most accurate assessment of intake; the first 48 hours of a diet diary are the most reliable. All intakes must be recorded including juices, water, and snacks. The child who consumes an excessive amount of milk or juice may not have the appetite to eat more nutrient-rich foods. A child needs no more than 16–24 oz of milk and should be limited to <12 oz of juice per day.

It is as important to assess mealtime habits as the meals themselves. Activity in the household during mealtime may be distracting to young children. Television viewing may preempt eating. Excessive attention to how much the child eats can increase the tension and ultimately decrease the child's intake. Most toddlers cannot sit for longer than 15 minutes; prolonging the table time in the hopes of increasing the amount eaten may only exacerbate the already fragile parent-child relationship. Many toddlers snack throughout the day, but some are unable to take in appropriate calories with this strategy.

The primary care provider should also discuss the family's beliefs about a healthy diet. Some families have dietary restrictions, either by choice or culturally, that affect growth. Many have read the dietary recommendations for a healthy adult diet, but a low-fat, low-cholesterol diet is not an appropriate diet for a toddler. Until the age of 2 years children should drink whole milk, and their fat intake should not be limited.

C. Physical Examination

In addition to reviewing the growth curve, the clinician must complete a physical examination. A weight, length, or height as appropriate for the child's age, and head circumference are indicated for all children. Growth parameters may be roughly interpreted using the following guidelines:

- **Acute undernutrition**: low weight, normal height, normal head circumference
- **Chronic undernutrition**: short height, normal weight for height, normal head circumference
- **Acute or chronic undernutrition**: short height, proportionately low weight for height, normal head circumference
- **Congenital infection or genetic disorder impairing growth**: short height, normal to low weight for height, small head circumference

The general examination provides a wealth of information. Vital signs should be documented. Bradycardia and hypotension are worrisome findings in the malnourished child and should prompt consideration of immediate hospitalization. It is important to document observations of the parent-child interaction. It is also useful to note both the caregiver's and the child's affects. Parental depression has been associated with higher risk of FTT. Occasionally the examiner may find subtle indications of neglect such as a flat occiput, indicating that the child is left alone for long periods. However, a flat occiput may be a normal finding when caregiver's follow current infant sleeping recommendations.

Children with undernutrition often have objective findings of their nutritional state. Unlike the genetically small child, children with FTT have decreased subcutaneous fat. If undernutrition has been prolonged, they will also have muscle wasting; in infants it is easier to assess muscle wasting in the calves and thighs rather than in the interosseous muscles. It is also important to remember that infants suck rather

than chew; therefore they will not have the characteristic facies of temporal wasting. Nailbeds and hair should be carefully noted as nutritional deficiencies may cause pitting or lines in the nails. Hair may be thin or brittle. Skin should be examined for scaling and cracking, which may be seen with both zinc and fatty acid deficiencies. Presence of eczema may indicate allergic diathesis and eosinophilic enteritis.

The physical examination should be completed with special attention directed to the organ systems of concern uncovered in the history. However, examination of some organ systems may reveal abnormalities not elicited through history. A thorough abdominal examination is of particular importance. Organomegaly in the child with FTT suggests possible inborn errors of metabolism and requires laboratory evaluation. The examiner should note the genitourinary (GU) examination. Undescended testicles may indicate panhypopituitarism, and ambiguous genitalia may indicate congenital adrenogenital hyperplasia (CAH). A careful neurologic examination may reveal subtly increased or decreased muscle tone consistent with cerebral palsy and, therefore, increased caloric requirements or inability to coordinate suck and swallow, respectively.

Children with undernutrition have been repeatedly shown to have behavioral and cognitive delays. Unfortunately, the Denver Development Screen II is an inadequate tool to assess the subtle but real delays in these children. It has been suggested that the Bayley test may be a more sensitive tool when assessing these children. Even with nutritional and social support, behavioral and cognitive lags may not resolve. Children who have suffered FTT remain sensitive to undernutrition throughout childhood; one study found a significant decrease in fluency in children with a remote history of undernutrition when they did not eat breakfast. Children with a normal nutritional history were not found to be similarly affected.

The immune system is affected by nutritional status. Children with FTT may present with recurrent mucosal infections: otitis media, sinusitis, pneumonia, and gastroenteritis. Immunoglobulin A (IgA) production is extremely sensitive to undernutrition. Children with more severe malnutrition may be lymphopenic (lymphocyte count <1500) or anergic.

Undernourished children are frequently iron-deficient, even in the absence of anemia. Iron and calcium deficiencies enhance the absorption of lead. In areas in which there is any concern for lead exposure, lead levels should be assessed as part of the workup for FTT.

D. Laboratory Findings

No single battery of laboratory tests or imaging studies can be advocated in the workup of FTT. Testing should be guided by the history and physical examination. Fewer than 1% of "routine laboratory tests" ordered in the evaluation of FTT provide useful information for treatment or diagnosis.

Tests that had been advocated as markers of nutritional status have limitations. Albumin has an extremely long half-life (21 days) and is a poor indicator of recent undernutrition. Prealbumin, which has been touted as a marker for recent protein nutrition, is decreased in both acute inflammation and undernutrition.

Children with more severe malnutrition may be lymphopenic (lymphocyte count <1500) or anergic.

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Laboratory evaluation is indicated when the history and physical examination suggest underlying organic disease. Children with developmental delay and organomegaly or severe episodic illness should have a metabolic workup, including urine organic and serum amino acids; there is a 5% yield in this subset of patients. Children with a history of recurrent respiratory tract infections or diarrhea should have a sweat chloride testing. A history of poorly defined febrile illnesses or recurrent "viral illness" may be followed up with a urinalysis, culture, and renal function to evaluate for occult urinary tract disease. In children with diarrhea, it may be useful to send stool for *Giardia* antigen, qualitative fat, white blood cell (WBC) count, occult blood, ova and parasites (O&P), rotavirus, and α_1-antitrypsin. Rotavirus has been associated with a prolonged gastroenteritis and FTT. Elevated α_1-antitrypsin in the stool is a marker for protein enteropathy.

For children who develop FTT after the addition of solid foods, an evaluation for celiac disease is warranted regardless of whether diarrhea is present. Fifteen percent of celiac patients present with constipation. Tissue transglutaminase along with a total IgA level may be useful for diagnosis (**Table 2-3**).

Infectious diseases need to be specifically addressed. Worldwide, tuberculosis (TB) is one of the most common causes of FTT. A Mantoux test and anergy panel must be placed on any child with risk factors for TB exposure. The possibility of HIV must also be entertained. FTT is frequently a presenting symptom of HIV in the infant.

Differential Diagnosis

It is essential to differentiate a small child from the child with FTT. No criterion is specific enough to exclude those who are small for other reasons. Included in the differential diagnosis of FTT are familial short stature, Turner syndrome, normal growth variant, prematurity, endocrine dysfunction, and genetic syndromes limiting growth.

The child with FTT has a deceleration in weight first. Height velocity continues unaffected for a time. Children with familial short stature manifest a simultaneous change in their height and weight curves. Height velocity slows first

Table 2-3. Laboratory evaluation.

CBC with differential	Anemia: possible inflammatory bowel disease or celiac Eosinophilia: possible eosinophilic enteritis
CMP	Low albumin: chronic inflammation Elevated transaminases: chronic undernutrition, metabolic disorder Bicarbonate: renal disease
Antigliadin Ab	Children <3 years to evaluate for celiac
Tissue transglutaminase with total IgA	Older children to evaluate for celiac
Urinalysis	Chronic urinary tract infection
Sweat chloride	Cystic Fibrosis

(it can even plateau) in endocrine disorders such as hypothyroidism. The preterm infant's growth parameters need to be adjusted for gestational age; head circumference is adjusted until 18 months, weight until 24 months, and height through 40 months.

