Nelson Textbook of

PEDIATRICS

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19th Edition

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This edition is dedicated to the leadership, mentorship, and editorial wisdom of Richard E. Behrman. Dick's monumental commitment to the field of pediatrics spans more than five decades as an editor, teacher, researcher, and clinician and has contributed greatly to the growth of the profession and the improved health and well-being of children across the globe. We are privileged to work with Dick and are grateful to him for his steadfast counsel and guidance.

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Assistant Professor, Case Western Reserve University School of Medicine, Rainbow Babies & Children's Hospital, Pediatric Infectious Diseases, RBC, Center for Global Health & Diseases, Cleveland, Ohio
Ascariasis (Ascaris lumbricoides); *Trichuriasis* (Trichuris trichiura); *Enterobiasis* (Enterobius vermicularis); *Strongyloidiasis* (Strongyloides stercoralis); *Lymphatic Filariasis* (Brugia malayi, Brugia timori, *and* Wuchereria bancrofti); *Other Tissue Nematodes; Toxocariasis (Visceral and Ocular Larva Migrans); Trichinosis* (Trichinella spiralis)

Nirupama K. DeSilva, MD
Assistant Professor, Resident Program Director; Director, Pediatric and Adolescent Gynecology, University of Oklahoma-Tulsa, Tulsa, Oklahoma
Breast Concerns

Robert J. Desnick, PhD, MD
Dean for Genetics and Genomics; Professor and Chairman, Department of Genetics and Genomic Sciences, Mount Sinai School of Medicine; Physician-in-Chief, Department of Medical Genetics and Genomics, The Mount Sinai Hospital, New York, New York
Defects in Metabolism of Lipids; Defects in Metabolism of Carbohydrates; The Porphyrias

Gabrielle deVeber, MD
Professor of Paediatrics, University of Toronto; Senior Scientist, Hospital for Sick Children Research Institute; Director, Children's Stroke Program and Staff Neurologist, Division of Neurology, Hospital for Sick Children, Toronto, Ontario, Canada
Pediatric Stroke Syndromes

Esi Morgan DeWitt, MD, MSCE
Assistant Professor, Division of Pediatric Rheumatology, Division of Health Policy and Clinical Effectiveness, Cincinnati Children's Hospital Medical Center, Cincinnati, Ohio
Treatment of Rheumatic Diseases; Sarcoidosis

Chetan Anil Dhamne, MD
Fellow, Pediatric Hematology Oncology, University of Texas MD Anderson Cancer Center, Houston, Texas
Neoplasms of the Kidney

Prof. Anil Dhawan, MD, FRCPCH
Professor of Paediatric Hepatology, Pediatric Liver, GI, and Nutrition Centre, King's College London School of Medicine, King's College Hospital NSH Foundation Trust, Denmark Hill, London
Liver and Biliary Disorders Causing Malabsorption

Harry Dietz III, MD
Victor A. McKusick Professor of Medicine and Genetics, Department of Pediatrics, Institute of Genetic Medicine; Investigator, Howard Hughes Medical Institute, Johns Hopkins University School of Medicine, Baltimore, Maryland
Marfan Syndrome

Lydia J. Donoghue, MD
CHM Department of Pediatric Surgery, Wayne State University, Detroit, Michigan
Tumors of the Digestive Tract

Patricia A. Donohoue, MD
Professor and Chief of Pediatric Endocrinology and Diabetes, Department of Pediatrics, Medical College of Wisconsin, Milwaukee, Wisconsin
Development and Function of the Gonads; Hypofunction of the Testes; Pseudoprecocity Resulting from Tumors of the Testes; Gynecomastia; Hypofunction of the Ovaries; Pseudoprecocity Due to Lesions of the Ovary; Disorders of Sex Development

Mary K. Donovan, RN, CS, PNP
Pediatric Nurse Practitioner, Shriners Hospital for Children, Shriners Burns Hospital, Boston, Massachusetts
Burn Injuries; Cold Injuries

John P. Dormans, MD
Professor of Orthopedic Surgery, Department of Orthopedics, University of Pennsylvania, The Children's Hospital of Philadelphia, Philadelphia, Pennsylvania
Growth and Development; Evaluation of the Child; The Hip; The Spine; The Neck; Common Fractures

Daniel A. Doyle, MD
Associate Professor of Pediatrics, Thomas Jefferson University, Philadelphia, Pennsylvania; Staff Endocrinologist, Alfred I. duPont Hospital for Children, Wilmington, Delaware
Hormones and Peptides of Calcium Homeostasis and Bone Metabolism; Hypoparathyroidism; Pseudohypoparathyroidism (Albright Hereditary Osteodystrophy); Hyperparathyroidism

Jefferson Doyle, MBBChir, MHS, MA(Oxon)
Post-Doctoral Fellow, Institute of Genetic Medicine, Johns Hopkins University School of Medicine, Baltimore, Maryland
Marfan Syndrome

Stephen C. Dreskin, MD, PhD
Professor of Medicine and Immunology, Division of Allergy and Clinical Immunology, University of Colorado School of Medicine, Aurora, Colorado
Urticaria (Hives) and Angioedema

Denis S. Drummond, MD, FRCS(C)
The Children's Hospital of Philadelphia, Professor of Orthopaedic Surgery, University of Pennsylvania, Philadelphia, Pennsylvania
Arthrogryposis

Howard Dubowitz, MD, MS
Professor of Pediatrics; Director, Center for Families; Chief, Division of Child Protection, Department of Pediatrics, University of Maryland School of Medicine, Baltimore, Maryland
Abused and Neglected Children

J. Stephen Dumler, MD
Professor, Division of Medical Microbiology, Department of Pathology, Johns Hopkins University School of Medicine, Johns Hopkins Hospital, Baltimore, Maryland
Spotted Fever and Transitional Group Rickettsioses; Scrub Typhus (Orientia tsutsugamushi); *Typhus Group Rickettsioses; Ehrlichioses and Anaplasmosis; Q Fever* (Coxiella burnetii)

Janet Duncan, RN, MSN, CPNP, CPON
Nursing Director, Pediatric Palliative Care Division, Children's Hospital Boston and Dana-Farber Cancer Institute, Boston, Massachusetts
Pediatric Palliative Care

Paula M. Duncan, MD
Professor, Department of Pediatrics, University of Vermont, Burlington, Vermont
Maximizing Children's Health: Screening, Anticipatory Guidance, and Counseling

LauraLe Dyner, MD
Assistant Professor, Lucile Packard Children's Hospital at Stanford, Stanford University, Palo Alto, California
Central Nervous System Infections; Brain Abscess

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Associate Professor of Internal Medicine and Pediatrics, Divisions of Adult Cardiovascular Medicine and Pediatric Cardiology, Children's Hospital of Wisconsin, Medical College of Wisconsin, Milwaukee, Wisconsin
Congenital Heart Disease in Adults

Elizabeth A. Edgerton, MD, MPH, FAAP
Division of Emergency Medicine, Children's National Medical Center, Washington, District of Columbia
Interfacility Transport of the Seriously Ill or Injured Pediatric Patient

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Associate Professor, Departments of Pediatrics and Cellular and Molecular Physiology, Yale School of Medicine, New Haven, Connecticut
Cystic Fibrosis

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Associate Director, Vattikuti Urology Institute; Chief of Urology, Henry Ford Health System, Department of Urology, Children's Hospital of Michigan, Detroit, Michigan; Clinical Professor of Urology, Case Western Reserve University School of Medicine, Cleveland, Ohio
Congenital Anomalies and Dysgenesis of the Kidneys; Urinary Tract Infections; Vesicoureteral Reflux; Obstruction of the Urinary Tract; Anomalies of the Bladder; Neuropathic Bladder; Voiding Dysfunction; Anomalies of the Penis and Urethra; Disorders and Anomalies of the Scrotal Contents; Trauma to the Genitourinary Tract; Urinary Lithiasis

Sara B. Eleoff, MD
Clinical Instructor in Pediatrics, University of Rochester School of Medicine and Dentistry, Rochester, New York
Foster and Kinship Care

Dianne S. Elfenbein, MD
Professor of Pediatrics, Clinical Educator, St. Louis University School of Medicine; Director of Adolescent Medicine, Cardinal Glennon Children's Medical Center, Department of Pediatrics, St. Louis, Missouri
Adolescent Pregnancy

Stephen C. Eppes, MD
Professor of Pediatrics, Jefferson Medical College; Division Chief, Pediatric Infectious Diseases, Alfred I. duPont Hospital for Children, Wilmington, Delaware
Lyme Disease (Borrelia burgdorferi)

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Assistant Professor of Pediatrics, Harvard Medical School, Pediatric Emergency Medicine/Toxicology, Children's Hospital Boston, Boston, Massachusetts
Poisonings

Jessica K. Fairley, MD
Fellow, Division of Infectious Diseases and HIV Medicine, Case Western Reserve University School of Medicine, University Hospitals Case Medical Center, Cleveland, Ohio
Health Advice for Children Traveling Internationally

Susan Feigelman, MD
Associate Professor, Department of Pediatrics, University of Maryland School of Medicine, Baltimore, Maryland
Overview and Assessment of Variability; The First Year; The Second Year; The Preschool Years; Middle Childhood

Marianne E. Felice, MD
Professor and Chair, Department of Pediatrics, University of Massachusetts Medical School; Physician-in-Chief, UMass Memorial Children's Medical Center, Worcester, Massachusetts
Adolescent Pregnancy; Adolescent Rape

Eric I. Felner, MD, MSCR
Associate Professor of Pediatrics, Division of Pediatric Endocrinology, Children's Healthcare of Atlanta (CHOA); Director, Pediatric Endocrinology Fellowship Program, Emory University School of Medicine; Adjunct Associate Professor of Chemical and Biomolecular Engineering, School of Chemical and Biomolecular Engineering, Georgia Institute of Technology, Atlanta, Georgia
Hormones of the Hypothalamus and Pituitary; Hypopituitarism

Edward Fels, MD
Pediatric and Adult Rheumatology, Rheumatology Associates, P.A., Portland, Maine
Vasculitis Syndromes

Thomas Ferkol, MD
Professor of Pediatrics, Cell Biology and Physiology, Washington University School of Medicine in St. Louis, St. Louis, Missouri
Primary Ciliary Dyskinesia (Immotile Cilia Syndrome)

Jonathan D. Finder, MD
Professor of Pediatrics, University of Pittsburgh School of Medicine; Clinical Director, Division of Pulmonology Medicine, Children's Hospital of Pittsburgh, Pittsburgh, Pennsylvania
Bronchomalacia and Tracheomalacia; Congenital Disorders of the Lung

Kristin N. Fiorino, MD
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Motility Disorders and Hirschsprung Disease

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Associate Professor of Clinical Pediatrics, Pediatrics, Temple University School of Medicine, Philadelphia, Pennsylvania
Sporotrichosis (Sporothrix schenckii)

Patricia M. Flynn, MD
Member, Department of Infectious Diseases, St. Jude Children's Research Hospital; Professor, Departments of Pediatrics and Preventive Medicine, University of Tennessee Health Science Center, Memphis, Tennessee
Infection Associated with Medical Devices; Cryptosporidium, Isospora, Cyclospora, *and Microsporidia*

Joel A. Forman, MD
Associate Professor, Departments of Pediatrics and Preventive Medicine; Vice-Chair for Education and Residency Program Director, Department of Pediatrics, Mount Sinai School of Medicine, New York, New York
Chemical Pollutants

Michael M. Frank, MD
Samuel L. Katz Professor of Pediatrics, Professor of Medicine and Immunology, Duke University Medical Center, Durham, North Carolina
Urticaria (Hives) and Angioedema

Melvin H. Freedman, MD, FRCPC, FAAP
Professor Emeritus, Department of Pediatrics, University of Toronto Faculty of Medicine; Honorary Consultant, Hematology-Oncology, Hospital for Sick Children, Toronto, Ontario, Canada
The Inherited Pancytopenias

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Assistant Professor of Pediatrics, University of Texas Health Science Center at San Antonio, Division of Hematology-Oncology, CHRISTUS Santa Rosa Children's Hospital, San Antonio, Texas
Hemoglobinopathies

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New York State/American Program, Sackler School of Medicine, Tel Aviv University, Tel Aviv, Israel
Leg-Length Discrepancy

Sheila Gahagan, MD, MPH
Professor and Chief, Child Development and Community Health, Martin Stein Endowed Chair, Developmental-Behavioral Pediatrics, University of California, San Diego, California; Research Scientist, Center for Human Growth and Development, University of Michigan, Ann Arbor, Michigan
Overweight and Obesity

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Assistant Professor, Department of Family Medicine, Boston University Medical Center, Boston, Massachusetts
Herbs, Complementary Therapies, and Integrative Medicine

Luigi Garibaldi, MD
Professor of Pediatrics; Clinical Director, Division of Pediatric Endocrinology, Children's Hospital of the University of Pittsburgh Medical Center, Pittsburgh, Pennsylvania
Physiology of Puberty; Disorders of Pubertal Development

Gregory M. Gauthier, MD, MS
Assistant Professor (CHS), Department of Medicine, Section of Infectious Diseases, University of Wisconsin–Madison, Madison, Wisconsin
Blastomycosis (Blastomyces dermatitidis)

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Professor & Chief, Division of Pediatric Rheumatology, Department of Pediatrics, Children's Hospital of New Orleans, New Orleans, Louisiana
Behçet Disease; Sjögren Syndrome; Hereditary Periodic Fever Syndromes; Amyloidosis

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Respiratory Care, Children's Hospital of Michigan, Detroit, Michigan
Long-Term Mechanical Ventilation in the Acutely Ill Child

Michael A. Gerber, MD
Cincinnati Children's Hospital Medical Center, Division of Infectious Diseases, Cincinnati, Ohio
Group A Streptococcus; Non–Group A or B Streptococci

K. Michael Gibson, PhD, FACMG
Professor and Chair, Department of Biological Sciences, Michigan Technological University, Houghton, Michigan
Genetic Disorders of Neurotransmitters

Mark Gibson, MD
Obstetrics and Gynecology, University of Utah School of Medicine, Salt Lake City, Utah
Polycystic Ovary Syndrome and Hirsutism

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Professor of Pediatrics, Chief of Infectious Diseases; Associate Chair for Academic Affairs, Department of Pediatrics, Infectious Diseases, Microbiology and Immunology, University of Rochester Medical Center, Rochester, New York
Pneumocystis jirovecii

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Associate Professor in Child Psychiatry and Psychology, Yale School of Medicine, Child Study Center, New Haven, Connecticut
Child Care: How Pediatricians Can Support Children and Families

Janet R. Gilsdorf, MD
Robert P. Kelch Research Professor and Director, Pediatric Infectious Diseases, University of Michigan Medical Center, Ann Arbor, Michigan
Neisseria meningitidis *(Meningococcus)*

Charles M. Ginsburg, MD
Marilyn R. Corrigan Distinguished Chair in Pediatric Research; Senior Associate Dean, University of Texas, Southwestern Medical Center, Dallas, Texas
Animal and Human Bites

Frances P. Glascoe, MD, PhD
Department of Pediatrics, Vanderbilt University, Mertztown, Pennsylvania
Developmental-Behavioral Screening and Surveillance

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Professor of Pediatrics, Harvard Medical School; Professor of Immunology and Infectious Diseases, and Epidemiology, Harvard School of Public Health; Senior Associate in Infectious Diseases, Children's Hospital Boston, Boston, Massachusetts
Diagnostic Microbiology

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Division of Critical Care Medicine, Children's Memorial Hospital, Northwestern University Feinberg School of Medicine, Chicago, Illinois
Wheezing, Bronchiolitis, and Bronchitis

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Professor and Chief, Pediatric Emergency Medicine, Medical College of Wisconsin, Children's Corporate Center, Milwaukee, Wisconsin
Evaluation of the Sick Child in the Office and Clinic

Gary J. Gosselin, MD
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Habit and Tic Disorders; Pervasive Developmental Disorders and Childhood Psychosis

Jane M. Gould, MD
Attending Physician/Hospital Epidemiologist/Assistant Professor of Pediatrics, Pediatrics/Section of Infectious Diseases, Drexel University School of Medicine/St. Christopher's Hospital for Children, Philadelphia, Pennsylvania
Cryptococcus neoformans; *Histoplasmosis* (Histoplasma capsulatum); Paracoccidioides brasiliensis; *Zygomycosis (Mucormycosis)*

Olivier Goulet, MD, PhD
Professor of Pediatrics, Pediatric Gastroenterology-Hepatology and Nutrition, Reference Center for Rare Digestive Diseases, Intestinal Failure Rehabilitation Center, Hôpital Necker-Enfants Malades/AP-HP, University of Paris V—René Descartes, Paris, France
Other Malabsorptive Syndromes

Dan M. Granoff, MD
Clorox Endowed Chair for Immunobiology and Vaccine Development, Senior Research Scientist and Director, Center for Immunobiology and Vaccine Development, Children's Hospital Oakland Research Institute, Oakland, California
Neisseria meningitidis *(Meningococcus)*

Michael Green, MD, MPH
Professor of Pediatrics, Surgery and Clinical & Translational Science, University of Pittsburgh School of Medicine, Division of Infectious Diseases, Children's Hospital of Pittsburgh, Pittsburgh, Pennsylvania
Infections in Immunocompromised Persons

Thomas P. Green, MD
Founder's Board Centennial Professor and Chair, Department of Pediatrics, Northwestern University Medical School, Children's Memorial Hospital, Chicago, Illinois
Diagnostic Approach to Respiratory Disease; Chronic or Recurrent Respiratory Symptoms; Pulmonary Edema

Larry A. Greenbaum, MD, PhD
Director, Division of Pediatric Nephrology, Emory University and Children's Healthcare of Atlanta, Atlanta, Georgia
Rickets and Hypervitaminosis D; Vitamin E Deficiency; Vitamin K Deficiency; Micronutrient Mineral Deficiencies; Electrolyte and Acid-Base Disorders; Maintenance and Replacement Therapy; Deficit Therapy

Marie Michelle Grino, MD
Pediatrics, University of Texas Medical Branch, Department of Pediatrics, Galveston, Texas
Aspartic Acid (Canavan Disease)

Andrew B. Grossman, MD
Clinical Assistant Professor of Pediatrics, University of Pennsylvania School of Medicine; Attending Physician, Division of GI, Hepatology, and Nutrition, The Children's Hospital of Philadelphia, Philadelphia, Pennsylvania
Inflammatory Bowel Disease; Eosinophilic Gastroenteritis

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Senior Investigator, Group Health Research Institute; Professor, Health Services; Adjunct Professor, Pediatrics, University of Washington, Seattle, Washington
Injury Control

Alfredo Guarino, MD
Professor of Pediatrics, University of Naples "Federico II"; Chief, Division of Infectious Disease, Department of Pediatrics, University of Naples "Federico II," Naples, Italy
Chronic Diarrhea

Lisa R. Hackney, MD
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Hereditary Stomatocytosis; Enzymatic Defects

Gabriel G. Haddad, MD
Chairman, Department of Pediatrics; Professor of Pediatrics & Neurosciences; Physician-in-Chief & Chief Scientific Officer, Rady Children's Hospital-San Diego, Department of Pediatrics, University of California, San Diego, California
Diagnostic Approach to Respiratory Disease

Joseph Haddad, Jr., MD
Director, Pediatric Otolaryngology/Head & Neck Surgery, Morgan Stanley Children's Hospital of New York–Presbyterian, New York, New York
Congenital Disorders of the Nose; Acquired Disorders of the Nose; Nasal Polyps; General Considerations and Evaluation; Hearing Loss; Congenital Malformations; External Otitis (Otitis Externa); The Inner Ear and Diseases of the Bony Labyrinth; Traumatic Injuries of the Ear and Temporal Bone; Tumors of the Ear and Temporal Bone

Joseph F. Hagan, Jr., MD, FAAP
Clinical Professor in Pediatrics, University of Vermont College of Medicine; Hagan and Rinehart Pediatricians, PLLC, Burlington, Vermont
Maximizing Children's Health: Screening, Anticipatory Guidance, and Counseling

Scott B. Halstead, MD
Director, Supportive Research and Development, Pediatric Dengue Vaccine Initiative, International Vaccine Institute, Seoul, Korea
Arboviral Encephalitis in North America; Arboviral Encephalitis outside North America; Dengue Fever and Dengue Hemorrhagic Fever; Yellow Fever; Other Viral Hemorrhagic Fevers; Hantavirus Pulmonary Syndrome

Margaret R. Hammerschlag, MD
Professor of Pediatrics and Medicine; Director, Division of Pediatric Infectious Diseases, SUNY Downstate Medical Center, Brooklyn, New York
Chlamydophila pneumoniae; Chlamydia trachomatis; *Psittacosis* (Chlamydophila psittaci)

Aaron Hamvas, MD
Professor, Department of Pediatrics, Washington University School of Medicine in St. Louis, St. Louis Children's Hospital, St. Louis, Missouri
Pulmonary Alveolar Proteinosis; Inherited Disorders of Surfactant Metabolism

James C. Harris, MD
Professor of Psychiatry and Behavioral Sciences, Pediatrics, and Mental Hygiene; Director, Developmental Neuropsychiatry, Department of Psychiatry and Behavioral Sciences, Johns Hopkins Medical Institutions, Baltimore, Maryland
Disorders of Purine and Pyrimidine Metabolism

Mary E. Hartman, MD, MPH
Assistant Professor of Pediatrics, Pediatrics/Pediatric Critical Care Medicine, Duke Children's Hospital, Duke University Medical Center, Durham, North Carolina
Pediatric Emergencies and Resuscitation

David B. Haslam, MD
Associate Professor of Pediatrics and Molecular Microbiology, Division of Infectious Diseases, Washington University School of Medicine in St. Louis, St. Louis, Missouri
Enterococcus

Fern R. Hauck, MD, MS
Professor of Family Medicine and Public Health Sciences; Director, International Family Medicine Clinic, Department of Family Medicine and Public Health Sciences, University of Virginia Health System, Charlottesville, Virginia
Sudden Infant Death Syndrome

Gregory F. Hayden, MD
Professor, Department of Pediatrics, University of Virginia School of Medicine; Attending Physician, University of Virginia Children's Hospital, Charlottesville, Virginia
The Common Cold; Acute Pharyngitis

Jacqueline T. Hecht, MS, PhD
Professor and Vice Chair for Research, Department of Pediatrics, University of Texas Medical School at Houston, Houston, Texas
General Considerations; Disorders Involving Cartilage Matrix Proteins; Disorders Involving Transmembrane Receptors; Disorders Involving Ion Transporters; Disorders Involving Transcription Factors; Disorders Involving Defective Bone Resorption; Disorders for Which Defects Are Poorly Understood or Unknown

Sabrina M. Heidemann, MD
Professor of Pediatrics, Wayne State University, Detroit, Michigan
Respiratory Pathophysiology and Regulation

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Professor of Pediatrics, Department of Pediatrics, University of Virginia Health System, Charlottesville, Virginia
Sinusitis; Retropharyngeal Abscess, Lateral Pharyngeal (Parapharyngeal) Abscess, and Peritonsillar Cellulitis/Abscess

Fred M. Henretig, MD
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Biologic and Chemical Terrorism

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Professor, Pediatric Infectious Diseases, The University of Texas Health Science Center, Houston, Texas
Campylobacter; Yersinia; Aeromonas *and* Plesiomonas

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Professor of Pediatrics and Neurology, University of Cincinnati; Director, Headache Center; Associate Director, Neurology Research, Cincinnati Children's Hospital Medical Center, University of Cincinnati, College of Medicine, Cincinnati, Ohio
Headaches

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Retinoblastoma; Gonadal and Germ Cell Neoplasms; Neoplasms of the Liver; Benign Vascular Tumors; Rare Tumors

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Lymphoma

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Professor, Department of Otolaryngology—Head and Neck Surgery, Northwestern University Feinberg School of Medicine; Paul H. Holinger, MD, Professor, Head, Division of Otolaryngology, Department of Surgery, The Children's Memorial Hospital, Chicago, Illinois
Congenital Anomalies of the Larynx, Trachea, and Bronchi; Foreign Bodies of the Airway; Laryngotracheal Stenosis and Subglottic Stenosis; Neoplasms of the Larynx, Trachea, and Bronchi

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Director, Pediatric Hematology/Oncology; Professor of Pediatrics, NEOUCOMP, Akron, Ohio
The Acquired Pancytopenias

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Assistant Professor of Clinical Orthopaedic Surgery, University of Pennsylvania School of Medicine, Division of Orthopaedic Surgery, Philadelphia, Pennsylvania
The Hip

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Director of Research, Shriners Hospital for Children; Professor of Molecular & Medical Genetics, Oregon Health & Sciences University, Portland, Oregon
General Considerations; Disorders Involving Cartilage Matrix Proteins; Disorders Involving Transmembrane Receptors; Disorders Involving Ion Transporters; Disorders Involving Transcription Factors; Disorders Involving Defective Bone Resorption; Disorders for Which Defects Are Poorly Understood or Unknown

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Attending Orthopedic Surgeon, Clinical Professor of Orthopedic Surgery, School of Medicine, UCSD; Co-Director of International Center for Pediatric and Adolescent Hip Disorders; Director Hip Research Program, Pediatric Hip and Trauma Specialist, AONA Faculty for Pediatric Orthopedic Trauma, Rady Children's Hospital, UCSD, San Diego, California
The Foot and Toes; Arthrogryposis

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Hyperpituitarism, Tall Stature, and Overgrowth Syndromes

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Distinguished Research Professor & Chair, Department of Microbiology, Immunology, and Tropical Medicine, George Washington University, Washington, District of Columbia
*Hookworms (*Necator americanus *and* Ancylostoma *spp.)*

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Interstitial Lung Diseases

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Polycystic Ovary Syndrome and Hirsutism

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Neoplasms of the Kidney

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Growth and Development; Examination of the Eye; Abnormalities of Refraction and Accommodation; Disorders of Vision; Abnormalities of Pupil and Iris; Disorders of Eye Movement and Alignment; Abnormalities of the Lids; Disorders of the Lacrimal System; Disorders of the Conjunctiva; Abnormalities of the Cornea; Abnormalities of the Lens; Disorders of the Uveal Tract; Disorders of the Retina and Vitreous; Abnormalities of the Optic Nerve; Childhood Glaucoma; Orbital Abnormalities; Orbital Infections; Injuries to the Eye

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Gonadal and Germ Cell Neoplasms

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Sudden Infant Death Syndrome

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Pyloric Stenosis and Other Congenital Anomalies of the Stomach

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Psychosomatic Illness

Richard F. Jacobs, MD, FAAP
Robert H. Fiser, Jr., M.D. Endowed Chair in Pediatrics; Professor and Chair, Department of Pediatrics, University of Arkansas for Medical Sciences, Arkansas Children's Hospital, Little Rock, Arkansas
Actinomyces; Nocardia; *Tularemia* (Francisella tularensis); Brucella

Peter Jensen, MD
President and CEO, The REACH Institute; New York, New York; Co-Director, Division of Child Psychiatry & Psychology, The Mayo Clinic, Rochester, Minnesota
Attention-Deficit/Hyperactivity Disorder

Hal B. Jenson, MD, MBA
Chief Academic Officer, Baystate Medical Center; Professor of Pediatrics, and Dean, Western Campus of Tufts University School of Medicine, Springfield, Massachusetts
Chronic Fatigue Syndrome; Epstein-Barr Virus; Human T-Lymphotropic Viruses (1 and 2)

Chandy C. John, MD
Director, Center for Global Pediatrics; Professor of Pediatrics and Medicine, University of Minnesota Medical School, Minneapolis, Minnesota
Health Advice for Children Traveling Internationally; Giardiasis and Balantidiasis; Malaria (Plasmodium)

Michael V. Johnston, MD
Professor of Neurology, Pediatrics and Physical Medicine and Rehabilitation, Johns Hopkins University School of Medicine; Blum-Moser Chair for Pediatric Neurology, Kennedy Krieger Institute, Baltimore, Maryland
Congenital Anomalies of the Central Nervous System; Encephalopathies

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Professor of Pediatrics; Associate Dean for Research Development, University of Colorado School of Medicine—National Jewish Health, Aurora, Colorado
Monocytes, Macrophages, and Dendritic Cells; The Complement System; Disorders of the Complement System

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Principles of Drug Therapy

James F. Jones, MD
Research Medical Officer/Chronic Viral Diseases Branch, Division of High-Consequence Pathogens and Pathology, National Center for Emerging and Infectious Diseases, Centers for Disease Control and Prevention, Atlanta, Georgia
Chronic Fatigue Syndrome

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Pediatric Palliative Care

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Yersinia

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Cultural Issues in Pediatric Care

Deepak Kamat, MD, PhD, FAAP
Professor and Vice Chair of Education, Department of Pediatrics, Wayne State University School of Medicine, Children's Hospital of Michigan, Detroit, Michigan
Fever; Fever without a Focus

Alvina R. Kansra, MD
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Hypofunction of the Ovaries; Pseudoprecocity Due to Lesions of the Ovary

Sheldon L. Kaplan, MD
Professor and Vice-Chairman for Clinical Affairs; Head, Section of Infectious Diseases, Department of Pediatrics, Baylor College of Medicine; Chief, Infectious Disease Service, Texas Children's Hospital, Houston, Texas
Osteomyelitis; Septic Arthritis

Emily R. Katz, MD
Assistant Professor of Psychiatry and Human Behavior (Clinical), Alpert Medical School, Brown University; Director, Child and Adolescent Psychiatry, Consultation/Liaison Service, Hasbro Children's Hospital/ Rhode Island Hospital, Providence, Rhode Island
Rumination, Pica, and Elimination (Enuresis, Encopresis) Disorders

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Professor of International Health and Medicine, Center for Global Health and Diseases, Case Western Reserve University School of Medicine, Cleveland, Ohio
Ascariasis (Ascaris lumbricoides); *Trichuriasis* (Trichuris trichiura); *Enterobiasis* (Enterobius vermicularis); *Strongyloidiasis* (Strongyloides stercoralis); *Lymphatic Filariasis* (Brugia malayi, Brugia timori, *and* Wuchereria bancrofti); *Other Tissue Nematodes; Toxocariasis (Visceral and Ocular Larva Migrans); Trichinosis* (Trichinella spiralis)

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Assessment of Growth

Gregory L. Kearns, PharmD, PhD
Marion Merrell Dow/Missouri Chair of Medical Research; Professor of Pediatrics and Pharmacology, University of Missouri–Kansas City; Chairman, Department of Medical Research; Associate Chairman, Department of Pediatrics; Director, Pediatric Pharmacology Research Unit, Children's Mercy Hospitals and Clinics, Kansas City, Missouri
Principles of Drug Therapy

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Medical Director, Division of Developmental-Behavioral Pediatrics; Vice Chair for Academics, Children's Hospital, Greenville Hospital System; GHS Professor of Clinical Pediatrics, University of South Carolina School of Medicine, Columbia, South Carolina
Neurodevelopmental Function and Dysfunction in the School-Aged Child

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Foreign Bodies and Bezoars

Kathi J. Kemper, MD, MPH, FAAP
Caryl J. Guth Chair for Complementary and Integrative Medicine; Professor, Pediatrics and Public Health Sciences, Wake Forest University School of Medicine, Winston-Salem, North Carolina
Herbs, Complementary Therapies, and Integrative Medicine

Melissa Kennedy, MD
Clinical Fellow, Pediatric Gastroenterology, Hepatology, and Nutrition, The Children's Hospital of Philadelphia, Philadelphia, Pennsylvania
Intestinal Atresia, Stenosis, and Malrotation; Intestinal Duplications, Meckel Diverticulum, and Other Remnants of the Omphalomesenteric Duct; Ileus, Adhesions, Intussusception, and Closed-Loop Obstructions; Malformations; Ascites

Eitan Kerem, MD
Professor and Chair, Department of Pediatrics, Hadassah University Medical Center, Jerusalem, Israel
Impact of Violence on Children

Joseph E. Kerschner, MD, FACS, FAAP
CEO, Children's Specialty Group; Senior Associate Dean of Clinical Affairs, Medical College of Wisconsin (MCW); Executive Vice President, Children's Hospital and Health System; Professor and Interim Chair, Department of Otolaryngology (MCW), Children's Hospital of Wisconsin, Milwaukee, Wisconsin
Otitis Media

Seema Khan, MBBS
Associate Professor of Pediatrics, Thomas Jefferson University, Philadelphia, Pennsylvania; Division of Gastroenterology, Nemours/Alfred I. duPont Hospital for Children, Wilmington, Delaware
Embryology, Anatomy, and Function of the Esophagus; Congenital Anomalies; Obstructing and Motility Disorders of the Esophagus; Dysmotility; Hiatal Hernia; Gastroesophageal Reflux Disease; Eosinophilic Esophagitis and Non-GERD Esophagitis; Esophageal Perforation; Esophageal Varices; Ingestions

Young-Jee Kim, MD
Associate Professor of Pediatrics, Section of Pediatric Pulmonology, Riley Hospital for Children, Indianapolis, Indiana
Interstitial Lung Diseases

Charles H. King, MD
Professor of International Health, Center for Global Health and Diseases, Case Western Reserve University School of Medicine, Cleveland, Ohio
Schistosomiasis (Schistosoma); *Flukes (Liver, Lung, and Intestinal)*

Stephen L. Kinsman, MD
Associate Professor of Neurology, Pediatric Neurology, Department of Neurosciences, Medical University of South Carolina, Charleston, South Carolina
Congenital Anomalies of the Central Nervous System

Adam Kirton, MD, MSc, FRCPC
Director, Calgary Pediatric Stroke Program; Assistant Professor of Pediatrics and Clinical Neuroscience, Faculty of Medicine, University of Calgary; Pediatric Neurologist, Alberta Children's Hospital, Calgary, Alberta, Canada
Pediatric Stroke Syndromes

Priya S. Kishnani, MD
Professor of Pediatrics, Division Chief, Medical Genetics, Duke University Medical Center, Durham, North Carolina
Defects in Metabolism of Carbohydrates

Nora T. Kizer, MD
Gynecologic Oncology Fellow, Division of Gynecologic Oncology, Washington University School of Medicine in St. Louis, St. Louis, Missouri
Neoplasms and Adolescent Screening for Human Papilloma Virus

Martin B. Kleiman, MD
Ryan White Professor of Pediatrics, Indiana University School of Medicine, Riley Children's Hospital, Indianapolis, Indiana
Coccidioidomycosis (Coccidioides *species*)