The family history is helpful in differentiating the child with FTT from the child with constitutional growth delay or familial short stature. Midparental height, which can be calculated from the family history, is a useful calculation of probable genetic potential:

- **For girls**: (father's height in in − 5 + mother's height)/2 ± 2 in
- **For boys**: (mother's height in in + 5 + father's height)/2 ± 2 in

If the child's current growth curve translates into an adult height that falls within the range of midparental height, reassurance may be offered.

It is most difficult to differentiate the older child with constitutional growth delay from the child with FTT. These children typically have reduced weight for height, as do children with FTT. However, unlike children with FTT, they ultimately gain both weight and height on a steady curve. Family history is often revealing in constitutional growth delay. Querying parents about the onset of their own pubertal signs may seem intrusive, but often gives the clinician the information needed to reassure parents about their child's growth.

Breastfeeding infants may be growing normally and not follow the CDC growth curves. After 4–6 months their weight may decrease relative to their peers. After 12 months their weight may catch up to that of age-matched formula-fed infants. However, a decrease in weight in early infancy is a symptom of unsuccessful breastfeeding and FTT should be considered.

Complications

Developmental delay may persist in children with FTT well past the period of undernutrition. Studies have repeatedly shown that these children, as a group, have more behavioral and cognitive problems in school than their peers, even into adolescence. One caveat about these studies is that many investigators defined FTT by that classic definition: growth failure associated with disordered behavior and development. These studies do not doom every child with FTT to scholastic and social failure, but the clinician must be vigilant and act as the child's advocate. Formal developmental screening is especially important in the child with a history of FTT. Intervention should be offered early rather than waiting "to see if the child catches up." Children with FTT are generally successful but may need specific supports on the road to achieving that success.

Treatment

A. Nutrition

The cornerstone of therapy is nutrition. The goal of treatment is catchup growth. Children with FTT may need 1.5–2 times the usual daily calories to achieve catch-up growth. For an infant this is roughly 150-200 cal/kg per day. There are many formulas for calculating caloric requirements. One simple estimate is:

$$\text{kcal/kg} = 120\ \text{kcal/kg} \times \text{median weight for current height/current weight (kg)}$$

It is important that this nutrition include adequate protein calories. Children with undernutrition require 3 grams of protein per kilogram of body weight per day to initiate catchup growth and may need as much as 5 g/kg. In severe malnutrition the protein needs can double this amount. High-calorie diets should continue until the child achieves an age-appropriate weight for height. Infant formula can often be mixed in a more concentrated way to facilitate caloric intake at a lower volume.

It is almost impossible for any child to take in twice the usual volume of food. Some solutions are to offer higher-calorie formulas (24–30 cal/oz) to infants. For older children it is possible to replace or add higher-calorie foods. Heavy cream may be substituted for milk on cereal or in cooking. Cheese may be added to vegetables. Instant breakfast drinks may be offered as snacks. It is advisable to enlist a dietician in designing a high-calorie diet for the child with FTT. Achieving an effective nutritional plan may require structured trials of meal timing and rewards as well food types, colors, temperatures, and textures.

Tube feedings are sometimes indicated in the child with FTT. Some children may benefit from nighttime feedings through a nasogastric or a percutaneous endoscopic gastrostomy tube. This solution is particularly useful in children with underlying increased caloric requirements, for example,

children with cystic fibrosis and cerebral palsy. Children with mechanical feeding difficulties may also require tube feeding for some period of time. Early intervention with an occupational or speech therapist is recommended for a child who is primarily tube-fed. Without therapy the child may develop oral aversions or fail to develop appropriate oral-motor coordination. Parents need to be educated at the onset of nutritional therapy. Catchup growth is expected within the first month. However, some children may not show accelerated weight gain until after the first 2 weeks of increased nutrition. Children usually gain 1.5 times their daily expected weight gains during the catchup phase. Children's weight improves well before their height increases. This change in body habitus does not indicate overfeeding; rather it indicates successful therapy. It does not matter how quickly the child gains; the composition of weight gain will be 45–65% lean body mass.

B. Medications

Few medications are indicated in the treatment of FTT. Those few are nutritional supports. Children with FTT should be supplemented with iron. Zinc has also been shown to improve linear growth. It is sufficient to supplement children with a multivitamin containing zinc and iron. Vitamin D supplementation should also be considered. Vitamin D replacement is especially important in dark-skinned children and in children who are not regularly exposed to sunlight.

C. Social Support

Social support is essential. The services offered must be tailored to the family and the child. Certainly frequent visits with the primary care provider are useful; weight gain can be measured and concerns addressed. Home visits by social services have been shown to decrease hospitalizations and improve weight gain. Children with developmental delay need early assessment and intervention by the appropriate therapists.

These interventions, if performed early in childhood, have longlasting ramifications throughout the lifespan.

D. Indications for Referral or Hospital Admission

Most FTT can and should be managed by the primary care provider. A trusting relationship between the clinician and the family is an invaluable asset in the treatment of FTT. Parents struggling with the diagnosis often believe that the health care system views them as neglectful. This anxiety creates barriers to open and honest communication about the child's feeding and developmental status. However, suspicions may be allayed when primary care providers enlist themselves as allies in the treatment.

The primary indication for referral is the treatment of an underlying organ dysfunction that requires specialized care. Referral is also warranted when the primary care provider feels that specialized testing is needed, for example, endoscopic biopsies for the further evaluation of celiac disease or eosinophilic enteritis. The clinician may also wish to reevaluate the child who fails to begin catchup growth after 1–2 months of nutritional intervention.

Most children with FTT can be managed in the outpatient setting. A few may need hospitalization at some point during their evaluation. Indications for admission at initial evaluation are bradycardia or hypotension, which often indicate severe malnutrition. Children who are <61% of the median weight for their age should be admitted for nutritional support. Children with FTT who are admitted electively during the usual workweek have a shorter length of stay and less unhelpful lab and imaging studies. Children with hypoglycemia should be admitted. A low serum glucose is worrisome for severe malnutrition and metabolic disease.

If the clinician suspects abuse or neglect, the child should be admitted. About 10% of children with FTT are abused. These children ultimately experience poorer developmental outcomes than other children with FTT if unrecognized. When abuse is documented social services must be involved.

Another group of children who may be considered for hospital admission are those who have failed to initiate catchup growth with outpatient management. A hospital stay of several days will allow the clinician to observe feeding practices and enable the family to internalize the plan of care. Further testing for organ dysfunction may be indicated during this hospitalization. It can also be a time to enlist other health professionals in the treatment plan; occupational therapists and social workers are often helpful allies in the treatment of FTT.

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3 Neonatal Hyperbilirubinemia

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ESSENTIALS OF DIAGNOSIS

- Visible yellowing of the skin, ocular sclera, or both are present in neonatal jaundice; however, because visual estimates of total bilirubin are prone to error, quantitative testing (serum or transcutaneous) should be completed in infants noted to be jaundiced within the first 24 hours of life.
- Risk of subsequent hyperbilirubinemia can be assessed by plotting serum bilirubin levels onto a nomogram; all bilirubin levels should be interpreted according to the infant's age (in hours).

General Considerations

Nearly every infant is born with a serum bilirubin level higher than that of the normal adult. Approximately 60% of newborns are visibly jaundiced during the first week of life. The diagnostic and therapeutic challenge for the physician is to differentiate normal physiologic jaundice from pathologic jaundice, and to institute appropriate evaluation and therapy when necessary.

Several factors are considered as major predictors for the development of severe hyperbilirubinemia among infants of ≥35 weeks' gestation. Among the most significant clinical characteristics associated with severe hyperbilirubinemia are predischarge levels in the high-risk zone on the serum bilirubin nomogram (**Figure 3-1**) and jaundice noted within 24 hours of birth. Other risk factors include various forms of hemolytic disease [eg, ABO incompatibility, glucose-6-phosphate dehydrogenase (G6PD) deficiency], elevated end-tidal carbon monoxide, gestation age of 35–36 weeks, a sibling who required phototherapy, cephalohematoma or significant bruising, exclusive breastfeeding, East Asian race, maternal age ≥25 years, and male gender.