Bruce L. Klein, MD
Chief, Division of Transport Medicine, Children's National Medical Center, Washington, District of Columbia
Emergency Medical Services for Children; Acute Care of the Victim of Multiple Trauma

Bruce S. Klein, MD
Gerard B. Odell Professor, Pediatrics, Medicine and Medical Microbiology and Immunology, University of Wisconsin-Madison, Madison, Wisconsin
Blastomycosis (Blastomyces dermatitidis)

Michael D. Klein, MD
Arvin I. Philippart Endowed Chair in Pediatric Surgical Research; Professor of Surgery, Wayne State University, Children's Hospital of Michigan, Detroit, Michigan
Anorectal Malformations; Tumors of the Digestive Tract

Robert M. Kliegman, MD
Professor and Chair, Department of Pediatrics, Medical College of Wisconsin; Pediatrician-in-Chief, Pamela and Leslie Muma Chair in Pediatrics, Children's Hospital of Wisconsin; Executive Vice President, Children's Research Institute, Milwaukee, Wisconsin
Psychosis Associated with Epilepsy; Dysfluency (Stuttering, Stammering); Cholestasis; Liver Abscess

William C. Koch, MD, FAAP, FIDSA
Associate Professor of Pediatrics, Division of Infectious Diseases, Virginia Commonwealth University School of Medicine; Attending Physician, VCU Children's Medical Center, Medical College of Virginia Hospitals, Richmond, Virginia
Parvovirus B19

Patrick M. Kochanek, MD
Director, Safar Center for Resuscitation Research; Professor and Vice Chairman, Department of Critical Care Medicine; Professor of Anesthesiology, Clinical and Translational Science, and Pediatrics, University of Pittsburgh School of Medicine, Pittsburgh, Pennsylvania
Neurologic Emergencies and Stabilization

Eric Kodish, MD
F.J. O'Neill Professor and Chairman, Department of Bioethics, The Cleveland Clinic Foundation; Professor of Pediatrics, Lerner College of Medicine, Cleveland, Ohio
Ethics in Pediatric Care

Stephan A. Kohlhoff, MD
Assistant Professor, Department of Pediatrics, SUNY Downstate Medical Center, Brooklyn, New York
Chlamydophila pneumoniae; *Psittacosis* (Chlamydophila psittaci)

Elliot J. Krane, MD
Professor of Pediatrics and Anesthesia, Stanford University School of Medicine; Chief, Pediatric Pain Management Service, Lucile Packard Children's Hospital at Stanford, Stanford, California
Pediatric Pain Management

Peter J. Krause, MD
Senior Research Scientist, Yale School of Public Health, New Haven, Connecticut
Malaria (Plasmodium); *Babesiosis* (Babesia)

Richard E. Kreipe, MD
Professor, Division of Adolescent Medicine, Department of Pediatrics, Golisano Children's Hospital, University of Rochester School of Medicine, Rochester, New York
Eating Disorders

Steven E. Krug, MD
Professor of Pediatrics, Northwestern University Feinberg School of Medicine; Head, Division of Emergency Medicine, Children's Memorial Hospital, Chicago, Illinois
Emergency Medical Services for Children

John F. Kuttesch, Jr., MD, PhD
Director of Clinical Research, Division of Pediatric Hematology/Oncology and Stem Cell Transplantation, Penn State Hershey Children's Hospital; Professor of Pediatrics, Pennsylvania State University College of Medicine, Hershey, Pennsylvania
Brain Tumors in Childhood

Jennifer M. Kwon, MD, MPH
Associate Professor of Neurology and Pediatrics, University of Rochester Medical Center, Rochester, New York
Neurodegenerative Disorders of Childhood

Catherine S. Lachenauer, MD
Assistant Professor of Pediatrics, Harvard Medical School; Associate in Medicine, Division of Infectious Diseases, Children's Hospital Boston, Boston, Massachusetts
Group B Streptococcus

Stephan Ladisch, MD
Bosworth Chair in Cancer Biology, Center for Cancer and Immunology Research, Children's Research Institute; Children's National Medical Center and Vice Chair, Department of Pediatrics; Professor of Pediatrics and Biochemistry/Molecular Biology, George Washington University School of Medicine, Washington, District of Columbia
Histiocytosis Syndromes of Childhood

Stephen LaFranchi, MD
Professor, Department of Pediatrics, Oregon Health & Science University, Portland, Oregon
Thyroid Development and Physiology; Defects of Thyroxine-Binding Globulin; Hypothyroidism; Thyroiditis; Goiter; Hyperthyroidism; Carcinoma of the Thyroid

Oren Lakser, MD
Assistant Professor of Pediatrics, Medical College of Wisconsin; Pediatric Pulmonologist, Children's Physician Group—Illinois, Gurnee, Illinois
Parenchymal Disease with Prominent Hypersensitivity, Eosinophilic Infiltration, or Toxin-Mediated Injury; Bronchiectasis; Pulmonary Abscess

Marc B. Lande, MD, MPH
Associate Professor, Pediatric Nephrology, University of Rochester, School of Medicine and Dentistry, Rochester, New York
Systemic Hypertension

Philip J. Landrigan, MD, MSc
Ethel H. Wise Professor and Chairman, Department of Preventive Medicine; Professor of Pediatrics; Director, Children's Environmental Health Center; Dean for Global Health, Mount Sinai School of Medicine, New York, New York
Chemical Pollutants

Gregory L. Landry, MD
Professor, Department of Pediatrics, University of Wisconsin School of Medicine and Public Health, Madison, Wisconsin
Epidemiology and Prevention of Injuries; Management of Musculoskeletal Injury; Head and Neck Injuries; Heat Injuries; Female Athletes: Menstrual Problems and the Risk of Osteopenia; Performance-Enhancing Aids; Specific Sports and Associated Injuries

Wendy G. Lane, MD, MPH
Assistant Professor, Department of Epidemiology and Preventive Medicine and Department of Pediatrics, University of Maryland School of Medicine, Baltimore, Maryland
Abused and Neglected Children

Philip S. LaRussa, MD
Professor of Clinical Pediatrics, College of Physicians and Surgeons, Columbia University, New York, New York
Varicella-Zoster Virus Infections

Brendan Lee, MD, PhD
Professor, Department of Molecular and Human Genetics, Baylor College of Medicine; Houston, Texas; Investigator, Howard Hughes Medical Institute, Chevy Chase, Maryland
Integration of Genetics into Pediatric Practice; The Genetic Approach in Pediatric Medicine; The Human Genome; Patterns of Genetic Transmission; Cytogenetics; Genetics of Common Disorders

Chul Lee, PhD
Professor, Department of Preventive Medicine and Community Health, The University of Texas Medical Branch, Galveston, Texas
The Porphyrias

K. Jane Lee, MD, MA
Assistant Professor of Pediatrics, Medical College of Wisconsin, Milwaukee, Wisconsin
Brain Death

J. Steven Leeder, PharmD, PhD
Marion Merrell Dow/Missouri Endowed Chair in Pediatric Clinical Pharmacology; Chief, Division of Clinical Pharmacology and Medical Toxicology, Children's Mercy Hospital, Kansas City, Missouri
Pediatric Pharmacogenetics, Pharmacogenomics, and Pharmacoproteomics

Rebecca K. Lehman, MD
Instructor of Neurology & Pediatrics, University of Rochester Medical Center, Division of Child Neurology, Strong Memorial Hospital, Rochester, New York
Neurologic Evaluation

Michael J. Lentze, MD
Professor of Pediatrics, Zentrum für Kinderheilkunde, University Hospitals Bonn/Germany, Bonn, Germany
Disorders of Malabsorption

Norma B. Lerner, MD, MPH
Chief, Section of Hematology, St. Christopher's Hospital for Children, Philadelphia, Pennsylvania
The Anemias; Congenital Hypoplastic Anemia (Diamond-Blackfan Anemia); Pearson's Syndrome; Acquired Pure Red Blood Cell Anemia; Anemia of Chronic Disease and Renal Disease; Congenital Dyserythropoietic Anemias; Physiologic Anemia of Infancy; Megaloblastic Anemias; Iron-Deficiency Anemia

Steven Lestrud, MD
Department of Pediatrics, Feinberg School of Medicine, Northwestern University, Chicago, Illinois
Bronchopulmonary Dysplasia

Donald Y.M. Leung, MD, PhD
Professor of Pediatrics, University of Colorado Medical School; Edelstein Family Chair of Pediatric Allergy-Immunology, National Jewish Health, Denver, Colorado
Allergy and the Immunologic Basis of Atopic Disease; Diagnosis of Allergic Disease; Principles of Treatment of Allergic Disease; Allergic Rhinitis; Childhood Asthma; Atopic Dermatitis (Atopic Eczema); Insect Allergy; Ocular Allergies; Urticaria (Hives) and Angioedema; Anaphylaxis; Serum Sickness; Adverse Reactions to Foods; Adverse Reactions to Drugs

Chris A. Liacouras, MD
Professor of Pediatrics, Division of Gastroenterology, Hepatology and Nutrition, The Children's Hospital of Philadelphia, The University of Pennsylvania School of Medicine, Philadelphia, Pennsylvania
Normal Digestive Tract Phenomena; Major Symptoms and Signs of Digestive Tract Disorders; Normal Development, Structure, and Function; Pyloric Stenosis and Other Congenital Anomalies of the Stomach; Intestinal Atresia, Stenosis, and Malrotation; Intestinal Duplications, Meckel Diverticulum, and Other Remnants of the Omphalomesenteric Duct; Motility Disorders and Hirschsprung Disease; Ileus, Adhesions, Intussusception, and Closed-Loop Obstructions; Foreign Bodies and Bezoars; Functional Abdominal Pain (Nonorganic Chronic Abdominal Pain); Malformations; Ascites

Susanne Liewer, PharmD, BCOP
Assistant Professor, Adjunct Title Series, Division of Pharmacy Practice & Science, University of Kansas School of Pharmacy; Assistant Clinical Professor, Adjunct Title Series, Division of Pharmacy Practice & Science, University of Missouri–Kansas City School of Pharmacy; Clinical Pharmacy Manager, Clinical Pharmacy Specialist, Stem Cell Transplant, Children's Mercy Hospital, Kansas City, Missouri
Principles of Drug Therapy

Andrew H. Liu, MD
Associate Professor, Department of Pediatrics, National Jewish Health, University of Colorado School of Medicine, Aurora, Colorado
Childhood Asthma

Stanley F. Lo, PhD
Associate Professor, Pediatric Pathology, Children's Hospital of Wisconsin, Milwaukee, Wisconsin
Laboratory Testing in Infants and Children; Reference Intervals for Laboratory Tests and Procedures

Franco Locatelli, MD
Full Professor of Pediatrics, IRCCS Ospedale Bambino Gesù, University of Pavia, Rome, Italy
Principles and Clinical Indications; HSCT from Alternative Sources and Donors; Graft Versus Host Disease (GVHD) and Rejection; Infectious Complications of HSCT; Late Effects of HSCT

Sarah S. Long, MD
Professor of Pediatrics, Drexel University College of Medicine; Chief, Section of Infectious Diseases, St. Christopher's Hospital for Children, Philadelphia, Pennsylvania
Pertussis (Bordetella pertussis *and* Bordetella parapertussis)

Anna Lena Lopez, MD, MPH, FAAP
Director, Scientific Affairs, Asia-Pacific, Pfizer, Inc., Hong Kong
Cholera

Steven V. Lossef, MD
Associate Professor of Radiology; Director, Pediatric Interventional Radiology, Children's National Medical Center, Washington, District of Columbia
Pleurisy, Pleural Effusions, and Empyema; Pneumothorax; Hydrothorax; Hemothorax; Chylothorax

Jennifer A. Lowry, MD
Division of Clinical Pharmacology and Medical Toxicology, Children's Mercy Hospital; Assistant Professor, Department of Pediatrics, University of Missouri–Kansas City School of Medicine, Kansas City, Missouri
Principles of Drug Therapy

Kerith Lucco, MD
Clinical Instructor, Obstetrics, Gynecology and Reproductive Sciences, UCSF, San Francisco General Hospital; Volunteer Clinical Faculty, UCSF, San Francisco General Hospital, San Francisco, California
History and Physical Examination

G. Reid Lyon, PhD
Distinguished Professor and Chairman, Department of Education Policy and Leadership, Southern Methodist University; Distinguished Scientist in Cognition and Neuroscience, Center for Brain Health, University of Texas, Dallas, Texas
Dyslexia

Prashant V. Mahajan, MD, MPH, MBA
Division Chief and Research Director, Pediatric Emergency Medicine; Associate Professor of Pediatrics and Emergency Medicine, Carman and Ann Adams Department of Pediatrics, Children's Hospital of Michigan, Detroit, Michigan
Heavy Metal Intoxication

Akhil Maheshwari, MD
Associate Professor of Pediatrics; Director, Division of Neonatology, Department of Pediatrics, University of Illinois at Chicago, Chicago, Illinois
Respiratory Tract Disorders; Digestive System Disorders; Blood Disorders

Joseph A. Majzoub, MD
Professor of Pediatrics and Medicine, Harvard Medical School; Chief, Division of Endocrinology, Children's Hospital Boston, Boston, Massachusetts
Diabetes Insipidus; Other Abnormalities of Arginine Vasopressin Metabolism and Action

Asim Maqbool, MD
Assistant Professor of Pediatrics, Gastroenterology, Hepatology and Nutrition, The Children's Hospital of Philadelphia, University of Pennsylvania School of Medicine, Philadelphia, Pennsylvania
Nutritional Requirements

Ashley M. Maranich, MD
Staff, Pediatric Infectious Disease, San Antonio Military Medical Consortium, San Antonio, Texas
Malassezia

Mona Marin, MD
Medical Epidemiologist, Division of Viral Diseases, National Center for Immunization and Respiratory Diseases, Centers for Disease Control and Prevention, Atlanta, Georgia
Varicella-Zoster Virus Infections

Joan C. Marini, MD, PhD
Chief, Bone and Extracellular Matrix Branch, National Institute for Child Health and Development, National Institutes of Health, Bethesda, Maryland
Osteogenesis Imperfecta

Morri Markowitz, MD
Professor of Pediatrics, Albert Einstein College of Medicine; Clinical Director, Division of Pediatric Environmental Sciences, The Children's Hospital at Montefiore, Albert Einstein College of Medicine, Bronx, New York
Lead Poisoning

Kevin P. Marks, MD
General Pediatrician, PeaceHealth Medical Group; Assistant Clinical Professor, Oregon Health & Sciences University School of Medicine, Eugene, Oregon
Developmental-Behavioral Screening and Surveillance

Stacene R. Maroushek, MD, PhD, MPH
Assistant Professor of Pediatrics, Pediatric Infectious Diseases and General Pediatrics, Hennepin County Medical Center, Minneapolis, Minnesota
Adoption; Principles of Antimycobacterial Therapy

Wilbert H. Mason, MD, MPH
Chief Medical Quality Officer; Former Head, Division of Infectious Diseases, Children's Hospital of Los Angeles, Los Angeles, California
Measles; Rubella; Mumps

Christopher Mastropietro, MD
Assistant Professor of Pediatrics, Wayne State University, Carman and Ann Adams Department of Pediatrics, Division of Critical Care, Children's Hospital of Michigan, Detroit, Michigan
Mechanical Ventilation

Kimberlee M. Matalon, MD, PhD
Professor of Pediatrics, Biochemistry and Molecular Biology, University of Texas Medical Branch, Galveston, Texas
Aspartic Acid (Canavan Disease)

Reuben K. Matalon, MD, PhD
Professor of Pediatrics and Genetics, University of Texas Children's Hospital, Galveston, Texas
Aspartic Acid (Canavan Disease)

Robert Mazor, MD
Clinical Assistant Professor of Pediatrics, Division of Critical Care Medicine, Seattle Children's Hospital, Seattle, Washington
Pulmonary Edema

Susanna A. McColley, MD
Head, Division of Pulmonary Medicine; Director, Cystic Fibrosis Center, Northwestern University Feinberg School of Medicine, Children's Memorial Hospital, Chicago, Illinois
Pulmonary Tumors; Extrapulmonary Diseases with Pulmonary Manifestations

Margaret M. McGovern, MD, PhD
Professor and Chair, Department of Pediatrics, Stony Brook University Medical Center, Stony Brook, New York
Defects in Metabolism of Lipids; Defects in Metabolism of Carbohydrates

Heather S. McLean, MD
Assistant Professor, Division of Hospital and Emergency Medicine, Department of Pediatrics, Duke University Medical Center, Durham, North Carolina
Failure to Thrive

Rima McLeod, MD
Professor, Departments of Surgery (Visual Sciences) and Pediatrics (Infectious Diseases); Committees on Molecular Medicine, Immunology and Genetics, and Institute of Genomics and Systems Biology, University of Chicago, Chicago, Illinois
Toxoplasmosis (Toxoplasma gondii)

Peter C. Melby, MD
Director, Center for Tropical Diseases; Professor, Internal Medicine (Infectious Diseases), Microbiology and Immunology, and Pathology, University of Texas Medical Branch, Galveston, Texas
Leishmaniasis (Leishmania)

Joseph John Melvin, DO, JD
Assistant Professor, Child Neurology, Alfred I. DuPont Hospital for Children: Nemours Foundation, Wilmington, Delaware
Phenylalanine

Diane F. Merritt, MD
Professor, Obstetrics and Gynecology, Washington University School of Medicine in St. Louis, St. Louis, Missouri
History and Physical Examination; Vulvovaginitis; Bleeding; Breast Concerns; Neoplasms and Adolescent Screening for Human Papilloma Virus; Vulvovaginal and Müllerian Anomalies

Ethan A. Mezoff, MD
Research Associate, Division of Pediatric Gastroenterology, Hepatology, and Nutrition, Cincinnati Children's Hospital Medical Center, Cincinnati, Ohio
Clostridium difficile *Infection*

Marian G. Michaels, MD, MPH
Professor, Pediatrics and Surgery, Division of Pediatric Infectious Diseases, University of Pittsburgh School of Medicine, Children's Hospital of Pittsburgh, Pittsburgh, Pennsylvania
Infections in Immunocompromised Persons

Alexander G. Miethke, MD
Assistant Professor of Pediatrics, Division of Gastroenterology, Hepatology and Nutrition, Cincinnati Children's Hospital Medical Center, Cincinnati, Ohio
Morphogenesis of the Liver and Biliary System

Mohamad A. Mikati, MD
Wilburt C. Davison Distinguished Professor of Pediatrics; Professor of Neurobiology; Chief, Division of Pediatric Neurology, Duke University Medical Center, Durham, North Carolina
Seizures in Childhood; Conditions That Mimic Seizures

Henry Milgrom, MD
Professor, Department of Pediatrics, University of Colorado School of Medicine, National Jewish Health, Aurora, Colorado
Allergic Rhinitis

E. Kathryn Miller, MD, MPH
Assistant Professor, Pediatric Allergy and Immunology, Vanderbilt Children's Hospital, Nashville, Tennessee
Rhinoviruses

Jonathan W. Mink, MD, PhD
Professor, Departments of Neurology, Neurobiology and Anatomy, Brain and Cognitive Sciences, and Pediatrics, University of Rochester Medical Center, Rochester, New York
Movement Disorders

Grant A. Mitchell, MD
Professor, Division of Medical Genetics, Department of Pediatrics, CHU Sainte-Justine, University of Montreal, Montreal, Quebec, Canada
Tyrosine

Robert R. Montgomery, MD
Program Director, TS Zimmerman Program for the Molecular and Clinical Biology of VWD; Senior Investigator, Blood Research Institute; Professor of Pediatric Hematology, Department of Pediatrics, Medical College of Wisconsin, Milwaukee, Wisconsin
Hemostasis; Hereditary Clotting Factor Deficiencies (Bleeding Disorders); von Willebrand Disease; Postneonatal Vitamin K Deficiency; Liver Disease; Acquired Inhibitors of Coagulation; Disseminated Intravascular Coagulation; Platelet and Blood Vessel Disorders

Joseph G. Morelli, MD
Professor of Dermatology and Pediatrics, University of Colorado School of Medicine; Section Head, Pediatric Dermatology, The Children's Hospital, Aurora, Colorado
Morphology of the Skin; Evaluation of the Patient; Principles of Therapy; Diseases of the Neonate; Cutaneous Defects; Ectodermal Dysplasias; Vascular Disorders; Cutaneous Nevi; Hyperpigmented Lesions; Hypopigmented Lesions; Vesiculobullous Disorders; Eczematous Disorders; Photosensitivity; Disorders of Keratinization; Diseases of the Dermis; Diseases of Subcutaneous Tissue; Disorders of the Sweat Glands; Disorders of Hair; Disorders of the Nails; Disorders of the Mucous Membranes; Cutaneous Fungal Infections; Cutaneous Viral Infections; Arthropod Bites and Infestations; Acne; Tumors of the Skin; Nutritional Dermatoses

Anna-Barbara Moscicki, MD
Professor of Pediatrics; Associate Director, Division of Adolescent Medicine, University of California, San Francisco, California
Human Papillomaviruses

Hugo W. Moser, MD[†]
Professor of Neurology and Pediatrics, Johns Hopkins University; Director of Neurogenetics Research, Kennedy Krieger Institute, Johns Hopkins University School of Medicine, Baltimore, Maryland
Defects in Metabolism of Lipids

Kathryn D. Moyer, MD
Pediatric gastroenterologist, NW Pediatric Gastroenterology, LLC, Portland, Oregon
Liver Disease Associated with Systemic Disorders

James R. Murphy, PhD
Professor, Department of Pediatrics, University of Texas Health Science Center, Houston, Texas
Campylobacter; Yersinia; Aeromonas *and* Plesiomonas

Timothy F. Murphy, MD
UB Distinguished Professor, Departments of Medicine and Microbiology, University at Buffalo, State University of New York, Buffalo, New York
Moraxella catarrhalis

[†]Deceased.

Thomas S. Murray, MD, PhD
Assistant Professor, Yale University School of Medicine, Departments of Pediatrics and Laboratory Medicine, Sections of Infectious Disease and Medical Microbiology, New Haven, Connecticut
Pseudomonas, Burkholderia, *and* Stenotrophomonas

Mindo J. Natale, PsyD
Senior Staff Psychologist; Director of Training; Pediatric, Adolescent and Sports Medicine; Neuropsychologist, Department of Pediatric Services, Division of Psychology; Developmental-Behavioral Pediatrics, Greenville Hospital System Children's Hospital; Assistant Professor of Clinical Pediatrics, University of South Carolina School of Medicine, Greenville, South Carolina
Neurodevelopmental Function and Dysfunction in the School-Aged Child

William A. Neal, MD
James H. Walker Chair of Pediatric Cardiology, West Virginia University, Morgantown, West Virginia
Defects in Metabolism of Lipids

Jayne Ness, MD, PhD
Associate Professor of Pediatrics, Division of Pediatric Neurology, University of Alabama at Birmingham, Children's Hospital of Alabama, Birmingham, Alabama
Demyelinating Disorders of the CNS

Kathleen A. Neville, MD, MS
Associate Professor of Pediatrics, Divisions of Pediatric Clinical Pharmacology and Medical Toxicology and Pediatric Hematology/Oncology, Children's Mercy Hospitals and Clinics, Kansas City, Missouri
Pediatric Pharmacogenetics, Pharmacogenomics, and Pharmacoproteomics

Mary A. Nevin, MD, FAAP
Attending Physician, Pulmonary Medicine, Children's Memorial Hospital, Chicago, Illinois; Assistant Professor of Pediatrics, Northwestern Feinberg School of Medicine, Chicago, Illinois
Pulmonary Hemosiderosis; Pulmonary Embolism, Infarction, and Hemorrhage

Jane W. Newburger, MD, MPH
Commonwealth Professor of Pediatrics, Harvard Medical School; Associate Chief for Academic Affairs, Department of Cardiology, Boston, Massachusetts
Kawasaki Disease

Peter E. Newburger, MD
Ali and John Pierce Professor of Pediatric Hematology/Oncology; Vice Chair for Research, Department of Pediatrics, University of Massachusetts Medical School, Worcester, Massachusetts
Neutrophils; Eosinophils; Disorders of Phagocyte Function; Leukopenia; Leukocytosis

Linda S. Nield, MD
Associate Professor of Pediatrics, West Virginia University School of Medicine, Morgantown, West Virginia
Fever; Fever without a Focus

Zehava Noah, MD
Associate Professor, Department of Pediatrics, Northwestern University Feinberg School of Medicine, Children's Memorial Hospital, Chicago, Illinois
Chronic Severe Respiratory Insufficiency

Lawrence M. Nogee, MD
Professor of Pediatrics, Division of Neonatology, Johns Hopkins University School of Medicine, The Johns Hopkins Hospital, Baltimore, Maryland
Pulmonary Alveolar Proteinosis; Inherited Disorders of Surfactant Metabolism

Robert L. Norris, MD
Professor of Surgery, Emergency Medicine, Stanford University Medical Center, Palo Alto, California
Envenomations

Stephen K. Obaro, MD, PhD, FWACP, FRCPCH, FAAP
Associate Professor of Pediatrics, Division of Pediatric Infectious Disease, Department of Pediatrics and Human Development, College of Human Medicine, Michigan State University, East Lansing, Michigan
Nonvenereal Treponemal Infections; Relapsing Fever (Borrelia)

Makram Obeid, MD
Child Neurology Resident, Division of Pediatric Neurology, Department of Neurology, College of Physicians and Surgeons, Columbia University, New York, New York
Conditions That Mimic Seizures

Theresa J. Ochoa, MD
Assistant Professor of Pediatrics, Universidad Peruana Cayetano Heredia, Lima, Peru; Assistant Professor of Epidemiology, University of Texas School of Public Health, Houston, Texas
Shigella; Escherichia coli

Katherine A. O'Donnell, MD
Instructor in Pediatrics, Harvard Medical School; Attending Physician, Medical Toxicology and Hospitalist Services, Children's Hospital Boston, Boston, Massachusetts
Poisonings

Robin K. Ohls, MD
Professor of Pediatrics; Director of Pediatric Integration, CTSC, University of New Mexico, Albuquerque, New Mexico
Development of the Hematopoietic System

Jean-Marie Okwo-Bele, MD, MPH
Director, Immunization, Vaccines and Biologicals Department, World Health Organization, Geneva, Switzerland
Immunization Practices

Keith T. Oldham, MD
Professor and Chief, Division of Pediatric Surgery, Medical College of Wisconsin; Marie Z. Uihlein Chair and Surgeon-in-Chief, Children's Hospital of Wisconsin, Milwaukee, Wisconsin
Acute Appendicitis; Inguinal Hernias; Epigastric Hernia

Scott E. Olitsky, MD
Professor, Section of Ophthalmology, University of Missouri–Kansas City School of Medicine, Kansas City, Missouri
Growth and Development; Examination of the Eye; Abnormalities of Refraction and Accommodation; Disorders of Vision; Abnormalities of Pupil and Iris; Disorders of Eye Movement and Alignment; Abnormalities of the Lids; Disorders of the Lacrimal System; Disorders of the Conjunctiva; Abnormalities of the Cornea; Abnormalities of the Lens; Disorders of the Uveal Tract; Disorders of the Retina and Vitreous; Abnormalities of the Optic Nerve; Childhood Glaucoma; Orbital Abnormalities; Orbital Infections; Injuries to the Eye

John Olsson, MD
Brody School of Medicine, East Carolina University, Greenville, North Carolina
The Newborn

Susan R. Orenstein, MD
Professor Emerita, Pediatric Gastroenterology, University of Pittsburgh School of Medicine, Pittsburgh, Pennsylvania
Embryology, Anatomy, and Function of the Esophagus; Congenital Anomalies; Obstructing and Motility Disorders of the Esophagus; Dysmotility; Hiatal Hernia; Gastroesophageal Reflux Disease; Eosinophilic Esophagitis and Non-GERD Esophagitis; Esophageal Perforation; Esophageal Varices; Ingestions

Walter A. Orenstein, MD, D.Sc. (Hon)
Deputy Director for Immunization Programs, Vaccine Delivery, Global Health Program, Bill & Melinda Gates Foundation, Seattle, Washington
Immunization Practices

Judith A. Owens, MD, MPH
Director, Pediatric Sleep Disorders Clinic, Department of Pediatrics, Hasbro Children's Hospital, Providence, Rhode Island
Sleep Medicine

Charles H. Packman, MD
Clinical Professor of Medicine, University of North Carolina School of Medicine; Chief, Hematology-Oncology Division, Carolinas Medical Center, Charlotte, North Carolina
Hemolytic Anemias Resulting from Extracellular Factors—Immune Hemolytic Anemias

Michael J. Painter, MD
Division of Child Neurology, Children's Hospital of Pittsburgh, Pittsburgh, Pennsylvania
Progeria

Priya Pais, MBBS, MS
Assistant Professor, Pediatric Nephrology, Department of Pediatrics, Medical College of Wisconsin, Wauwatosa, Wisconsin
Lower Urinary Tract Causes of Hematuria; Introduction to the Child with Proteinuria; Fixed Proteinuria; Nephrotic Syndrome; Cortical Necrosis

Cynthia G. Pan, MD
Professor of Pediatrics; Section Head, Pediatric Nephrology, Medical College of Wisconsin; Medical Director, Pediatric Dialysis and Transplant Services, Children's Hospital of Wisconsin, Milwaukee, Wisconsin
Introduction to Glomerular Diseases; Clinical Evaluation of the Child with Hematuria; Isolated Glomerular Disease with Recurrent Gross Hematuria; Glomerulonephritis Associated with Infections; Glomerulonephritis Associated with Systemic Lupus Erythematosus

Vijay Pannikar, MD
Former Team Leader, WHO Global Leprosy Programme, Bangalore, Karnataka, India
Hansen Disease (Mycobacterium leprae)

Diane E. Pappas, MD, JD
Associate Professor of Pediatrics, University of Virginia School of Medicine, Charlottesville, Virginia
Sinusitis; Retropharyngeal Abscess, Lateral Pharyngeal (Parapharyngeal) Abscess, and Peritonsillar Cellulitis/Abscess

Anjali Parish, MD
Assistant Professor of Pediatrics, Division of Neonatology, Medical College of Georgia, Augusta, Georgia
Feeding Healthy Infants, Children, and Adolescents

John S. Parks, MD, PhD
Professor, Department of Pediatrics, Emory University School of Medicine, Decatur, Georgia
Hormones of the Hypothalamus and Pituitary; Hypopituitarism

Laura A. Parks, MD
Assistant Professor, Department of Obstetrics and Gynecology, Washington University School of Medicine in St. Louis, St. Louis, Missouri
Bleeding

Maria Jevitz Patterson, MD, PhD
Professor, Departments of Microbiology/Molecular Genetics and Pediatrics, Michigan State University, East Lansing, Michigan
Syphilis (Treponema pallidum)

Pallavi P. Patwari, MD
Assistant Professor of Pediatrics at Northwestern University Feinberg School of Medicine; Assistant Director, Center for Autonomic Medicine in Pediatrics (C.A.M.P.), Children's Memorial Hospital, Chicago, Illinois
Chronic Respiratory Insufficiency

Timothy R. Peters, MD
Assistant Professor of Pediatrics, Wake Forest University School of Medicine, Winston-Salem, North Carolina
Streptococcus pneumoniae *(Pneumococcus)*

Larry K. Pickering, MD, FAAP
Senior Advisor to the Director, National Center for Immunization and Respiratory Diseases; Executive Secretary, Advisory Committee on Immunization Practices, Centers for Disease Control and Prevention, Atlanta, Georgia
Immunization Practices

Misha L. Pless, MD
Associate Professor of Neurology, Harvard Medical School; Chief, Divisions of Neuro-ophthalmology and General Neurology, Massachusetts General Hospital, Boston, Massachusetts
Pseudotumor Cerebri

Laura S. Plummer, MD
Assistant Professor, University of Missouri–Kansas City; Clinical Assistant Professor, Kansas University, Department of Ophthalmology, Children's Mercy Hospitals and Clinics, Kansas City, Missouri
Growth and Development; Examination of the Eye; Abnormalities of Refraction and Accommodation; Disorders of Vision; Abnormalities of Pupil and Iris; Disorders of Eye Movement and Alignment; Abnormalities of the Lids; Disorders of the Lacrimal System; Disorders of the Conjunctiva; Abnormalities of the Cornea; Abnormalities of the Lens; Disorders of the Uveal Tract; Disorders of the Retina and Vitreous; Abnormalities of the Optic Nerve; Childhood Glaucoma; Orbital Abnormalities; Orbital Infections; Injuries to the Eye

Craig C. Porter, MD
Professor and Vice Chair for Faculty, Department of Pediatrics, Division of Nephrology, Medical College of Wisconsin, Milwaukee, Wisconsin
Upper Urinary Tract Causes of Hematuria; Hematologic Diseases Causing Hematuria; Anatomic Abnormalities Associated with Hematuria; Transient Proteinuria; Orthostatic (Postural) Proteinuria; Tubulointerstitial Nephritis; Toxic Nephropathy

Dwight A. Powell, MD
Professor of Pediatrics, The Ohio State University College of Medicine, Nationwide Children's Hospital, Columbus, Ohio
Hansen Disease (Mycobacterium leprae); Mycoplasma pneumoniae; *Genital Mycoplasmas* (Mycoplasma hominis, Mycoplasma genitalium, *and* Ureaplasma urealyticum)

David T. Price, MD
Pediatrics/Hospital and Emergency Medicine, Duke University Health System, Durham, North Carolina
Failure to Thrive

Charles G. Prober, MD
Professor of Pediatrics, Microbiology & Immunology; Senior Associate Dean, Medical Education, Stanford University School of Medicine, Stanford, California
Central Nervous System Infections; Brain Abscess

Linda Quan, MD
Professor, Division of Emergency Medicine, Department of Pediatrics, University of Washington School of Medicine, Seattle, Washington
Drowning and Submersion Injury

Elisabeth H. Quint, MD
Clinical Professor, Department of Obstetrics and Gynecology, University of Michigan Health System, Ann Arbor, Michigan
Gynecologic Care for Girls with Special Needs

C. Egla Rabinovich, MD, MPH
Associate Professor of Pediatrics; Co-Chief, Division of Pediatric Rheumatology, Pediatrics/Rheumatology, Duke University Health System, Durham, North Carolina
Evaluation of Suspected Rheumatic Disease; Treatment of Rheumatic Diseases; Juvenile Idiopathic Arthritis; Scleroderma and Raynaud Phenomenon