While the American Academy of Pediatrics currently recommends universal predischarge bilirubin screening using total serum bilirubin (TSB) or total cutaneous bilirubin (TcB) measurements, the United States Preventive Services Task Force (USPSTF) determined that the evidence is insufficient to recommend screening infants for hyperbilirubinemia to prevent chronic bilirubin encephalopathy; the American Academy of Family Physicians concurs with the USPSTF position. In clinical practice, however, testing is completed for the vast majority of infants.

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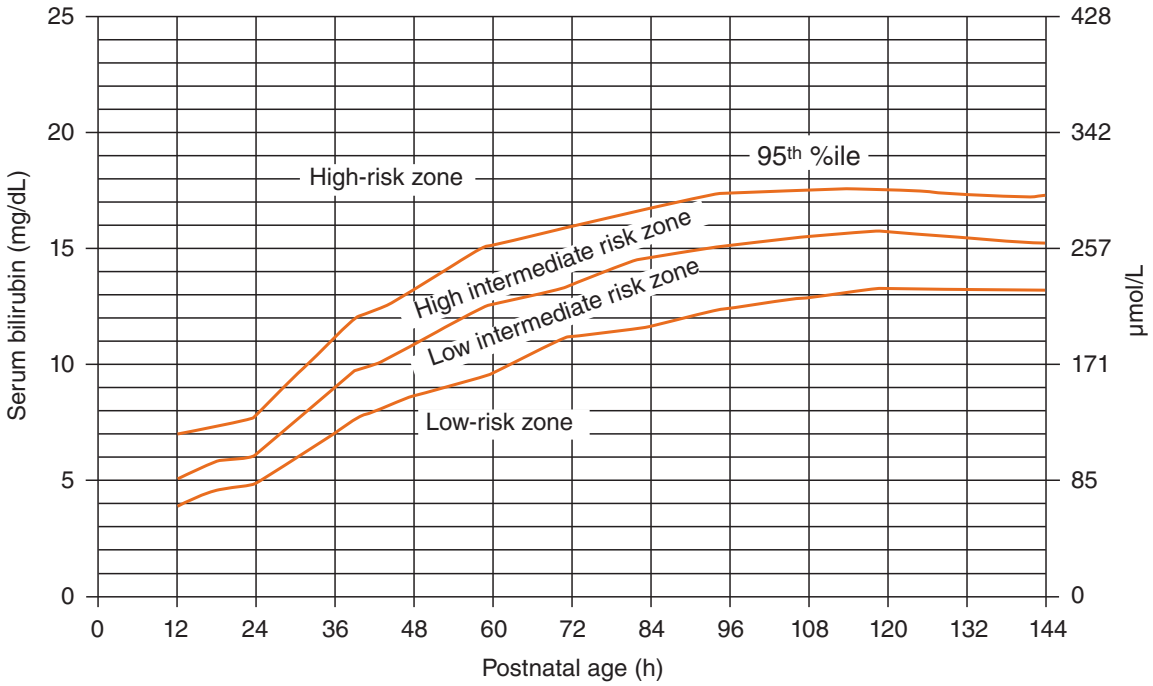
Pathogenesis

A. Physiologic Jaundice

The three classifications of neonatal hyperbilirubinemia are based on the following mechanisms of accumulation: increased bilirubin load, decreased bilirubin conjugation, and impaired bilirubin excretion. In the newborn, unconjugated bilirubin is produced faster and removed more slowly than in the normal adult because of the immaturity of the glucuronyl transferase enzyme system. The main source of unconjugated bilirubin is the breakdown of hemoglobin in senescent red blood cells. Newborns have an increased erythrocyte mass at birth (average hematocrit of 50% vs 33% in the adult) and a shorter lifespan for erythrocytes (90 days vs 120 days in the adult). The newborn cannot readily excrete unconjugated bilirubin, and much of it is reabsorbed by the intestine and returned to the enterohepatic circulation.



▲ **Figure 3-1.** Nomogram for designation of risk in 2840 well newborns of ≥36 weeks' gestational age with birth weight of ≥2000 g or ≥35 weeks' gestational age and birth weight of ≥2500 g based on the hour-specific serum bilirubin value. (*Reproduced with permission from American Academy of Pediatrics Subcommittee on Hyperbilirubinemia. Management of hyperbilirubinemia in the newborn infant 35 or more weeks of gestation. Pediatrics. 2004;114:297.*)

Increased production and decreased elimination of bilirubin lead to a *physiologic jaundice* in most normal newborns. Bilirubin is a very effective and potent antioxidant, and physiologic jaundice may provide a mechanism for protecting the newborn from oxygen free-radical injury. The average full-term white newborn experiences a peak serum bilirubin concentration of 5–6 mg/dL (86–103 µmol/L), which begins to rise after the first day of life, peaks on the third day of life, and falls to normal adult levels by days 10–12. African American infants tend to have slightly lower peaks in serum bilirubin. In Asian infants, serum bilirubin levels rise more quickly than in white infants and tend to reach higher peaks on average (8–12 mg/dL; 135–205 µmol/L). This leads to a longer period of physiologic jaundice among Asian and Native American newborns. Preterm infants (<37 weeks' gestation) of all races may take 4–5 days to reach peak serum bilirubin levels, and these peaks may be twice those observed among full-term infants.

B. Breastfeeding and Breast Milk Jaundice

Infants who are breastfed may experience exaggerated bilirubin levels as a result of two separate phenomena associated with breastfeeding and breast milk.

Breastfed infants may experience relative starvation in the first few days of life, due to delayed release of milk by the mother and/or difficulties with breastfeeding. This nutritional inadequacy can result in increased enterohepatic circulation of bilirubin, leading to elevated serum bilirubin levels in the first few days of life. Termed *breastfeeding jaundice,* this finding is considered abnormal and can be overcome by offering frequent feedings (10–12 times per day) and by avoiding water supplementation in breastfed infants.

Breast milk is believed to increase the enterohepatic circulation of bilirubin; however, the specific factor(s) in breast milk that is (are) responsible for this action is (are) unknown. For the first 5 days of life, the serum bilirubin level in breastfed infants parallels that in nonbreastfed infants. Beginning at approximately day 6, *breast milk jaundice* occurs in breastfed infants as serum bilirubin either rises a little for a few days or declines more slowly. Approximately two-thirds of breastfed infants may be expected to have hyperbilirubinemia from 3 weeks to 3 months of age, with as many as one-third exhibiting clinical jaundice. Breast milk jaundice (unlike breastfeeding jaundice) is considered a form of normal physiologic jaundice in healthy, thriving breastfed infants.

C. Pathologic Jaundice

Exaggerated physiologic jaundice occurs at serum bilirubin levels between 7 and 17 mg/dL (between 104 and

291 μmol/L). Bilirubin levels above 17 mg/dL in full-term infants are no longer considered physiologic, and further investigation is warranted.

The onset of jaundice within the first 24 hours of life or a rate of increase in serum bilirubin exceeding 0.5 mg/dL (8 μmol/L) per hour is potentially pathologic and suggestive of hemolytic disease. Conjugated serum bilirubin concentrations exceeding 10% of total bilirubin or 2 mg/dL (35 μmol/L) are also not physiologic and suggest hepatobiliary disease or a general metabolic disorder.

Differentiating between pathologic and physiologic jaundice requires consideration of historical as well as clinical factors. Important historical features increasing the likelihood that jaundice is pathologic include family history of hemolytic disease, ethnicity suggestive of inherited disease (eg, G6PD deficiency), onset of jaundice in the first 24 hours of life, and jaundice lasting >3 weeks. Clinical assessment requires careful attention to general appearance, vital signs, weight loss, feeding patterns, stool and urine appearance, activity levels, and hepatosplenomegaly, which may be indicative of inborn errors in metabolism, sepsis, or other conditions. A rapid rise in serum bilirubin levels and lack of response to phototherapy are also indicative of pathologic jaundice. Cholestatic jaundice, manifesting as pale-colored stool and dark urine, indicates the need to explore for the presence of biliary atresia or other pathology.