Leslie J. Raffini, MD, MSCE
Assistant Professor of Pediatrics, University of Pennsylvania School of Medicine; Medical Director, Hemostasis and Thrombosis Center, Children's Hospital of Philadelphia, Philadelphia, Pennsylvania
Hemostasis; Hereditary Predisposition to Thrombosis; Thrombotic Disorders in Children; Anticoagulant and Thrombolytic Therapy; Disseminated Intravascular Coagulation

Denia Ramirez-Montealegre, MD, MPH, PhD
Pediatric Neurology Chief Resident, Department of Neurology, Division of Child Neurology, University of Rochester Medical Center, Rochester, New York
Movement Disorders

Giuseppe Raviola, MD
Instructor in Psychiatry, Harvard Medical School; Director, Patient Safety and Quality, Department of Psychiatry, Children's Hospital Boston, Boston, Massachusetts
Pervasive Developmental Disorders and Childhood Psychosis

Ann M. Reed, MD
Professor of Pediatrics; Chair, Pediatric Rheumatology, Mayo Clinic, Rochester, Minnesota
Juvenile Dermatomyositis

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Spinal Cord Disorders

Megan E. Reller, MD, MPH
Assistant Professor of Pathology, Division of Medical Microbiology, Department of Pathology, Johns Hopkins University School of Medicine, Baltimore, Maryland
Spotted Fever and Transitional Group Rickettsioses; Scrub Typhus (Orientia tsutsugamushi); *Typhus Group Rickettsioses; Ehrlichioses and Anaplasmosis; Q Fever* (Coxiella burnetii)

Gary Remafedi, MD, MPH
Professor of Pediatrics, University of Minnesota; Director, Youth and AIDS Projects, Minneapolis, Minnesota
Adolescent Homosexuality

Jorge D. Reyes, MD
Professor of Surgery, University of Washington; Chief of the Division of Transplantation Surgery, University of Washington Medical Center; Chief of Pediatric Transplantation, Seattle Children's Hospital, Seattle, Washington
Intestinal Transplantation in Children with Intestinal Failure; Liver Transplantation

Geoffrey Rezvani, MD
Assistant Professor, Department of Pediatrics, Drexel University College of Medicine; Section of Endocrinology, Diabetes and Metabolism, St. Christopher's Hospital for Children, Philadelphia, Pennsylvania
An Approach to Inborn Errors of Metabolism

Iraj Rezvani, MD
Professor of Pediatrics (Emeritus), Temple University School of Medicine; Adjunct Professor of Pediatrics, Drexel University College of Medicine, Section of Pediatric Endocrinology and Metabolism, St. Christopher's Hospital for Children, Philadelphia, Pennsylvania
An Approach to Inborn Errors of Metabolism; Defects in Metabolism of Amino Acids

A. Kim Ritchey, MD
Chief, Division of Pediatric Hematology/Oncology, Children's Hospital of Pittsburgh of UPMC; Professor of Pediatrics; Vice Chair for Clinical Affairs, Department of Pediatrics, University of Pittsburgh School of Medicine, Pittsburgh, Pennsylvania
Principles of Diagnosis; Principles of Treatment; The Leukemias

Frederick P. Rivara, MD, MPH
Children's Hospital Guild Endowed Chair, Professor of Pediatrics; Adjunct Professor of Epidemiology, University of Washington, Seattle, Washington
Maximizing Children's Health Screening, Anticipatory Guidance, and Counseling

Angela Byun Robinson, MD, MPH
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Juvenile Dermatomyositis; Miscellaneous Conditions Associated with Arthritis

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Aspergillus

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Associate Professor of Pediatrics, Section of Emergency Medicine, University of Colorado School of Medicine, Aurora, Colorado
Acute Inflammatory Upper Airway Obstruction (Croup, Epiglottitis, Laryngitis, and Bacterial Tracheitis)

David R. Rosenberg, MD
Miriam L. Hamburger Endowed Chair of Child Psychiatry, Children's Hospital of Michigan and Wayne State University; Professor and Chief of Child Psychiatry and Psychology, Wayne State University, Detroit, Michigan
Anxiety Disorders

Melissa Beth Rosenberg, MD
Assistant Professor, Michigan State University, College of Osteopathic Medicine, Department of Pediatrics, East Lansing, Michigan
Leptospira

David S. Rosenblatt, MD
Chair, Department of Human Genetics; Professor of Human Genetics, Pediatrics and Medicine, McGill University, Montreal, Quebec, Canada
Defects in Metabolism of Amino Acids

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Assistant Clinical Professor of Pediatrics, Pediatric Emergency Medicine, Columbia University College of Physicians and Surgeons, New York, New York
Acute Care of the Victim of Multiple Trauma

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Infection Prevention and Control Coordinator, Children's Hospital of Wisconsin, Milwaukee, Wisconsin
Infection Prevention and Control

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Associate Professor of Pediatrics, Northwestern University Feinberg School of Medicine, Children's Memorial Hospital, Chicago, Illinois
Atelectasis

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Brain Tumors in Childhood

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Attending, Child and Adolescent Psychiatry Inpatient Service, Children's Hospital Boston; Instructor, Harvard Medical School, Boston, Massachusetts
Habit and Tic Disorders

Prof. H.P.S. Sachdev, MD, Hon. FRCPCH
Senior Consultant Pediatrics and Clinical Epidemiology, Sitaram Bhartia Institute of Science and Research, New Delhi, India; Adjunct Professor, Division of Population Health, St. John's Research Institute, St. John's National Academy of Health Sciences, Bangalore, India
Vitamin B Complex Deficiencies and Excess; Vitamin C (Ascorbic Acid)

Ramesh C. Sachdeva, MD, PhD, FAAP, FCCM
Professor of Pediatrics (Critical Care and Sleep Medicine), Medical College of Wisconsin; Corporate Vice President and Chief Quality Officer, Children's Hospital and Health System, Milwaukee, Wisconsin
Quality and Safety in Health Care for Children

Mustafa Sahin, MD, PhD
Department of Neurology, Children's Hospital Boston, Boston, Massachusetts
Neurocutaneous Syndromes

Robert A. Salata, MD
Professor and Executive Vice Chair, Department of Medicine; Chief, Division of Infectious Diseases and HIV Medicine, Case Western Reserve University, University Hospitals Case Medical Center, Cleveland, Ohio
Amebiasis; Trichomoniasis (Trichomonas vaginalis); *African Trypanosomiasis (Sleeping Sickness;* Trypanosoma brucei *Complex); American Trypanosomiasis* (*Chagas Disease*; Trypanosoma cruzi)

Denise A. Salerno, MD
Professor of Pediatrics; Pediatric Clerkship Director; Associate Chair for Undergraduate Education, Department of Pediatrics, Temple University School of Medicine, Philadelphia, Pennsylvania
Nonbacterial Food Poisoning

Edsel Maurice T. Salvana, MD, DTM&H (Diploma in Tropical Medicine and Hygiene)
Associate Professor of Medicine, Section of Infectious Diseases, Department of Medicine, Philippine General Hospital, University of the Philippines Manila; Research Faculty, Institute of Molecular Biology and Biotechnology, National Institutes of Health, University of the Philippines Manila, Manila, Philippines
Amebiasis; Trichomoniasis (Trichomonas vaginalis); *African Trypanosomiasis (Sleeping Sickness;* Trypanosoma brucei *Complex); American Trypanosomiasis* (*Chagas Disease;* Trypanosoma cruzi)

Hugh A. Sampson, MD
Kurt Hirschhorn Professor of Pediatrics; Dean for Translational Biomedical Sciences; Director, Jaffe Food Allergy Institute, Mount Sinai School of Medicine, New York, New York
Anaphylaxis; Adverse Reactions to Foods

Thomas J. Sandora, MD, MPH
Hospital Epidemiologist; Medical Director of Infection Prevention and Control, Division of Infectious Diseases, Children's Hospital Boston; Assistant Professor of Pediatrics, Harvard Medical School, Boston, Massachusetts
Community-Acquired Pneumonia

Tracy Sandritter, PharmD
Clinical Pharmacy Specialist, Personalized Medicine, Children's Mercy Hospitals and Clinics; Adjunct Associate Clinical Professor, University of Missouri–Kansas City School of Pharmacy, Kansas City, Missouri
Principles of Drug Therapy

Wudbhav N. Sankar, MD
Assistant Professor of Orthopaedic Surgery, University of Pennsylvania School of Medicine; Attending Physician, The Children's Hospital of Philadelphia, Philadelphia, Pennsylvania
The Hip

Ajit Ashok Sarnaik, MD
Staff Intensivist, Children's Hospital of Michigan; Assistant Professor of Pediatrics, Wayne State University School of Medicine, Detroit, Michigan
Respiratory Distress and Failure

Ashok P. Sarnaik, MD
Chief, Critical Care Medicine, Children's Hospital of Michigan; Professor of Pediatrics, Wayne State University School of Medicine, Detroit, Michigan
Respiratory Distress and Failure; Respiratory Pathophysiology and Regulation; Regulation of Respiration

Harvey B. Sarnat, MS, MD, FRCPC
Professor of Paediatrics, Pathology, (Neuropathology) and Clinical Neurosciences, Divisions of Paediatric Neurology and Neuropathology, University of Calgary, Faculty of Medicine, Alberta Children's Hospital, Calgary, Alberta, Canada
Evaluation and Investigation; Developmental Disorders of Muscle; Muscular Dystrophies; Endocrine and Toxic Myopathies; Metabolic Myopathies; Disorders of Neuromuscular Transmission and of Motor Neurons; Hereditary Motor-Sensory Neuropathies; Toxic Neuropathies; Autonomic Neuropathies; Guillain-Barré Syndrome; Bell Palsy

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Renal Transplantation

Mary Saunders, MD
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Evaluation of the Sick Child in the Office and Clinic

Laura E. Schanberg, MD
Professor of Pediatrics; Co-Chief, Division of Pediatric Rheumatology, Duke University Medical Center, Durham, North Carolina
Treatment of Rheumatic Diseases; Systemic Lupus Erythematosus; Musculoskeletal Pain Syndromes

Mark R. Schleiss, MD
American Legion Chair of Pediatrics; Director, Division of Infectious Diseases and Immunology; Associate Head for Research, Department of Pediatrics, University of Minnesota School of Medicine, Center for Infectious Diseases and Microbiology Translational Research, Minneapolis, Minnesota
Principles of Antibacterial Therapy; Principles of Antiviral Therapy; Principles of Antiparasitic Therapy

Nina F. Schor, MD, PhD
William H. Eilinger Professor and Chair, Department of Pediatrics; Professor, Department of Neurology; Pediatrician-in-Chief, Golisano Children's Hospital, University of Rochester Medical Center, Rochester, New York
Neurologic Evaluation; Neuromyelitis Optica; Acute Disseminated Encephalomyelitis (ADEM)

Bill J. Schroeder, DO
Clinical Assistant Professor, Emergency Medicine/Pediatric Emergency Medicine, University of Illinois at Chicago, Advocate Christ Hospital/ Hope Children's Hospital, Oak Lawn, Illinois
Envenomations

Robert L. Schum, PhD
Professor, Department of Pediatrics, Medical College of Wisconsin; Clinical Psychologist, Child Development Center, Children's Hospital of Wisconsin, Milwaukee, Wisconsin
Language Development and Communication Disorders

Gordon E. Schutze, MD, FAAP
Professor of Pediatrics, Vice-Chairman for Educational Affairs, Department of Pediatrics, Section of Retrovirology; Vice President, Baylor International Pediatric AIDS Initiative at Texas Children's Hospital, Baylor College of Medicine, Houston, Texas
Actinomyces; Nocardia; *Tularemia* (Francisella tularensis); Brucella

Daryl A. Scott, MD, PhD
Assistant Professor, Department of Molecular and Human Genetics, Baylor College of Medicine, Houston, Texas
The Genetic Approach in Pediatric Medicine; The Human Genome; Patterns of Genetic Transmission

J. Paul Scott, MD
Professor, Department of Pediatrics, Medical College of Wisconsin, BloodCenter of Wisconsin, Milwaukee, Wisconsin
Hemostasis; Hereditary Clotting Factor Deficiencies (Bleeding Disorders); von Willebrand Disease; Hereditary Predisposition to Thrombosis; Thrombotic Disorders in Children; Postneonatal Vitamin K Deficiency; Liver Disease; Acquired Inhibitors of Coagulation; Disseminated Intravascular Coagulation; Platelet and Blood Vessel Disorders

Theodore C. Sectish, MD
Program Director, Children's Hospital Boston; Associate Professor, Harvard Medical School; Executive Director, Federation of Pediatric Organizations, Boston, Massachusetts
Community-Acquired Pneumonia

George B. Segel, MD
Professor of Pediatrics and Medicine, Department of Pediatrics, University of Rochester Medical Center, Rochester, New York
Definitions and Classification of Hemolytic Anemias; Hereditary Spherocytosis; Hereditary Elliptocytosis; Hereditary Stomatocytosis; Other Membrane Defects; Enzymatic Defects; Hemolytic Anemias Resulting from Extracellular Factors—Immune Hemolytic Anemias; Hemolytic Anemias Secondary to Other Extracellular Factors

Kriti Sehgal, BA
Clinical Research Coordinator, Department of Orthopaedics, The Children's Hospital of Philadelphia, Philadelphia, Pennsylvania
Growth and Development; Evaluation of the Child; Torsional and Angular Deformities; The Knee; Common Fractures

Ernest G. Seidman, MDCM, FRCPC, FACG
Professor of Medicine and Pediatrics, Canada Research Chair in Immune Mediated Gastrointestinal Disorders; Bruce Kaufman Endowed Chair in IBD at McGill Digestivelab, Research Institute of McGill University Health Centre, Montreal, Quebec, Canada
Disorders of Malabsorption

Janet R. Serwint, MD
Professor of Pediatrics; Director of Pediatric Resident Education, Johns Hopkins University School of Medicine, Baltimore, Maryland
Loss, Separation, and Bereavement

Dheeraj Shah, MD (Pediatrics), DNB (Pediatrics), MNAMS
Associate Professor, Department of Pediatrics, University College of Medical Sciences (University of Delhi) and Guru Tegh Bahadur Hospital, Delhi, India
Vitamin B Complex Deficiencies and Excess; Vitamin C (Ascorbic Acid)

Prof. Raanan Shamir, MD
Chairman, Institute of Gastroenterology, Nutrition and Liver Diseases, Schneider Children's Medical Center of Israel; Professor of Pediatrics, Sackler Faculty of Medicine, Tel-Aviv University, Petach-Tikva, Israel
Disorders of Malabsorption

Bruce K. Shapiro, MD
The Arnold J. Capute, MD, MPH Chair in Neurodevelopmental Disabilities; Professor of Pediatrics, Johns Hopkins University School of Medicine; Vice President, Training, Kennedy Krieger Institute, Baltimore, Maryland
Intellectual Disability

Richard J. Shaw, MB, BS
Professor of Psychiatry and Pediatrics, Stanford University School of Medicine; Medical Director, Pediatric Psychosomatic Medicine Service, Lucile Packard Children's Hospital at Stanford, Stanford, California
Psychosomatic Illness

Bennett A. Shaywitz, MD
The Charles and Helen Schwab Professor in Dyslexia and Learning Development, Pediatrics and Neurology, Yale University School of Medicine, New Haven, Connecticut
Dyslexia

Sally E. Shaywitz, MD
The Audrey G. Ratner Professor in Learning Development, Department of Pediatrics, Yale University School of Medicine, New Haven, Connecticut
Dyslexia

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Lead Health and Nutrition Specialist, World Bank, Human Development Network, Washington, District of Columbia
Nutrition, Food Security, and Health

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Drowning and Submersion Injury

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Disorders of Malabsorption

Benjamin L. Shneider, MD
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Autoimmune Hepatitis

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Insect Allergy; Serum Sickness

Richard Sills, MD
Professor of Pediatrics; Director, Pediatric Hematology/Oncology, Upstate Medical University, Syracuse, New York
Iron-Deficiency Anemia; Other Microcytic Anemias

Mark D. Simms, MD, MPH
Chief, Section of Child Development, Department of Pediatrics, Medical College of Wisconsin; Medical Director, Child Development Center, Children's Hospital of Wisconsin, Milwaukee, Wisconsin
Language Development and Communication Disorders; Adoption

Eric A.F. Simões, MBBS, DCH, MD
Professor of Pediatrics, Division of Infectious Diseases, The Children's Hospital, Aurora, Colorado
Polioviruses

Thomas L. Slovis, MD
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Biologic Effects of Radiation on Children

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Assistant Professor, Department of Pediatrics, Duke University Medical Center, Duke Clinical Research Institute, Durham, North Carolina
Candida

Mary Beth F. Son, MD
Instructor in Pediatrics, Harvard Medical School, Boston, Massachusetts
Kawasaki Disease

Laura Stout Sosinsky, PhD
Assistant Professor, Department of Psychology, Fordham University, Bronx, New York
Child Care: How Pediatricians Can Support Children and Families

Joseph D. Spahn, MD
Associate Professor Pediatrics, Department of Pediatrics, National Jewish Health, Denver, Colorado
Childhood Asthma

Mark A. Sperling, MD
Professor of Pediatrics, Division of Endocrinology, Children's Hospital of Pittsburgh, Pittsburgh, Pennsylvania
Hypoglycemia