The primary concern with severe hyperbilirubinemia is the potential for neurotoxic effects as well as general cellular injury, which can occur at TSB levels exceeding 20–25 mg/dL. The term *kernicterus* refers to the yellow staining of the basal ganglia observed postmortem among infants who died with severe jaundice. (Bilirubin deposition in the basal ganglia can also be imaged using magnetic resonance techniques.) The American Academy of Pediatrics (AAP) has recommended that the term *acute bilirubin encephalopathy* be used to describe the acute manifestations of bilirubin toxicity seen in the first weeks after birth and that the term *kernicterus* be reserved for the chronic and permanent clinical sequelae of bilirubin toxicity.

Although kernicterus was a common complication of hyperbilirubinemia in the 1940s and 1950s due to Rh erythroblastosis fetalis and ABO hemolytic disease, it is rare today, with the use of Rh immunoglobulin and with the intervention of phototherapy and exchange transfusion. With early discharge to home, however, a small resurgence of kernicterus has been observed in countries in which this complication had essentially disappeared. The reported incidence of chronic kernicterus in the United States is ~1 case/27,000 live births and 1 case/44,000 live births in Canada.

Bilirubin can interfere with various metabolic pathways and may also impair cerebral glucose metabolism. The concentration of bilirubin in the brain and the duration of exposure are important determinants of the neurotoxic effects of bilirubin. Bilirubin can enter the brain when not bound to albumin, so infants with low albumin are at increased risk of developing kernicterus. Conditions that alter the blood-brain barrier such as infection, acidosis, hypoxia, sepsis, prematurity, and hyperosmolarity may affect the entry of bilirubin into the brain.

In infants without hemolysis, serum bilirubin levels and encephalopathy do not correlate well. In infants with hemolysis, TSB levels of >20 mg/dL are associated with worse neurologic outcomes, although some infants with concentrations of 25 mg/dL are normal. Kernicterus has been detected in 8% of infants with associated hemolysis who had TSB levels of 19–25 mg/dL, 33% of infants with levels of 25–29 mg/dL, and 73% of infants with levels of 30–40 mg/dL. It should be noted that the majority of cases of kernicterus described in recent years have been among neonates who had TSB levels of >30 mg/dL at the time of diagnosis, which is well above the recommended treatment thresholds of 15 or 20 mg/dL.

In its acute form, kernicterus (eg, acute bilirubin encephalopathy) may present in the first 1–2 days with poor sucking, stupor, hypotonia, and seizures, although 15% of affected infants may be asymptomatic. During the middle of the first week, hypertonia of extensor muscles, opisthotonus (backward arching of the trunk), retrocollis (backward arching of the neck), and fever may be observed. After the first week, the infant may exhibit generalized hypertonia. Some of these changes disappear spontaneously or can be reversed with exchange transfusion. In most infants with moderate (10–20 mg/dL) to severe (>20 mg/dL) hyperbilirubinemia, evoked neurologic responses return to normal within 6 months. A minority of infants (ranging between 6% and 23%) exhibit persistent neurologic deficits.

In its chronic form, kernicterus may present in the first year with hypotonia, active deep-tendon reflexes, obligatory tonic neck reflexes, dental dysplasia, and delayed motor skills. After the first year, movement disorders, upward gaze, and sensorineural hearing loss may develop. It has been suggested that long-term effects of severe hyperbilirubinemia on intelligence quotient (IQ) are more likely in boys than in girls. Seidman and colleagues studied 1948 subjects from Hadaasah Hebrew University Medical Center in Jerusalem born in 1970–1971 and drafted into the Israeli army 17 years later and found a higher risk of lowered IQ (< 85) among males with a history of TSB exceeding 20 mg/dL [odds ratio (OR) 2.96; 95% confidence interval (CI) 1.29–6.79] (Seidman et al. 1991).

Carceller-Blanchard A, Cousineau J, Delvin EE. Point of care testing: transcutaneous bilirubinometry in neonates. *Clin Biochem.* 2009;42(3). [PMID:18929553]

Kaplan M, Shchors I, Algur N, et al. Visual screening versus transcutaneous bilirubinometry for predischarge. jaundice assessment. *Acta Paediatr.* 2008;97:759–763.

Kuzniewicz M, Newman TB. Interaction of hemolysis and hyperbilirubinemia on neurodevelopmental outcomes in the collaborative perinatal project. *Pediatrics.* 2009;123:3. [PMID: 19255038]
Seidman DS et al. Neonatal hyperbilirubinemia and physical and cognitive performance at 17 years of age. *Pediatrics.* 1991;88:828. [PMID: 1896294]
Sgro M, Campbell DM, Kandasamy S, Shah V. Incidence of chronic bilirubin encephalopathy in Canada, 2007–2008. *Pediatrics.* 2012;130:4. [PMID: 22966025]

Clinical Findings

In 2004, the AAP issued an updated practice parameter for the management of hyperbilirubinemia among newborns of ≥35 weeks' gestation. Elements of these recommendations are summarized below and can be accessed in full at http://www.aap.org.

A. Symptoms and Signs

Clinically, jaundice usually progresses from head to toe. Visual estimates of total bilirubin are prone to error, especially in infants with pigmented skin. TSB or total cutaneous bilirubin (TcB) levels should be measured in infants who develop jaundice within the first 24 hours, and all bilirubin levels should be interpreted according to the infant's age (in hours). TcB measurement devices may provide an alternative to frequent blood draws for the accurate assessment of serum bilirubin, although current guidelines indicate variability in the accuracy of TcB instruments from different manufacturers.

Evaluation of infants who develop abnormal signs such as feeding difficulty, behavior changes, apnea, and temperature changes is recommended regardless of whether jaundice has been detected in order to rule out underlying disease. Clinical protocols for evaluating jaundice, with assessments to be performed no less than every 8–12 hours in the newborn nursery, should be in place.

B. Laboratory Findings

When a pathologic cause for jaundice is suspected, laboratory studies should be promptly completed:

- When jaundice is noticed within the first 24 hours, clinicians should consider a sepsis workup, evaluation for rubella and toxoplasmosis infection, assessment of fractionated serum bilirubin levels, and blood typing to rule out erythroblastosis fetalis. Results of thyroid and galactosemia testing, obtained during the newborn metabolic screening, also should be reviewed.
- If the level of conjugated bilirubin is >2 mg/dL, a reason for impaired bilirubin excretion should be sought. If conjugated bilirubin is <2 mg/dL, hemoglobin levels and reticulocyte counts should be evaluated. A high hemoglobin concentration indicates polycythemia, whereas a low hemoglobin concentration with an abnormal reticulocyte count suggests hemolysis. If the reticulocyte count is normal, the infant must be evaluated for a nonhemolytic cause of jaundice.
- Infants with a poor response to phototherapy and those whose family history is consistent with the possibility of glucose-6-phosphate dehydrogenase (G6PD) deficiency require further testing.
- Maternal prenatal testing should include ABO and Rh (D) typing and a serum screen for unusual isoimmune antibodies. If the mother has not had prenatal blood grouping, or is Rh-negative, a direct Coombs test, blood type, and Rh (D) typing of the infant's cord blood should be performed. Institutions are encouraged to save cord blood for future testing, particularly when the mother's blood type is group O.

C. Neonatal Jaundice after Hospital Discharge

Follow-up should be provided to all neonates discharged less than 48 hours after birth. This evaluation by a health care professional should occur within 2–3 days of discharge.

Approximately one-third of healthy breastfed infants have persistent jaundice beyond 2 weeks of age. A report of dark urine or light-colored stools should prompt a measurement of direct serum bilirubin. If the history and physical examination are normal, continued observation is appropriate. If jaundice persists beyond 3 weeks, a urine sample should be tested for bilirubin, and a measurement of total and direct serum bilirubin should be obtained.