Robert Spicer, MD
Professor of Pediatrics, University of Cincinnati; Medical Director, Cardiac Transplantation; Director, Cardiology Fellowship Program; Director, Pediatric Cardiology Training Program, Cincinnati Children's Hospital, Cincinnati, Ohio
Diseases of the Myocardium; Diseases of the Pericardium; Tumors of the Heart

David A. Spiegel, MD
Pediatric Orthopaedic Surgeon, Division of Orthopaedic Surgery, The Children's Hospital of Philadelphia; Assistant Professor of Orthopaedic Surgery, University of Pennsylvania School of Medicine, Philadelphia, Pennsylvania
The Foot and Toes; The Spine; The Neck

Helen Spoudeas, MD, MBBS, DRCOG, FRCP, FRCPCH
Consultant/Honorary Senior Lecturer in Paediatric/Adolescent Neuroendocrinology at London Centre for Paediatric and Adolescent Endocrinology, Great Ormond Street and University College Hospitals, Neuroendocrine Division, London, United Kingdom
Chronic Diarrhea

Jürgen Spranger, MD
Professor, Im Fuchsberg, Sinzheim, Germany
Mucopolysaccharidoses

Rajasree Sreedharan, MD, MBBS
Assistant Professor, Medical College of Wisconsin, Pediatric Nephrology, Wauwatosa, Wisconsin
Tubular Function; Renal Tubular Acidosis; Nephrogenic Diabetes Insipidus; Bartter and Gitelman Syndromes and Other Inherited Tubular Transport Abnormalities; Renal Failure

Raman Sreedharan, MD, DCH, MRCPCH
Attending Physician, Division of Gastroenterology, Hepatology and Nutrition, The Children's Hospital of Philadelphia; Clinical Assistant Professor of Pediatrics, University of Pennsylvania School of Medicine, Philadelphia, Pennsylvania
Major Symptoms and Signs of Digestive Tract Disorders; Functional Abdominal Pain (Nonorganic Chronic Abdominal Pain)

Shawn J. Stafford, MD, FAAP
Assistant Clinical Professor, Pediatric Surgery, University of Arizona School of Medicine, Arizona Pediatric Surgery, Tucson, Arizona
Surgical Conditions of the Anus and Rectum

Margaret M. Stager, MD
Interim Chairman, Department of Pediatrics; Associate Professor of Pediatrics, Division of Adolescent Medicine, Case Western Reserve University School of Medicine, MetroHealth Medical Center, Cleveland, Ohio
Violent Behavior; Substance Abuse

Sergio Stagno, MD
Katharine Reynolds Ireland Distinguished Professor and Chairman, Department of Pediatrics, University of Alabama at Birmingham, Birmingham, Alabama
Cytomegalovirus

Virginia A. Stallings, MD
Professor of Pediatrics, University of Pennsylvania School of Medicine; Cortner Endowed Chair in Pediatric Gastroenterology; Director, Office of Faculty Development, Research Institute; Director, Nutrition Center, The Children's Hospital of Philadelphia, Philadelphia, Pennsylvania
Nutritional Requirements; Feeding Healthy Infants, Children, and Adolescents

Lawrence R. Stanberry, MD, PhD
Reuben S. Carpentier Professor and Chairman, Department of Pediatrics, Columbia University College of Physicians and Surgeons, New York, New York
Herpes Simplex Virus

Charles A. Stanley, MD
Professor of Pediatrics, The Children's Hospital of Philadelphia, Philadelphia, Pennsylvania
Defects in Metabolism of Lipids

Bonita F. Stanton, MD
Professor and Schotanus Family Endowed Chair of Pediatrics, Pediatrician-in-Chief, Carman and Ann Adams Department of Pediatrics, Children's Hospital of Michigan, Wayne State University School of Medicine, Detroit, Michigan
Overview of Pediatrics; Cultural Issues in Pediatric Care

Jeffrey R. Starke, MD
Professor of Pediatrics, Department of Pediatrics, Baylor College of Medicine, Texas Children's Hospital, Houston, Texas
Tuberculosis (Mycobacterium tuberculosis)

Merrill Stass-Isern, MD
Associate Clinical Professor, Department of Ophthalmology, Children's Mercy Hospitals and Clinics, University of Missouri–Kansas City, Kansas City, Missouri
Growth and Development; Examination of the Eye; Abnormalities of Refraction and Accommodation; Disorders of Vision; Abnormalities of Pupil and Iris; Disorders of Eye Movement and Alignment; Abnormalities of the Lids; Disorders of the Lacrimal System; Disorders of the Conjunctiva; Abnormalities of the Cornea; Abnormalities of the Lens; Disorders of the Uveal Tract; Disorders of the Retina and Vitreous; Abnormalities of the Optic Nerve; Childhood Glaucoma; Orbital Abnormalities; Orbital Infections; Injuries to the Eye

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Bartonella

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Miscellaneous Conditions Associated with Arthritis

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Principles of Antifungal Therapy; Aspergillus

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Nutritional Requirements; Feeding Healthy Infants, Children, and Adolescents

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George W. Brumley, Jr., Professor and Chair, Department of Pediatrics, Emory University School of Medicine, Atlanta, Georgia
Infections of the Neonatal Infant

Gregory A. Storch, MD
Ruth L. Siteman Professor of Pediatrics, Washington University School of Medicine in St. Louis, St. Louis, Missouri
Polyomaviruses

Ronald G. Strauss, MD
Professor Emeritus, Departments of Pathology and Pediatrics, University of Iowa College of Medicine, Coralville, Iowa
Red Blood Cell Transfusions and Erythropoietin Therapy; Platelet Transfusions; Neutrophil (Granulocyte) Transfusions; Plasma Transfusions; Risks of Blood Transfusions

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Autoimmune Hepatitis; Drug- and Toxin-Induced Liver Injury; Fulminant Hepatic Failure; Cystic Diseases of the Biliary Tract and Liver; Diseases of the Gallbladder; Portal Hypertension and Varices

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Cytogenetics

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Foster and Kinship Care

Norman Tinanoff, DDS, MS
Professor and Chair, Department of Health Promotion and Policy, University of Maryland Dental School, Baltimore, Maryland
Development and Developmental Anomalies of the Teeth; Disorders of the Oral Cavity Associated with Other Conditions; Malocclusion; Cleft Lip and Palate; Syndromes with Oral Manifestations; Dental Caries; Periodontal Diseases; Dental Trauma; Common Lesions of the Oral Soft Tissues; Diseases of the Salivary Glands and Jaws; Diagnostic Radiology in Dental Assessment

James K. Todd, MD
Professor of Pediatrics, Microbiology and Epidemiology, University of Colorado School of Medicine and Colorado School of Public Health, Jules Amer Chair of Community Pediatrics; Director of Epidemiology, The Children's Hospital, Aurora, Colorado
Staphylococcus

Lucy S. Tompkins, MD, PhD
Lucy Becker Professor of Medicine (Infectious Diseases); Professor of Microbiology and Immunology, Stanford University School of Medicine, Stanford University Medical Center, Stanford, California
Legionella

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Anatomy and Function of the Lymphatic System; Abnormalities of Lymphatic Vessels; Lymphadenopathy

Prof. Riccardo Troncone
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Disorders of Malabsorption

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Defects in Metabolism of Amino Acids

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Medical Director, Host Program, MD Anderson Physicians Network, University of Texas MD Anderson Cancer Center, Houston, Texas
The Leukemias

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Shock

Ronald B. Turner, MD
Associate Dean for Clinical Research; Professor of Pediatrics, University of Virginia School of Medicine, Charlottesville, Virginia
The Common Cold; Acute Pharyngitis

Christina Ullrich, MD, MPH
Attending Physician in Pediatric Hematology/Oncology and Pediatric Palliative Care, Children's Hospital Boston/Dana-Farber Cancer Institute; Instructor in Pediatrics, Harvard Medical School, Boston, Massachusetts
Pediatric Palliative Care

George F. Van Hare, MD
Louis Larrick Ward Professor of Pediatrics, Washington University in St. Louis; Director, Pediatric Cardiology, St. Louis Children's Hospital, St. Louis, Missouri
Disturbances of Rate and Rhythm of the Heart; Sudden Death

Jakko van Ingen, MD, PhD
National Tuberculosis Reference Laboratory, National Institute of Public Health and the Environment, Bilthoven, The Netherlands; Department of Pulmonary Diseases, Radboud University Nijmegen Medical Center, Nijmegen, The Netherlands
Nontuberculous Mycobacteria

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Juvenile Idiopathic Arthritis; Scleroderma and Raynaud Phenomenon

Prof. Dr. Dick van Soolingen
Head of the Tuberculosis Reference Laboratory, National Institute for Public Health and the Environment, Bilthoven, The Netherlands; Department of Pulmonary Diseases and Medical Microbiology, Radboud University Nijmegen Medical Centre, Nijmegen, The Netherlands
Nontuberculous Mycobacteria

Scott K. Van Why, MD
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Membranous Glomerulopathy; Membranoproliferative Glomerulonephritis; Henoch-Schönlein Purpura Nephritis; Rapidly Progressive (Crescentic) Glomerulonephritis; Goodpasture Disease; Hemolytic-Uremic Syndrome

Pankhuree Vandana, MD
Second Year Fellow, Child and Adolescent Psychiatry, Department of Child and Adolescent Psychiatry, Feinberg School of Medicine/Northwestern University/Children's Memorial Hospital, Chicago, Illinois
Anxiety Disorders

Douglas Vanderbilt, MD
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Impact of Violence on Children

Jon A. Vanderhoof, MD
Lecturer in Pediatrics, Harvard Medical School; Professor Emeritus, Pediatrics, University of Nebraska College of Medicine, Omaha, Nebraska
Disorders of Malabsorption

Andrea Velardi, MD
Professor of Hematology, Division of Hematology and Clinical Immunology, University of Perugia, Perugia, Italy
Principles and Clinical Indications; HSCT from Alternative Sources and Donors; Graft Versus Host Disease (GVHD) and Rejection; Infectious Complications of HSCT; Late Effects of HSCT

Elliott Vichinsky, MD
Medical Director, Department of Hematology/Oncology; Adjunct Professor UCSF, Oakland, California
Hemoglobinopathies

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Child Care and Communicable Diseases

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Rare Tumors

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Emergency Medical Services for Children

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Preface

The publication of the 19th edition of *Nelson Textbook of Pediatrics* combines an important synthesis of clinical pediatrics with the major advances in genomics, diagnosis, imaging, and therapeutics. The 19th edition continues to represent the "state of the art" on the care of the normal and ill neonate, child, or adolescent by presenting both evidence-based medicine and astute clinical experiences from leading international authors.

The promise that translational medicine will improve the lives of all children is greater than ever. Knowledge of human development, behavior, and diseases from the molecular to sociologic levels is increasing at fantastic rates. This has led to greater understanding of health and illness in children, as well as to substantial improvements in health quality for those who have access to health care. These exciting scientific advances also provide hope to effectively address new and emerging diseases threatening children and their families.

Unfortunately, many children throughout the world have not benefited from the significant advances in the prevention and treatment of health-related problems, primarily because of a lack of political will and misplaced priorities. Additionally, many children are at substantial risk from the adverse effects of poverty, war, and bioterrorism. In order for our increasing knowledge to benefit all children and youth, medical advances and good clinical practice must always be coupled with effective advocacy.

This new edition of *Nelson Textbook of Pediatrics* attempts to provide the essential information that practitioners, house staff, medical students, and other care providers involved in pediatric health care throughout the world need to understand to effectively address the enormous range of biologic, psychologic, and social problems that our children and youth may face. Our goal is to be comprehensive yet concise and reader friendly, embracing both the new advances in science as well as the time-honored art of pediatric practice.

The 19th edition is reorganized and revised from the previous edition. There are the additions of new diseases and new chapters, as well as substantial expansion or significant modification of others. In addition, many more tables, photographs, imaging studies, and illustrative figures, as well as up-to-date references, have been added. Every subject has been scrutinized for updating and improvement in its exposition and usefulness to pediatric health care providers. Although to an ill child and his or her family and physician, even the rarest disorder is of central importance, all health problems cannot possibly be covered with the same degree of detail in one general textbook of pediatrics. Thus, leading articles and subspecialty texts are referenced and should be consulted when more information is desired. In addition, to include as much information as possible and to take advantage of advances in providing background, pathophysiology, and literature citations, we have placed even more material on the website accompanying the printed text. This permits an unlimited ability to provide more detailed and updated information through our associated electronic media. Text vital to the care of children remains printed, but additional material will be provided to the reader at *www.expertconsult.com*, including links to Gold Standard's premier online formulary for the most current information available on drugs and dosing.

The outstanding value of the 19th edition of the textbook is due to its expert and authoritative contributors. We are all indebted to these dedicated authors for their hard work, knowledge, thoughtfulness, and good judgment. Our sincere appreciation also goes to Judy Fletcher and Jennifer Shreiner at Elsevier and to Carolyn Redman at the Pediatric Department of the Medical College of Wisconsin. We have all worked hard to produce an edition that will be helpful to those who provide care for children and youth and to those desiring to know more about children's health worldwide.

In this edition we have had informal assistance from many faculty and house staff of the departments of pediatrics at the Medical College of Wisconsin, Wayne State University School of Medicine, Duke University School of Medicine, and University of Rochester School of Medicine. The help of these individuals and of the many practicing pediatricians from around the world who have taken the time to offer thoughtful feedback and suggestions is always greatly appreciated and helpful.

Last and certainly not least, we especially wish to thank our families for their patience and understanding without which this textbook would not have been possible.

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Nelson Textbook of

PEDIATRICS

PART I The Field of Pediatrics

Chapter 1
Overview of Pediatrics

Bonita F. Stanton and Richard E. Behrman

Children are the world's most important resource. Pediatrics is the sole discipline concerned with all aspects of the well-being of infants, children, and adolescents, including their health; their physical, mental, and psychologic growth and development; and their opportunity to achieve full potential as adults. Pediatricians must be concerned not only with particular organ systems and biologic processes, but also with environmental and social influences, which have a major impact on the physical, emotional, and mental health and social well-being of children and their families.

Pediatricians must be advocates for the individual child and for all children, irrespective of culture, religion, gender, race, or ethnicity or of local, state, or national boundaries. Children cannot advocate for themselves. The more politically, economically, or socially disenfranchised a population or a nation is, the greater the need for advocacy for children by the profession whose entire purpose is to advance the well-being of children. The young are often among the most vulnerable or disadvantaged in society and, thus, their needs require special attention. As divides between nations blur through advanced transportation and communication, through globalization of the economy, and through modern means of warfare and as the categorization of countries into "developed" or "industrialized" and "developing" or "low income" break down due to uneven advances within and across countries, a global perspective for the field of pediatrics becomes both a reality and a necessity.

The world population is growing at the rate of 1.14%/yr, with that of the USA growing at 0.88%/yr. Worldwide children younger than age 15 yr account for 1.8 billion (28%) of the world's 6.4 billion persons; in the USA, children younger than age 18 yr constitute approximately one quarter of the population.

In 2006, there were an estimated 133 million births worldwide, 124 million (92%) of which were in developing countries and 4.3 million (3%) of which were in the USA.

SCOPE AND HISTORY OF PEDIATRICS AND VITAL STATISTICS

More than a century ago, pediatrics emerged as a medical specialty in response to increasing awareness that the health problems of children differ from those of adults and that a child's response to illness and stress varies with age. In 1959, the United Nations issued the Declaration of the Rights of the Child, articulating the universal presumption that children everywhere have fundamental needs and rights. Virtually all nations have practicing pediatricians and most medical schools across the globe have departments of pediatrics or child health.

The health problems of children and youth vary widely between and within populations in the nations of the world depending on a number of often interrelated factors. These factors include (1) economic considerations (economic disparities); (2) educational, social, and cultural considerations; (3) the prevalence and ecology of infectious agents and their hosts; (4) climate and geography; (5) agricultural resources and practices (nutritional resources); (6) stage of industrialization and urbanization; (7) the gene frequencies for some disorders; and (8) the health and social welfare infrastructure available within these countries. Health problems are not restricted to single nations and are not limited by country boundaries; the interrelation of health issues across the globe has achieved widespread recognition in the wake of the SARS (severe acute respiratory syndrome) and AIDS epidemics, expansions in the pandemics of cholera and West Nile virus, war and bioterrorism, the tsunami of 2004, and the global recession beginning in 2008.

Reducing Child Mortality

Despite global interconnectedness, child health priorities continue to reflect local politics, resources, and needs. The state of health of any community must be defined by the incidence of illness and by data from studies that show the changes that occur with time and in response to programs of prevention, case finding, therapy, and surveillance. To ensure that the needs of children and adults across the globe were not obscured by local needs, in 2000 the international community established 8 Millennium Development Goals (MDGs) to be achieved by 2015 *(www.countdown2015mnch.org)*. Although all 8 MDGs impact child well-being, MDG 4 ("Reduce by two-thirds, between 1990 and 2015, the under-five mortality rate") is exclusively focused on children. Globally, there has been a 23% reduction in under-5 mortality since 1990 (from 93 to 72 deaths per 1,000 live births), with a 40% reduction in developed countries (10 to 6) but only a 21% reduction in the least developed countries (180 to 142). In 62 countries progress was inadequate to meet the goals and 27 countries (including most of those in sub-Saharan Africa) made no progress or declined between 1990 and 2006. There were nearly 13 million under-5 deaths in 1990; 2006 marked the 1st year that there were fewer than 10 million deaths (9.7 million) with a further decrease to 9.0 million in 2007 and 8.8 million in 2008. However, overall progress has not been on target to reach the goal (Fig. 1-1).

In the late 19th century in the USA, 200 of every 1,000 children born alive died before the age of 1 yr of conditions such as diarrhea, pneumonia, measles, diphtheria, and whooping cough. In developing countries today, the leading causes of death remains diarrhea, pneumonia, malaria, and measles with much of the reductions in mortality that have occurred resulting from effective vaccine programs, oral rehydration therapy, early diagnosis and treatment of pneumonia, and, treated mosquito nets.

Neonatal (<1 mo) death contributes substantially to the under-5 mortality rate, growing in proportion as the under-5 death rate decreases. Globally, the neonatal mortality rate of 28 per 1,000 live births represents 62% of the infant mortality rate of 45 per 1,000 live births and 43% of the under-5 death rate of 72. The proportion of neonatal deaths in industrialized countries is higher (60% of infant deaths and 50% of under-5 mortality) than in the least developed countries (49% of infant deaths and 31% of under-5 deaths). In populations with the highest child mortality rates, however, just over 20% of all child deaths occurred in the neonatal period, but in countries with mortality rates <35/1,000 live births, >50% of child deaths were in neonates.

Across the globe, there are significant variations in infant mortality rates by nation, by region, by economic status, and by level of industrial development, the categorizations employed by the World Bank and the United Nations (Table 1-1). Most of the decline in infant mortality in the USA and other industrialized countries since 1970 is attributable to a decrease in the birthweight-specific infant mortality rate related to neonatal intensive care, not to the prevention of low-birthweight births

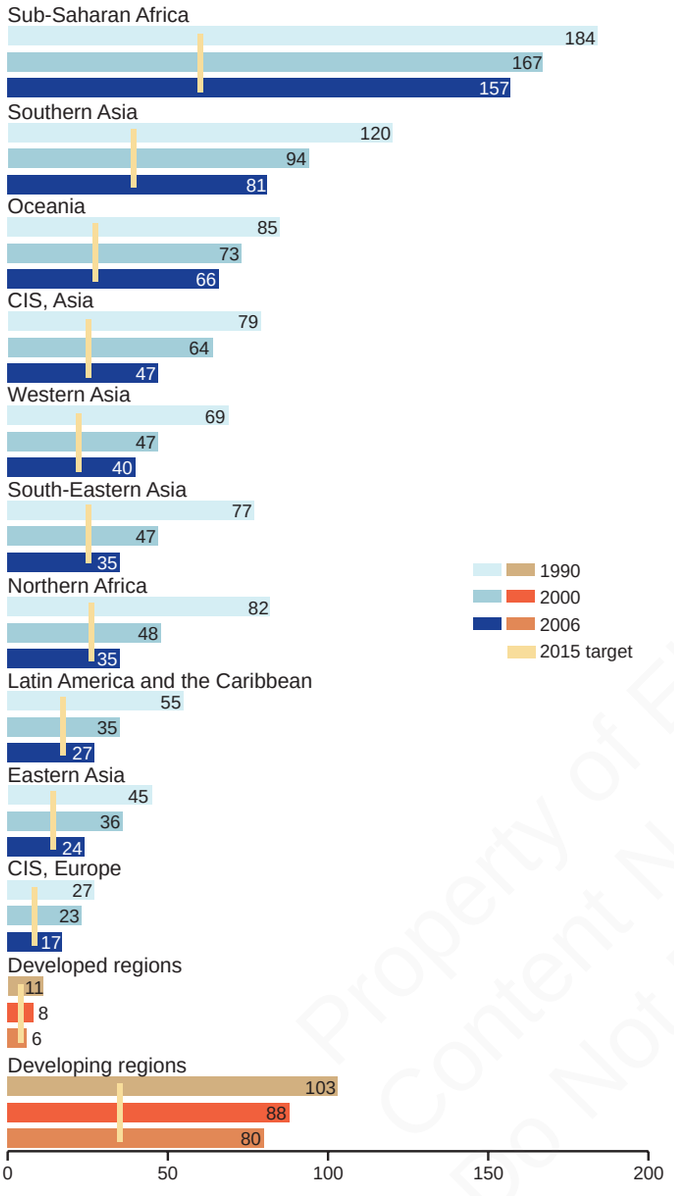

Figure 1-1 Under-5 mortality rate per 1,000 live births, 1990, 2000, and 2006. CIS, Commonwealth of Independent States (formerly the USSR). (From United Nations: *The millennium development goals report 2008,* New York, 2008, United Nations, p 20.)

(Chapter 87). The majority of deaths of infants younger than 1 yr of age occur in the 1st 28 days of life, most of these in the 1st 7 days; moreover, a large proportion of the deaths in the 1st 7 days occur on the 1st day. An increasing number of severely ill infants born at very low birthweight survive the neonatal period, however, and die later in infancy of neonatal disease, its sequelae, or its complications (Tables 1-2 through 1-4).

Causes of death vary by developmental status of the nation. In the USA, the 3 leading causes of death among infants were congenital anomalies, disorders related to gestation and low birthweight, and sudden infant death (Table 1-5). By contrast, in developing countries, the majority of infant deaths result from infectious diseases; even in the neonatal period, 24% of deaths are caused by severe infections and 7% by tetanus. In developing countries, 29% of neonatal deaths are due to birth asphyxia and 24% due to complications of prematurity.

In the majority of countries, the most robust predictor of infant mortality is a poor level of maternal education (and therefore another of the MDG addresses the need for universal access to primary schooling for girls). Other maternal risk characteristics, such as unmarried status, adolescence, and high parity, correlate with increased risk of postneonatal mortality and morbidity and low birthweight.

Health Among Postinfancy Children

A profound improvement in child health within industrialized nations occurred in the 20th century with the introduction of antibacterial disinfectants, antibiotic agents, and vaccines. Efforts to control infectious diseases were complemented by better understanding of nutrition. In the USA, Canada, and parts of Europe, new and continuing discoveries in these areas led to establishment of public well child clinics for low-income families. Although the timing of control of infectious disease was uneven around the globe, this focus on control was accompanied by significant decreases in morbidity and mortality in all countries. The smallpox eradication program of the 1970s resulted in the global eradication of smallpox in 1977. The introduction in the 1970s of the Expanded Program of Immunizations (universal vaccination against polio, diphtheria, measles, tuberculosis, tetanus, and pertussis) by the World Health Organization (WHO) and United Nations Children's Fund (UNICEF) has resulted in an estimated annual reduction of 1 to 2 million deaths per year globally. Recognizing the importance of prevention of infectious diseases to the health of children, several countries among the 50 currently ranked by the World Bank as among the poorest nations (per capita income <$750/yr) have invested heavily in infectious disease control through the development of internal vaccine production capability. As diarrheal diseases continued through the mid-1970s to account for ≈25% of infant and childhood deaths in the nonindustrialized countries (~4 million deaths per year at that time), attention turned to the development and utilization of oral resuscitation fluids to sustain children through potentially life-threatening episodes of acute diarrheal diseases. Oral rehydration solutions are largely credited with the current reduction of diarrheal deaths annually to 1.5 million.

In the later 20th century, with improved control of infectious diseases (including the elimination of polio in the Western hemisphere) through both prevention and treatment, pediatric medicine in industrialized nations increasingly turned its attention to a broad spectrum of conditions. These included both potentially lethal conditions and temporarily or permanently handicapping conditions; among these disorders were leukemia, cystic fibrosis, diseases of the newborn infant, congenital heart disease, mental retardation, genetic defects, rheumatic diseases, renal diseases, and metabolic and endocrine disorders. Thus, in industrialized nations, the end of the 20th century and 1st decade of the 21st century have been marked by accelerated understanding of new approaches to the management of many disorders as a consequence of advances in molecular biology, genetics, and immunology.

Increasing attention has also been given to behavioral and social aspects of child health, ranging from re-examination of child-rearing practices to creation of major programs aimed at prevention and management of abuse and neglect of infants and children. Developmental psychologists, child psychiatrists, neuroscientists, sociologists, anthropologists, ethnologists, and others have brought us new insights into human potential, including new views of the importance of the environmental circumstances during pregnancy, surrounding birth, and in the early years of child rearing. The later 20th century witnessed the beginning of nearly universal acceptance by pediatric professional societies of attention to normal development, child rearing, and psychosocial disorders across the continents. In the last decade, irrespective of level of industrialization, nations have developed programs addressing not only causes of mortality and physical morbidity (such as infectious diseases and protein-calorie malnutrition), but also factors leading to decreased cognition and thwarted psychosocial development, including punitive child-rearing practices,

Table 1-1 CHILD HEALTH INDICATORS WORLDWIDE BY REGION

	MORTALITY RATE BY YR PER 1,000 LIVE BIRTHS						Gross National per Capita Income 2008	Life Expectancy at Birth 2008	Primary School Attendance 2003-2008
	Under-5			Infant Mortality					
	1960	1990	2008	1960	1990	2008			
Sub-Saharan Africa	278	187	144	185	111	86	$1,109	52 yr	65%
Eastern and Southern Africa		165	120		102	76	$1,409	53 yr	71%
West and Central Africa		208	169		119	96	$833	51 yr	61%
Middle East and North Africa	249	79	43	157	58	33	$3,942	70 yr	84%
South Asia	244	123	76	148	87	57	$1,001	64 yr	81%
East Asia and Pacific	208	55	28	137	41	22	$3,136	72 yr	95%
Latin America and Caribbean	153	55	23	102	43	19	$6,888	74 yr	93%
CEE/CIS	112	53	23	83	43	20	$6,992	69 yr	93%
Industrialized countries	39	10	6	32	9	5	$40,772	80 yr	95%
Developing countries	224	103	72	142	70	49	$2,778	67 yr	83%
Least developed countries	278	180	129	171	113	82	$583	57 yr	66%
World	198	93	65	127	64	45	$8,633	69 yr	84%

Adapted from UNICEF: *The state of the world's children 2005: childhood under threat,* New York, 2004, UNICEF, Table 1, pp 108 and 117; and The State of The World's Children, Special Edition, Statistical Tables, 2009. Table 1, page 11.
CEE/CIS, Central and Eastern Europe/Commonwealth of Independent States (formerly the USSR).

Table 1-2 DEATH RATES FOR ALL CAUSES, BY SEX, RACE, AND AGE: UNITED STATES, SELECTED YEARS 1960 AND 2005

	1960		2005	
	White	Black	White	Black
MALE				
Under 1 yr	2,694.1	5,306.8	640.0	1,437.2
1-4 yr	104.9	208.5	30.9	46.7
5-14 yr	52.7	75.1	17.1	27.0
15-24 yr	143.7	212.0	110.4	172.1
FEMALE				
Under 1 yr	2,007.7	4,162.2	515.3	1,179.7
1-4 yr	85.2	173.3	22.9	36.7
5-14 yr	34.7	53.8	12.8	19.4
15-24 yr	54.9	107.5	41.5	51.2

Adapted from National Center for Health Statistics: *Health, United States, 2007: with chartbook on trends in the health of Americans,* Hyattsville, MD, 2007, U.S. Department of Health and Human Services, Table 35, pp 1–3, selected years 1960 and 2005.

Table 1-3 DEATHS RATES FOR ALL CAUSES AMONG CHILDREN AND YOUNG ADULTS ACCORDING TO SEX, RACE, HISPANIC ORIGIN, AND AGE: 2006

	DEATHS PER 100,000 RESIDENT POPULATION			
	Under 1 yr	1-4 yr	5-14 yr	15-24 yr
All persons	692.7	28.4	15.3	82.1
Male	757.6	30.5	17.5	119.1
Female	624.7	26.2	12.9	42.8
MALES				
White	635.9	27.5	16.4	111.7
Black male (African-American)	1387.0	46.8	24.9	171.1
American Indian or Alaska Native	1,066.6	58.1	16.8	153.2
Asian or Pacific Islander	478.0	18.6	11.4	60.8
Hispanic or Latino	642.1	28.8	16.0	118.8
White not Hispanic or Latino	625.7	26.8	16.2	107.9
FEMALES				
White	519.1	23.4	12.0	41.8
Black (African-American)	1194.9	39.5	17.3	51.1
American Indian or Alaska Native	689.9	51.7	17.0	63.2
Asian or Pacific Islander	368.6	21.3	10.3	25.6
Hispanic or Latino	542.5	23.9	11.8	34.5
White not Hispanic or Latino	505.4	23.2	11.9	43.1

Adapted from Heron MP, Hoyert DL, Xu J, et al: Deaths: preliminary data for 2006, *Natl Vital Stat Rep* 56(16):1–52, 2008.

child labor, undernutrition, war, and poor schooling. Obesity is recognized as a major health risk not only in industrialized nations, but increasingly in transitional countries. Progress at the turn of the 21st century in unraveling the human genome offers for the 1st time the realization that significant genetic screening, individualized pharmacotherapy, and genetic manipulation will be a part of routine pediatric treatment and prevention practices in the future. The prevention implications of the genome project give rise to the possibility of reducing costs for the care of illness but also increase concerns about privacy issues (Chapter 3).

Although local famines and disasters, and regional and national wars have periodically disrupted the general trend for global improvement in child health indices, it was not until the advent of the AIDS epidemic in the later 20th century that the 1st substantial global erosion of progress in child health outcomes occurred. This erosion has resulted in ever-widening gaps between childhood health indices in sub-Saharan Africa compared to the rest of the world. From 1990 to 2002, life expectancy in sub-Saharan Africa decreased from 50 yr to 46 yr; although, as of 2008, it had returned to 52 yrs. Increasing rates of tuberculosis and continued problems with pandemics such as cholera further challenge many of these nations. Strains of drug-resistant malaria are also a major concern in isolated areas around the world, but 90% of malarial deaths (the majority among children) are occurring in sub-Saharan Africa. Diseases once confined to limited geographic niches, including West Nile virus, and diseases previously uncommon among humans, such as the avian flu virus, increased awareness of the interconnectedness of health around the world. Formerly perceived as a problem of industrialized nations, motor vehicle crashes are now a major cause of mortality in developing countries as well.

Enormous disparities exist in childhood mortality rates across the globe (see Table 1-1). Among the ~8.7 million childhood deaths occurring worldwide, ≈50% occur in sub-Saharan Africa, home to <10% of the world's population. Fifty percent of the world's childhood deaths are occurring in 6 nations; 90% of childhood deaths are occurring in only 42 of the world's 192 nations. In 2008, the USA had an under-5 mortality rate of 8/1,000 live births. Forty-two nations had under-5 mortality rates

Table 1-4 INFANT, NEONATAL, AND POSTNATAL DEATHS AND MORTALITY RATES BY SPECIFIED RACE OR ORIGIN OF MOTHER: USA, 2005

RACE OF MOTHER	LIVE BIRTHS	MORTALITY RATE PER 1,000 LIVE BIRTHS		
		Infant	Neonatal	Postnatal
All races	4,138,573	6.86	4.54	2.32
White	3,229,494	5.73	3.77	1.96
Black or African American	633,152	13.26	8.92	4.33
American Indian or Alaska Native	44,815	8.06	4.04	4.02
Asian or Pacific Islander	231,112	4.89	3.37	1.51
Hispanic or Latino	985,513	5.62	3.86	1.76
Mexican	693,202	5.53	3.78	1.75
Puerto Rican	63,341	8.30	5.95	2.37
Cuban	16,064	4.42	3.05	1.37
Central and South American	151,202	4.68	3.23	1.46
Other and unknown Hispanic or Latino	61,704	6.43	4.31	2.14
Not Hispanic or Latino				
White	2,279,959	5.76	3.71	2.05
Black or African American	583,764	13.63	9.13	4.50

Adapted from Mathews TJ, MacDorman MF. Infant mortality statistics from the 2005 period linked birth/infant death data set, *Natl Vital Stat Rep* 57(2):1–32, 2008.

lower than that of the USA, with Singapore, Finland, Luxembourg, Iceland, and Sweden having the lowest rates at 3/1,000. The comparable child mortality rate in sub-Saharan Africa was 144/1,000 live births. As of 2008, Afghanistan has the highest under-5 mortality rate of 257/1,000 live births, followed by Angola at 220/1,000 live births and Chad at 209/1,000 live births. In 1990 Afghanistan and Angola had an under-5 mortality rate of 260/1,000 live births, showing minimal improvement over 2 decades. Causes of under-5 mortality differ markedly between developed and developing nations. In developing countries, 66% of all deaths resulted from infectious and parasitic diseases. Among the 42 countries having 90% of childhood deaths, diarrheal disease accounted for 22% of deaths, pneumonia 21%, malaria 9%, AIDS 3%, and measles 1%. Neonatal causes contributed to 33%. The contribution for AIDS varies greatly by country, being responsible for a substantial proportion of deaths in some countries and negligible amounts in others. Likewise, there is substantial co-occurrence of infections; a child may die with HIV, malaria, measles, and pneumonia. Infectious diseases are still responsible for much of the mortality in developing countries. In the USA, pneumonia (and influenza) accounted for only 2% of under-5 deaths, with only negligible contributions from diarrhea and malaria. Unintentional injury is the most common cause of death among U.S. children ages 1-5 yr, accounting for about 33% of deaths, followed by congenital anomalies (11%), malignant neoplasms (8%), and homicides (7%). Other causes accounted for <5% of total mortality within this age group (see Table 1-5). Although unintentional injuries in developing countries are proportionately less important causes of mortality than in developed countries, their absolute rates and their contributions to morbidity are substantially greater.