American Academy of Pediatrics Subcommittee on Hyperbilirubinemia. Management of hyperbilirubinemia in the newborn infant 35 or more weeks of gestation. *Pediatrics.* 2004;114:297. [PMID: 15231951]
Maisels MJ, Bhutani VK, et al. Hyperbilirubinemia in the newborn infant ≥35 weeks' gestation: an update with clarification. *Pediatrics.* 2009;124:1193–1198. [PMID: 19786452]

Prediction & Prevention

Shorter hospital stays after delivery limit the time for hospital-based assessment of infant feeding, instruction about breastfeeding, and the detection of jaundice. Hyperbilirubinemia and problems related to feeding are the main reasons for hospital readmission during the first week of life. Among 25,439 infants discharged between 2008 and 2009 from a large medical center in Israel, 143 (0.56%) were readmitted for phototherapy.

Because bilirubin levels usually peak on day 3 or 4 of life, and as most newborns are discharged within 48 hours, most cases of jaundice occur at home. It is therefore important that infants be seen by a health care professional within a few days of discharge to assess for jaundice and overall well-being. This is important in near-term infants (35–36 weeks'

gestation) who are at particular risk for hyperbilirubinemia because of both relative hepatic immaturity and inadequate nutritional intake.

Measuring TSB before discharge and then plotting this value on a nomogram (see **Figure 3-1**) can be useful for predicting the risk of subsequent moderately severe hyperbilirubinemia (>17 mg/dL) and identify neonates for whom close follow-up is warranted. A study of 17,854 live births reported that neonates in the high-risk group (95th percentile for TSB) at 18–72 hours of life had a 40% chance of developing moderately severe hyperbilirubinemia on discharge, whereas for those in the low-risk group (40th percentile for TSB), the probability for subsequently developing moderately severe hyperbilirubinemia was zero.

Bromiker R, Bin-Nun A, Schimmel MS, Hammerman C, Kaplan M. Neonatal hyperbilirubinemia in the low-intermediate-risk category on the bilirubin nomogram. *Pediatrics.* 2012;130(3): e470–e475. [PMID: 22926183]

Kuzniewicz MW, Escobar GJ, Wi S, et al. Risk factors for severe hyperbilirubinemia among infants with borderline bilirubin levels: a nested case-control study. *J Pediatr.* 2008;153:2. [PMID: 18534217]

Treatment

A. Suspected Pathologic Jaundice

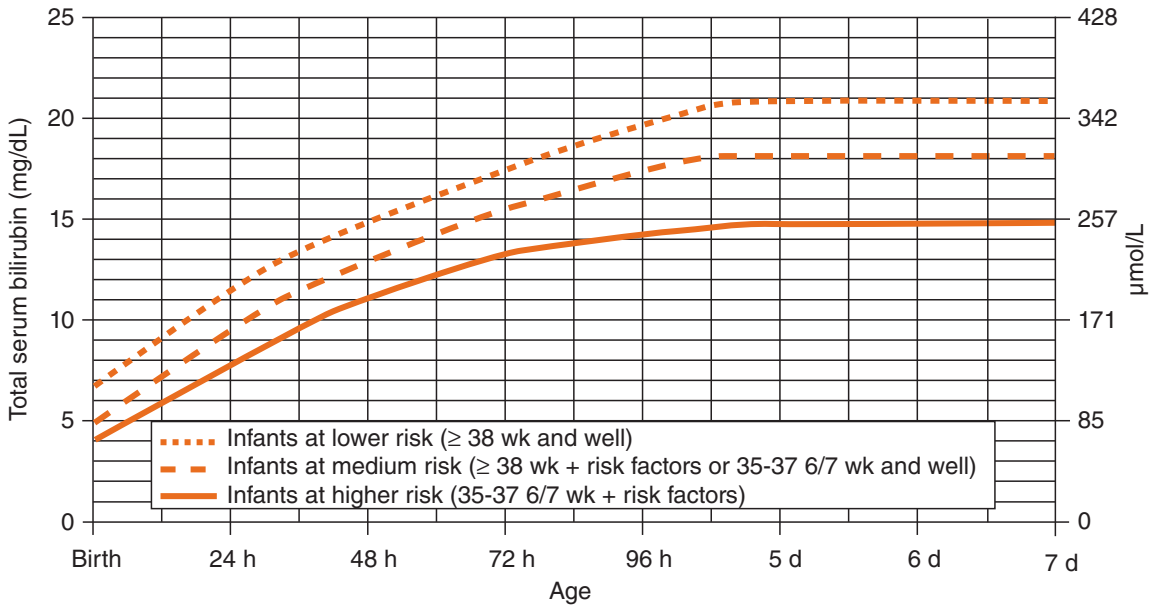
Treatment decisions for both phototherapy (**Figure 3-2**) and exchange transfusion (**Figure 3-3**) are based on TSB levels; management options should be discussed with the parents or guardians of the infant. Intensive phototherapy should produce a decline in TSB of 1–2 mg/dL within 4–6 hours, and the decline should continue thereafter. If the TSB does not respond appropriately to intensive phototherapy, exchange transfusion is recommended. If levels are in a range that suggests the need for exchange transfusion (see **Figure 3-3**), intensive phototherapy should be attempted while preparations for exchange transfusion are made. Exchange transfusion is also recommended in infants whose TSB levels rise to exchange transfusion levels despite intensive phototherapy. In any of the preceding situations, failure of intensive phototherapy to lower the TSB level strongly suggests the presence of hemolytic disease or other pathologic processes and strongly warrants further investigation or consultation.

In infants with isoimmune hemolytic disease, administration of intravenous gamma globulin (0.5–1 g/kg over 2 hours) is recommended if the TSB is rising despite intensive phototherapy or the TSB is within 2–3 mg/dL of the exchange level. If necessary, this dose can be repeated in 12 hours.

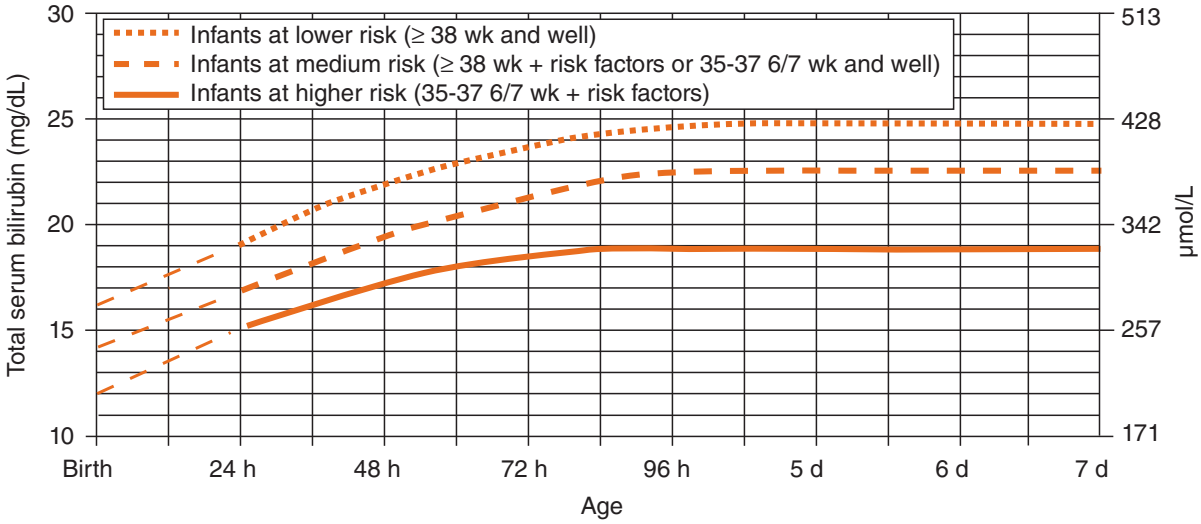
Figure 3-2 summarizes the management strategy for hyperbilirubinemia in infants of ≥35 weeks' gestation. Management decisions regarding phototherapy and exchange transfusion (see **Figure 3-3**) are based on the infant's age, risk factors, and TSB levels.

B. Phototherapy and Exchange Transfusion

1. Phototherapy—This procedure involves exposing the infant to high-intensity light in the blue-green wavelengths. Light interacts with unconjugated bilirubin in the skin,



▲ **Figure 3-2.** Guidelines for phototherapy in hospitalized infants of ≥35 weeks' gestation. (*Reproduced with permission from American Academy of Pediatrics Subcommittee on Hyperbilirubinemia. Management of hyperbilirubinemia in the newborn infant 35 or more weeks of gestation. Pediatrics. 2004;114:297.*)



▲ **Figure 3-3.** Guidelines for exchange transfusion in infants of ≥35 weeks' gestation. (*Reproduced with permission from American Academy of Pediatrics Subcommittee on Hyperbilirubinemia. Management of hyperbilirubinemia in the newborn infant 35 or more weeks of gestation. Pediatrics. 2004;114:297.*)

converting it to less toxic photoisomers that are excreted in the bile and urine without conjugation. The efficacy of phototherapy is strongly influenced by the energy output in the blue spectrum, the spectrum of the light, and the surface area of the infant exposed to phototherapy. Commonly used light sources for providing phototherapy are special blue fluorescent tubes, compact fluorescent tubes, and halogen spotlights; however, light-emitting diodes (LEDs) have been shown to be as efficacious as conventional sources, with less heat emission.

Eye protection is placed on the infant, and the bank of lights is placed 15–20 cm from the naked infant. Exposure is increased by placing a fiberoptic blanket under the infant, lightening units all around the infant, or a white sheet around the bassinet to serve as a reflecting surface. If slight warming of the infant is noted, the tubes can be moved away a bit. Phototherapy may be interrupted briefly for parental visits or breastfeeding.

In infants with TSB levels of >25 mg/dL, phototherapy should be administered continuously until a response is documented, or until exchange therapy is initiated. If the TSB is not responding to conventional phototherapy (a *response* is defined as a sustained reduction in TSB of 1–2 mg/dL in 4–6 hours), the intensity should be increased by adding more lights; the intensity of the lights should also be increased while exchange transfusion is prepared. With commonly used light sources, overdose is impossible, although the infant may experience loose stools. Phototherapy is continued until the TSB level is lower than 14–15 mg/dL. The infant may be discharged after the completion of phototherapy. Rebound of TSB following cessation of phototherapy is usually <1 mg/dL.

2. Exchange transfusion—This procedure rapidly removes bilirubin from the circulation. Circulating antibodies against erythrocytes are also removed. Exchange transfusion is particularly beneficial in neonates with hemolysis. One or two central catheters are placed. Small aliquots of blood (8–10 mL per pass) are removed from the infant's circulation and replaced with equal amounts of donor red cells mixed with plasma. The procedure is repeated until twice the infant's blood volume is replaced (~160–200 mL/kg). Serum electrolytes and bilirubin are measured periodically during the procedure. In some cases the procedure must be repeated to lower serum bilirubin levels sufficiently. Infusing salt-poor albumin at a dose of 1 g/kg 1–4 hours before exchange transfusion has been shown to increase the amount of bilirubin removed during the procedure.

Complications of exchange transfusion include thrombocytopenia, portal vein thrombosis, necrotizing enterocolitis, electrolyte imbalance, graft-versus-host disease, and infection. Mortality from exchange transfusion approaches 2%, and an additional 12% of infants may suffer serious complications. Therefore, exchange transfusion should be reserved for neonates who have failed intensive phototherapy and should be performed by clinicians and facilities with proper experience.

If exchange transfusion is being considered, the bilirubin/albumin ratio is used in conjunction with the TSB level and other factors in determining the need for exchange transfusion (see **Figure 3-3**).

C. Suspected Nonpathologic Jaundice

For the management of breastfeeding jaundice, interruption of breastfeeding in healthy full-term newborns is generally discouraged. Frequent breastfeeding sessions (at least 8–10 times in 24 hours) are advised. However, if the mother and

physician wish, they may consider using supplemental formula feedings or temporarily interrupting breastfeeding and replacing it with formula feedings. Phototherapy may be initiated, depending on TSB levels.

As discussed previously, breast milk jaundice is seen initially after day 6 of life in the majority of healthy breastfed infants between 3 weeks and 3 months of age. This is a form of normal physiologic jaundice.

Bhutani VK, Johns L. Kernicterus in the 21st century: frequently asked questions. *J Perinatol.* 2009; 29:S1. [PMID: 19177056]
Dijk PH, Hulzebos CV. An evidence-based view on hyperbilirubinaemia. *Acta Paediatrica.* 2012; 101:s464 [PMID: 22404885]
Maisels MJ, McDonagh AF. Phototherapy for neonatal jaundice. *N Engl J Med.* 2008;358:920–928. [PMID: 18305267]
Murki S et al. Light emitting diodes versus compact fluorescent tubes for phototherapy in neonatal jaundice: a multi-center randomized controlled trial. *Indian Pediatr.* 2010;47:2. [PMID: 19578227]

Conclusions

Because up to 60% of all newborns are noted to be clinically jaundiced, all family physicians who care for neonates will encounter this common clinical entity. In the overwhelming majority of cases, this jaundice is entirely benign. However, it is important that the family physician recognize cases in which jaundice could represent a pathologic process or the risk for development of severe hyperbilirubinemia.

Infants who are discharged prior to 48 hours of age, particularly those who are born at <35 weeks' gestation, should be seen in the office within 2 days of discharge to evaluate jaundice and overall clinical status.

Parental education should emphasize the need to monitor the infant for jaundice, the generally benign course of most cases of jaundice, and associated symptoms such as poor feeding, lethargy, dark urine, and light-colored stools. Family physicians should encourage parents to contact the office with specific questions and concerns. An example of a parent information sheet in English and Spanish is available at http://www.aap.org/family/jaundicefaq.htm

Maisels MJ, Bhutani VK, et al. Hyperbilirubinemia in the newborn infant ≥35 weeks' gestation: an update with clarification. *Pediatrics.* 2009;124. [PMID: 19786452]
Moerschel SK, Cianciaruso LB, Tracy LR. A practical approach to neonatal jaundice. *Am Fam Physician.* 2008;77:9. [PMID: 18540490]
Moyer VA, et al. Accuracy of clinical judgment in neonatal jaundice. *Arch Pediatric Adolesc Med.* 2000;154:391. [PMID: 1076879]

Breastfeeding & Infant Nutrition

4

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General Considerations

Nutrition is a critical capstone for the proper growth and development of infants. Breastfeeding of term infants by healthy mothers is the optimal mechanism for providing the caloric and nutrient needs of infants. Preterm infants can also benefit from breast milk and breastfeeding, although supplementation and fortification of preterm breast milk may be required. Barring some unique circumstances, human breast milk can provide nutritional, social, and motor developmental benefits for most infants.

Despite increased emphasis on breastfeeding education, according to the 2012 Breastfeeding Report Card published by the Centers for Disease Control, breastfeeding initiation 6- and 12-month continuance rates rose by only approximately two percentage points. Most women presently of childbearing age were not breastfed and report having no maternal relatives who breastfed their children. Because evidence clearly suggests familial influences in the development of infant feeding practices, practitioners may find it difficult to encourage breastfeeding behaviors among women with no direct familial breastfeeding experience. Efforts to alter knowledge, attitudes, and behaviors regarding breastfeeding must effectively address the numerous psychosocial barriers. Health care providers are critical conduits for maternal and familial education. All members of the health care team, including physicians, midwives, and nurses, are valuable sources of important evidence-based information as well as psychological support for mothers in search of guidance regarding infant feeding practices. Numerous studies have shown the superiority of breast milk and the health advantages that breastfed children have. Literature has shown a lower incidence of diarrheal illness, ear infections, and allergies among breastfed infants Exclusive breastfeeding for at least 4 months in infants at risk for developing atopic disease decreases the cumulative incidence of atopic dermatitis. Lower rates of childhood obesity, type 2 diabetes, sudden infant death syndrome (SIDS), and leukemia have also been associated with breastfeeding. There are likewise financial advantages to breastfeeding. Other, somewhat controversial, investigations suggest higher intelligence among breastfed infants.

There are also maternal benefits to breastfeeding. Mothers who breastfeed are less likely to develop premenopausal breast cancer. An association with decreased rates of type 2 diabetes and ovarian cancer also exists. Studies are also focusing on the relationship between breastfeeding and the rates of postpartum depression and cardiovascular disease. Most importantly, however, is the bonding relationship that breastfeeding promotes between mother and infant.

All major maternal-child health professional organizations recommend exclusive breastfeeding for the first 6 months of life prior to the introduction of age-appropriate solid foods, followed by continued breastfeeding for the next 6 months.

The American Academy of Pediatrics (AAP) Committee on Nutrition recommends breastfeeding for the first year of life with supplemental vitamin D at birth and the addition of supplemental iron at age 4 months and possible addition of fluoride at age 6 months for infants living in regions of fluoride-poor water. Vitamin D supplementation is particularly applicable in regions with limited sunlight and for infants of mothers with decreased daily intake of cow's milk. Further recommendations include delaying introduction of cow's milk until after 1 year and delaying addition of reduced-fat milk until 2 years of age. To this end, new mothers should be encouraged to continue prenatal vitamins containing supplemental iron, calcium, and vitamin D. Supplemental solid foods should be considered at or around 6 months of age once the infant demonstrates appropriate readiness.

Centers for Disease Control and Prevention. *Breastfeeding Report Card-United States, 2012* (http://www.cdc.gov/breastfeeding/data/reprtcard.htm; accessed Jan. 22, 2013).

US Department of Health and Human Services, Healthy People 2010 Objectives for Breastfeeding. *Healthy People 2010 Midcourse Review*. Washington, DC: US Department of Health and Human Services.
Crampton R, Zain-Ul-Abideen M, Whalen B. Optimizing successful breastfeeding in the newborn. *Curr Opin Pediatr*. 2009;21:386–396.

Anatomy of the Human Breast & Breastfeeding

Women are able to produce milk when they reach childbearing age. There is no evidence that breast function, breast milk production, or composition differs among younger women. The principal external structures of the mature human female breast are the nipple, areola, and Montgomery tubercles. The areola is the darker part of the breast, and the nipple is the central most structure through which milk ducts open and milk is expressed. The areola contains the Montgomery tubercles, through which sebaceous and sweat glands (Montgomery glands) open, producing lubricating substances for the nipple.

Underlying structures include adipose tissue, mammary gland cells, and contractile myoepithelial cells surrounding the gland cells (allowing for milk ejection). Milk produced within the alveoli is ejected into the milk ducts, which open out directly to the nipple. It was previously assumed that milk was stored in lactiferous sinuses; however, more recent research has revealed that these sinuses do not exist.

Infant breastfeeding draws the nipple and areola into the mouth, causing elongation of the nipple. The elongated nipple is compressed between the palate and the tongue, and milk is expressed less than 0.05 seconds after the nipple has elongated. Stimulation of the areola is essential for the oxytocin-mediated hormonal cascade that controls milk ejection.

Physiology of Breastfeeding

Two principal hormones are required for breast milk production—oxytocin and prolactin—controlled by the hypothalamic-pituitary axis. Oxytocin production and secretion are regulated by the posterior pituitary and are stimulated by suckling. Oxytocin production in response to suckling is intermittent and stimulates ejection ("letdown") of breast milk. Oxytocin does not appear to affect breast milk production, although numerous stressors can negatively impact breast milk letdown. Evidence suggests that lactogenesis may be delayed and letdown reduced following stressful vaginal delivery or cesarean section.

Milk production is controlled primarily by the release of prolactin. Prolactin is secreted through a feedback loop under dopaminergic control with the primary action on prolactin receptors on mammary epithelium. Suckling likewise stimulates prolactin release. Furthermore, prolactin acts as an inhibitor of ovulation through hormonal feedback control, although breastfeeding is considered a relatively unreliable contraceptive mechanism.

Several additional hormones are required for milk production: cortisol, human growth hormone, insulin, thyroid and parathyroid hormones, and feedback inhibitor of lactation (FIL). Not entirely understood, FIL appears to act at the level of breast tissue to inhibit continued breast milk production when the breast is not completely emptied.

Milk production begins during the postpartum period with prolactin production and concomitant decreased estrogen and progesterone production following placental delivery. Milk production will persist under this hormonal control for the first several days; however, continued milk production beyond the initial 48 hours postpartum requires suckling. Although mothers continue to produce milk between feedings once suckling has initiated the feedback loop, milk production significantly increases during breastfeeding.

Neville MC. Anatomy and physiology of lactation. *Pediatr Clin North Am*. 2001;48:13. [PMID: 11236721]

Breast Milk

A. Stages of Production

Production of human breast milk among healthy mothers who deliver full-term infants occurs in three phases—colostrum, transitional milk, and mature milk. Colostrum is a thick, yellow substance produced during the first several days postpartum. Healthy mothers produce approximately 80–100 mL daily. Colostrum is rich in calcium, antibodies, minerals, proteins, potassium, and fat-soluble vitamins. This milk has immunologic qualities that are vital to the infant, and it possesses gastrointestinal properties to facilitate secretion of meconium. Production of colostrum is followed for the next 5–6 days with transitional milk, which provides essential components more closely resembling mature breast milk. Most women will notice a significant change evidenced by the fullness of their breasts and the change in the consistency of the milk. True milk is white and sometimes has a bluish tint. The consistency is similar to that of cow's milk with a sweet taste. Mature breast milk, produced beginning at or near postpartum day 10, produces key components, discussed in the next section.

Numerous factors may affect the supply of breast milk, including anxiety, medications, maternal nutritional status, amount of sleep, exercise, breastfeeding frequency, tactile stimulation, and fluid intake. Breastfeeding mothers should be encouraged to consume generous amounts of fluids and express breast milk every 2–3 hours. The hormonal feedback loop that controls the production and release of prolactin and oxytocin is initiated by suckling or other tactile stimulation

of the breast. The greater the amount of suckling or other tactile breast stimulation, the greater the milk supply.

B. Components

Mature human breast milk contains protein, carbohydrate, and fat components and provides approximately 20 kcal/oz and 1 g of protein. The principal protein elements of both mature and premature breast milk are casein (40%) and whey (60%). Breast milk contains approximately 2.5 g/L of casein. Also called "curds," this protein forms calcium complexes. Higher concentrations of this protein are found in cow's milk. Whey (approximately 6.4 g/L) is a protein component composed of α-lactalbumin, lactoferrin, lysozyme, immunoglobulins, and albumin.

Free nitrogen, which is vital for amino acid synthesis, is also a significant component of mature breast milk and is integral for multiple biochemical pathways, including production of uric acid, urea, ammonia, and creatinine. It is also a key component of insulin and epidermal growth factor.

Mature breast milk contains ~70 g/L of lactose, the primary carbohydrate. Lactose is composed of galactose and glucose, and its concentration continues to increase throughout breastfeeding. Human milk fat likewise increases with continued breastfeeding. Mature breast milk provides approximately 40 g/L of lactose and includes triacylglycerides, phospholipids, and essential fatty acids.

The principal electrolytes in breast milk are sodium, potassium, magnesium, and calcium. Calcium appears to be mediated through the parathyroid hormone–related protein, which allows for mobilization of calcium stores from bone in otherwise healthy women. Bone calcium levels return to normal after termination of breastfeeding. Sodium and potassium concentrations in breast milk are regulated through corticosteroids.

Iron absorption is particularly high in newborns and infants, although the relative concentration of iron in mature breast milk is low. For infants younger than 6 months of age, the concentration of iron in breast milk is sufficient and supplementation is not necessary; however, recommendations for infants older than 6 months include supplemental iron from green vegetables, meats, and iron-rich cereals. The recommended daily amount of supplemental elemental iron is 1 mg/kg. Iron is an essential component in the synthesis of hemoglobin.

Vitamin K, a lipid-soluble vitamin and an important component in the clotting cascade, is routinely provided in the immediate postpartum period as a 1-mg intramuscular injection. There is evidence that oral vitamin K may produce similar benefit as well as maternal supplementation of 5 mg/d of oral vitamin K for 12 weeks following delivery.

Another lipid-soluble component, vitamin D, is essential for bone formation. Women who have limited exposure to sunlight or suboptimal vitamin D intake will produce little or no vitamin D in breast milk. The recommended daily intake of vitamin D is 400 IU (international units). Practitioners must be cognizant of mothers with special diets (ie, vegetarian diets) whose low vitamin D intake might indicate a need for supplemental vitamin D.

Other elemental minerals in breast milk (eg, zinc, copper, selenium, manganese, nickel, molybdenum, and chromium) are found in trace amounts but nonetheless are essential for a multitude of biochemical processes.

C. Composition of Preterm Breast Milk

The composition of breast milk in mothers of preterm infants is different from that in mothers of term infants. This difference persists for approximately 4 weeks before the composition approaches that of term infant breast milk. The difference in preterm milk composition reflects the increased nutrient demands of preterm infants. Preterm breast milk contains higher concentrations of total and bound nitrogen, immunoglobulins, sodium, iron, chloride, and medium-chain fatty acids. However, it may not contain sufficient amounts of phosphorus, calcium, copper, and zinc. Preterm infants are more likely to require fortification with human milk fortifiers (HMFs) to correct these deficiencies.

Lovelady CA, et al. Effect of exercise on immunologic factors in breast milk. *Pediatrics.* 2003;111:E148. [PMID: 12563088]

Breastfeeding Technique

Preparation for breastfeeding should begin in the preconception period or at the first contact with the patient. Most women choose their method of feeding prior to conception. Psychosocial support and education may encourage breastfeeding among women who might not otherwise have considered it. Evidence for this strategy, however, is anecdotal and requires further investigation.

There are numerous potential supports available to women who are considering feeding behaviors. Practitioners are encouraged to identify members of the patient's support network and provide similar education to minimize the potential barriers posed by uninformed support individuals.

One commonly perceived physical barrier is nipple inversion. Women who have inverted nipples will have difficulty with the latch-on process (discussed later in this section). Nipple shields are relatively inexpensive devices that can draw the nipple out. Manual or electric breast pumps may also be used to draw out inverted nipples, typically beginning after delivery.

Breastfeeding should begin immediately in the postpartum period, ideally in the first 30–40 minutes after delivery. This is easier to accomplish if the infant is left in the room with the mother before being bathed and before the newborn examination is performed. It is also safe to allow breastfeeding before administration of vitamin K and erythromycin ophthalmic ointment.

Certain clinical situations preclude initiation of breastfeeding in the immediate postpartum period (eg, cesarean delivery, maternal perineal repair, maternal or fetal distress). In such cases breastfeeding should be initiated as early as possible. Only when medically necessary should a supplemental feeding be initiated. If a mother has expressed a desire to breastfeed, the practitioner should coordinate an interim feeding plan, emphasizing that bottle feeding not be started. Acceptable alternatives include spoon, cup, or syringe feeding.

Breastfed children commonly feed at least every 2–3 hours during the first several weeks postpartum. Infants should not be allowed to sleep through feedings; however, if necessary, feeding intervals may be increased to every 3–4 hours overnight. The production of breast milk is on a supply-demand cycle. Breast stimulation through suckling and the mechanism of breastfeeding signals the body to produce more milk. When feedings are missed or breasts are not emptied effectively, the feedback loop decreases the milk supply. As the infant grows, feedings every 3–4 hours are acceptable. During growth spurts, the amount of milk needed for the rate of growth often exceeds milk production. Feeding intervals often must be adjusted to growth periods until the milk supply "catches up."

Although feeding intervals may be increased during nighttime periods, a common question becomes when to stop waking the infant for night feedings. Anecdotal evidence suggests that after the first 2 weeks postpartum, in the absence of specific nutritional concerns, the infant can determine its own overnight feeding schedule. Typically, most infants will begin to sleep through the night once they have reached approximately 10 lb.

Positioning of the infant is critical for effective feeding in the neonatal period, allowing for optimal latch-on. In general, infant and mother should face each other in one of the following three positions: the cradle (the most common), the football, or lying side by side. The cradle hold allows the mother to hold the infant horizontally across the front of her chest. The infant's head can be on the left or right side of the mother depending on which side it is feeding. The infant's head should be supported with the crook of the mother's arm. The football hold is performed with the mother sitting on a bed or chair, the infant's bottom against the bed or chair and its body lying next to the mother's side, and the infant's head cradled in her hand. The side position allows the mother to lie on her left or right side with the infant lying parallel to her. Again, the infant's head is cradled in the crook of the mother's elbow. This position is ideally suited for women postcesarean delivery as it reduces the pain associated with pressure from the infant on their incisions. It must be stressed that choice of position is based on mother and infant comfort. It is not unusual to experiment with any or all positions before determining the most desirable. It is likewise not uncommon to find previously undesirable positions more effective and comfortable as the infant grows and the breastfeeding experience progresses. All breastfeeding positions should allow for cradling of the infant's head with the mother's hand or elbow allowing for better head control in the latch-on stage. The infant should be placed at a height (often achieved with a pillow) appropriate for preventing awkward positioning, maximizing comfort, and encouraging latch-on.

Many of the difficulties with breastfeeding result from improper latch-on. Latch-on problems are often the source of multiple breastfeeding complaints among mothers, ranging from breast engorgement to sore, cracked nipples. Many women discontinue breastfeeding secondary to these issues. The latch-on process is governed by primitive reflexes. Stroking the infant's cheek will cause it to turn toward the side on which the cheek was stroked. This reflex is useful if the infant is not looking toward the breast. Tickling the infant's bottom lip will cause its mouth to open wide in order to latch on to the breast. The mother should hold her breast to help position the areola to ease latch-on. It is important that the mother's fingers be behind the areola to prevent a physical barrier to latch-on. Once the infant's mouth is opened wide, the head should be pulled quickly to the breast. The infant's mouth should encompass the entire areola to compress the milk ducts. If this is done improperly, the infant will compress the nipple, leading to pain and eventually cracking, with minimal or no milk expression. The mother should not experience pain with breastfeeding but if it does occur, she should break the suction by inserting a finger into the side of the infant's mouth and then latch the infant on again. This process should be repeated as many times as necessary until proper latch-on is achieved.

One issue that continually concerns parents is whether the infant is receiving adequate amounts of breast milk. Several clinical measures can be used to determine whether infants are receiving enough milk. Weight is an excellent method of assessment. Pre- and postfeed measurement of an infant with a scale that is of high quality and measures to the ounce is a very accurate means of determining weight. The problem is that this type of scale is not available to most families. Weight can also be evaluated on a longer-term basis. Infants should not lose more than ~8% of their birth weight after delivery and should gain this weight back in 2 weeks. Most infants with difficulties, however, will decompensate before this 2-week period. Breastfed infants should be evaluated 2–3 days after discharge, especially if discharged prior to 48 hours postdelivery. A more convenient way to determine the adequacy of the infant's milk intake is through clinical signs such as infant satisfaction postfeeding and bowel and bladder volumes. In most cases infants who are satisfied after feeding will fall asleep. Infants who do not receive enough milk will usually be fussy or irritable or continuously want to suck at the breast, their finger, and so on. Breastfed infants usually will stool after most feeds but at a minimum 5–6 times a day. After the first couple of days, the stool should turn from meconiumlike to a mustard-colored seedy type. If breastfed infants are still passing meconium or do not have an adequate amount of stool,