Morbidities Among Children

It is important to examine morbidities as well as mortality. Adequately addressing special health care needs is important in all countries both to minimize loss of life and to maximize the potential of each individual.

In the USA, ≈70% of all pediatric hospital bed days are for chronic illnesses; 80% of pediatric health expenditures are for 20% of children. In 2006, about 13.9% of U.S. children were reported to have special health care needs; 21.8 percent of households with children had ≥1 child with a special health care need (Chapter 39). Significantly more poor children and minority children have special health care needs. Although there are multiple chronic conditions and the prevalence of these disorders vary by population, 2 of these morbidities—obesity and asthma—have a substantial and increasing presence worldwide and are associated with substantial health consequences and costs. In the USA, ~25% of children and adolescents are overweight, representing a 2.3- to 3.3-fold increase over the past 25 yr. Similar rates have been reported from Australia and multiple countries in Europe, Egypt, Chile, Peru, and Mexico (Chapter 44).

Also increasing in prevalence among industrialized nations and in middle- and low-income nations with substantial urbanization are rates of asthma. In the mid-1990s, the USA reported an annual prevalence rate of wheezing of 57.8/1,000 among children ages 0-4 yr and 74.4/1,000 among youth ages 5-15 yr, approximately 2-fold higher than comparable prevalence rates in 1980. In 2007, the Centers for Disease Control and Prevention (CDC) estimated that 9% of U.S. children have asthma, including 19.2% of Puerto Rican and 12.7% of non-Hispanic black children. The International Study of Asthma and Allergies in Childhood has conducted a systematic review of asthma prevalence, with compelling evidence for a substantial global burden of childhood asthma, although rates vary substantially between and within countries. The highest annual prevalence rates are in the United Kingdom, Australia, New Zealand, and Ireland, with the lowest rates in Eastern European countries, Indonesia, China, Taiwan, India, and Ethiopia (Chapter 138).

Chronic cognitive morbidities represent another substantial problem. Although different diagnostic criteria have been applied, attention-deficit/hyperactivity disorder (ADHD) has been identified in 5-12% of children in countries across the globe. Rates exceeding 10% have been reported in the USA, New Zealand, Australia, Spain, Italy, Colombia, and Great Britain. Variations in cultural tolerance and/or differences in screening approaches or tools may account for some of the differences in prevalence of the disorder by country, but genetic and gene-environmental interactions may also play a role. Despite variations in rate, the condition is universal. Beyond the personal and familial stress caused by the disorder, costs to the educational system are considerable. It is estimated that in 2010 the U.S. drug treatment costs for ADHD will exceed $4 billion. In developing countries without resources for special education, these children are unlikely to fulfill their academic potential (Chapter 30).

Mental retardation affects ≈1-3% of children in the USA, with ~80% of these children having mild retardation. Rates are severalfold higher among very low birthweight infants, although data from European cerebral palsy (CP) registries has revealed a significant decrease in the prevalence of CP in very low birthweight infants, from 60.6 per 1,000 live births in 1980 to 39.5 per 1,000 live births in 1996. In the USA, there is substantial variation in rates of mild retardation by socioeconomic status (9-fold higher in the lowest compared to the highest socioeconomic stratum) but relatively equivalent rates of severe retardation. A similar income-related distribution is found in other countries, including some of the most impoverished countries such as Bangladesh. Lower overall rates have been reported in some countries, including countries ranging from Saudi Arabia to Sweden to China; the difference is primarily in the prevalence of mild retardation (Chapter 33).

The prevalence of post-traumatic stress disorder (PTSD) varies considerably around the globe, but in children with substantial exposure to violence, the rates may be very high. After the attacks on the World Trade Center towers and the Pentagon in 2001, 33% of U.S. children had experienced 1 or more symptoms of PTSD. One half of Palestinian children experience at least 1 significant lifetime trauma and >33% (66% of those experiencing

Table 1-5 LEADING CAUSES OF DEATH AND NUMBERS OF DEATHS, ACCORDING TO AGE: UNITED STATES 2005

AGE AND RANK ORDER	CAUSE OF DEATH	NUMBER	PERCENT OF TOTAL DEATHS
Under 1 yr	All causes	27,936	100.0
	Congenital malformations, deformations, and chromosomal abnormalities	5,622	20.1
	Disorders related to short gestation and low birthweight, not elsewhere classified	4,642	16.6
	Sudden infant death syndrome	2,246	8.0
	Newborn affected by maternal complications of pregnancy	1,715	6.1
	Accidents	1,052	3.8
	Newborn affected by complications of placenta, cord, and membranes	1,042	3.7
	Respiratory distress of newborn	875	3.1
	Bacterial sepsis of newborn	827	3.0
	Neonatal hemorrhage	616	2.2
	Diseases of the circulatory system	593	2.1
	All other causes	8,706	31.2
1-4 yr	All causes	4,785	100.0
	Accidents	1,641	34.3
	Congenital malformations, deformations, and chromosomal abnormalities	569	11.9
	Malignant neoplasms	399	8.3
	Assault	377	7.9
	Diseases of heart	187	3.9
	Influenza and pneumonia	119	2.5
	Septicemia	84	1.8
	Certain conditions originating in the perinatal period	61	1.3
	In situ neoplasms, benign neoplasms, and neoplasms of uncertain or unknown behavior	53	1.1
	Chronic lower respiratory diseases	48	1.0
	All other causes	1,247	26.1
5-9 yr	All causes	2,888	100.0
	Accidents	1,126	39.0
	Malignant neoplasms	526	18.2
	Congenital malformations, deformations, and chromosomal abnormalities	205	7.1
	Assault	122	4.2
	Diseases of heart	83	2.9
	Chronic lower respiratory diseases	46	1.6
	In situ neoplasms, benign neoplasms, and neoplasms of uncertain or unknown behavior	41	1.4
	Septicemia	38	1.3
	Cerebrovascular diseases	34	1.2
	Influenza and pneumonia	33	1.1
	All other causes	634	22.0
10-14 yr	All causes	3,946	100.0
	Accidents	1,540	39.0
	Malignant neoplasms	493	12.5
	Intentional self-harm	283	7.2
	Assault	207	5.2
	Congenital malformations, deformations, and chromosomal abnormalities	184	4.7
	Diseases of heart	162	4.1
	Chronic lower respiratory diseases	74	1.9
	Influenza and pneumonia	49	1.2
	In situ neoplasms, benign neoplasms, and neoplasms of uncertain or unknown behavior	43	1.1
	Cerebrovascular diseases	43	1.1
	All other causes	868	22.0
15-19 yr	All causes	13,706	100.0
	Accidents	6,825	49.8
	Assault	1,932	14.1
	Intentional self-harm	1,700	12.4
	Malignant neoplasms	731	5.3
	Diseases of heart	366	2.7
	Congenital malformations, deformations, and chromosomal abnormalities	257	1.9
	Cerebrovascular diseases	69	0.5
	Influenza and pneumonia	67	0.5
	Chronic lower respiratory diseases	85	0.6
	In situ neoplasms, benign neoplasms, and neoplasms of uncertain or unknown behavior	50	0.4
	Anemias	50	0.4
	All other causes	1,574	11.5
20-24 yr	All causes	19,715	100.0
	Accidents	8,624	43.7
	Assault	3,153	16.0
	Intentional self-harm	2,616	13.3
	Malignant neoplasms	978	5.0
	Diseases of heart	672	3.4
	Congenital malformations, deformations, and chromosomal abnormalities	226	1.1
	Human immunodeficiency virus	160	0.8
	Cerebrovascular diseases	142	0.7
	Pregnancy, childbirth, and the puerperium	131	0.7
	Influenza and pneumonia	118	0.6
	All other causes	2,895	14.7

Adapted from National Center for Health Statistics: Health, United States, 2007: with chartbook on trends in the health of Americans, Hyattsville, MD, 2007, U.S. Department of Health and Human Services.

trauma) meet the criteria of PTSD. Natural disasters such as the tsunami of 2004 and the Haitian and Chilean earthquakes and Pakistani floods of 2010; war, including those in Afghanistan, Sudan, and Iraq; and urban violence all leave their indelible marks on the minds of children.

SPECIAL RISK POPULATIONS

In addition to the enormous differences in infant and child health between regions and nations, within countries there are substantial variations in morbidity and mortality rates by socioeconomic class and ethnicity. Most children at special risk need a nurturing environment but have had their futures compromised by actions or policies arising from their families, schools, communities, nations, or the international community. These problems have several causes, whether the end result is homeless children, runaway children, children in foster care, or children in other disadvantaged groups. The most effective preventive approach involves alleviation of poverty, inadequate parenting, discrimination, violence, poor housing, and poor education. Optimal care of these children requires reducing barriers to health care with organized programs, multidiscipline teams, and special financing.

Children in Poverty

Family income is central to the health and well-being of children. Children living in poor families, especially those located in poor communities, are much more likely than children living in upper- or middle-class families to experience material deprivation and poor health, die during childhood, score lower on standardized tests, be retained in a grade or drop out of school, have out-of-wedlock births, experience violent crime, end up as poor adults, and suffer other undesirable outcomes. In 2008, 20.7% of U.S. children <18 yr (21% of those less than 6 yr) lived in poverty (defined as income <$21,756/yr for a family of 4), a rate among the highest of developed countries. Seven percent lived in extreme poverty. The poverty rates are higher for children than adults and are highest for infants and toddlers. Children who are poor have higher than average rates of death and illness from almost all causes (exceptions being suicide and motor vehicle crashes, which are most common among white, non-poor children). Many factors associated with poverty are responsible for these illnesses; crowding, poor hygiene and health care, poor diet, environmental pollution, poor education, and stress.

Similar poverty-linked disparities may exist in countries with very high infant mortality rates (sub-Saharan Africa). In the low-income developing countries, the rate of infant mortality among the poorest quintile of the population is more than twice that of the wealthiest quintile (Fig. 1-2).

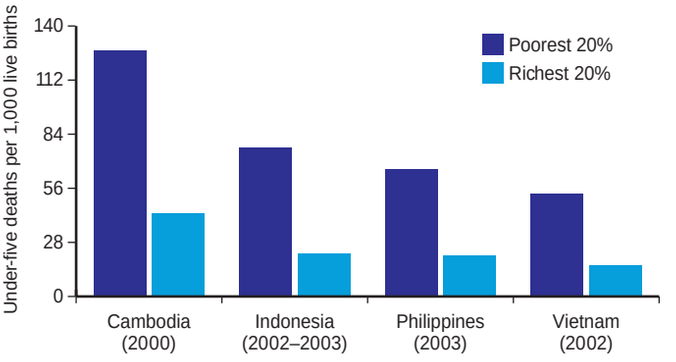

Figure 1-2 Poor children across South-Eastern Asia are much more likely to die before age 5 than their wealthier peers. (From World Health Organization: *World health statistics 2007*, Geneva, 2007, World Health Organization, p 74; and United Nations Development Programme: *Human Development Report 2007/08: fighting climate change: human solidarity in a divided world,* New York, 2007, United Nations Development Programme, p 255.)

Poverty and economic loss diminish the capacity of parents to be supportive, consistent, and involved with their children. Clinicians at all times but especially in the context of a national or global recession need to be especially alert to the development and behavior of children whose parents have lost their jobs or who live in permanent poverty. Fathers who become unemployed frequently develop psychosomatic symptoms, and their children often develop similar symptoms. Young children who grew up in the Great Depression in the USA and whose parents were subject to acute poverty suffered more than older children, especially if the older ones were able to take on responsibilities for helping the family economically. Such responsibilities during adolescence seem to give purpose and direction to an adolescent's life. The younger children, faced with parental depression and unable to do anything to help, suffered a higher frequency of illness and a diminished capacity to lead productive lives even as adults.

Pediatricians and other child health workers have a responsibility both to mitigate the effects of poverty on their patients and to contribute to efforts to reduce the number of children living in poverty. Clinicians should ask parents about their economic resources, adverse changes in their financial situation, and the family's attempts to cope. Encouraging concrete methods of coping, suggesting ways to reduce stressful social circumstances while increasing social networks that are supportive, and referring patients and their families to appropriate welfare, job training, and family agencies can significantly improve the health and functioning of children at risk when their families live in poverty. In many cases, special services, especially social services, need to be added to the traditional medical services; outreach is required to find and encourage parents to use health services and bring their children into the health care system. Pediatricians also have the responsibility to contribute to and advocate for safety net services for impoverished children within and outside the boundaries of their own country. An increasing number of programs are available to help children of greatest need worldwide, such as Project Smile, CARE, Project Hope, and Doctors without Borders.

Children of Immigrants and Racial Minority Groups Including U.S. Native Americans

Eleven percent of the U.S. population is foreign-born; 1 of every 5 children lives in an immigrant family. The USA is experiencing a wave of immigration larger than that occurring in the early 20th century. There has been an increase in immigration from China, India, Southeast Asia, Mexico, the Dominican Republic, and the former Soviet Union nations. Until the mid-20th century, emigrants to the USA were primarily white and from Europe. Such individuals now represent only about 10% of immigrants; the remainder are overwhelmingly of color and from throughout the world. Although immigrants in the USA have faced discrimination and oppression throughout history, the potential for such discrimination is compounded by the racial differences represented in the current immigrant pool. In the USA, about 240,000 children legally immigrate each year, and an estimated 50,000/yr enter the country illegally, although these numbers have been declining in the wake of the 2008 recession. Immigrants comprise >15% of the population in >50 countries, including many Western European countries.

The immigrant population constitutes a substantial proportion of the low-wage labor market. Immigrants represent 14% of all U.S. workers but 20% of low-wage workers. Immigrants are twice as likely as U.S.–born citizens to earn less than minimum wage. The poverty rate of children in immigrant families is 50% greater than in U.S.–born families, with 50% of immigrant children compared to 33% of children in U.S.–born families being below the 200% poverty level. Contributing to the lack of access to higher salaried jobs is the lack of proficiency in English (≈66% of immigrants) and the lack of education (40% have not completed high school). In the past decade, about 9 million immigrants attained permanent residency status. There may be 850,000-1,000,000 illegal immigrant children.

Families of different origins obviously bring different health problems and different cultural backgrounds, which influence health practices and use of medical care. To provide appropriate services, clinicians need to understand these influences (Chapter 4). For example, the high prevalence of hepatitis among women from Southeast Asia makes use of hepatitis B vaccine essential for their newborns. Children from Southeast Asia and South America have growth patterns that are generally below the norms established for children of Western European origin, as well as high rates of hepatitis, parasitic diseases, and nutritional deficiencies and high degrees of psychosocial stress. Foreign-born children may surpass American-born children in some health outcomes, but their health deteriorates as they become acculturated (Chapter 4).

Refugee children who escape from war or political violence and whose families have been subjected to extreme stress represent a subset of immigrant children who have faced severe trauma. These children have a particularly high incidence of mental and behavioral problems (Chapter 23).

"Linguistically isolated households," in which no one older than 14 yr of age speaks English, often present significant obstacles to providing quality health care to children because of difficulties in understanding and communicating basic concerns and instructions, avoiding compromising privacy and confidentiality interests, and obtaining informed consent (Chapter 4).

The USA is home to multiple minority populations, including the 2 largest groups, Latinos and African-Americans. The nonwhite minority groups will constitute >50% of the U.S. population by 2050 (Chapter 4). Nonwhite children in the USA disproportionately experience adverse child health outcomes (see Tables 1-2 through 1-4). Infants that are born to African-American mothers experience low birthweight and infant mortality rates twice those with white mothers (Chapter 87). Rates of these 2 adverse health outcomes are also substantially higher among some groups of Hispanic infants and children, although there is great variation by country of origin. The rates are particularly high among those of Puerto Rican descent (≈1.5 times the rates for white infants). In 2006, the overall infant mortality rate was 6.7/1,000 live births, whereas that for non-Hispanic African-America infants was 13.6; for Native Americans, 8.1; and for Puerto Ricans, 8.3. Mexicans, Asians, Pacific Islanders, Central and South Americans, and Cubans were below the national average. Latino, Native American, and African-American children are substantially more likely to live in poverty than are white children.

There are ≈2.5 million Native Americans (4.1 million in combination with other races/ethnicities) and 558 federally recognized tribes. With 840,000 children (1.4 million in combination), the Native American population has a much higher proportion of children (34%) than does the remainder of the U.S. population (26%). About 60% of Native Americans live in urban areas, not on or near native lands. Like their minority immigrant counterparts, they have faced social and economic discrimination. The unemployment and poverty levels of Native Americans are, respectively, 3-fold and 4-fold that of the white population, and far fewer Native Americans graduate from high school or go to college. The rate of low birthweight among Native Americans is more than the white rate but less than the black rate. The neonatal and the postneonatal mortality rates are higher for Native Americans living in urban areas than for urban white Americans. Deaths in the 1st yr of life due to sudden infant death syndrome, pneumonia, and influenza are higher than the average in the USA, whereas deaths due to congenital anomalies, respiratory distress syndrome, and disorders relating to short gestation and low birthweight are similar.

Unintended injury deaths among Native Americans occur at twice the rate for other U.S. populations; deaths due to malignant neoplasms are lower. During adolescence and young adulthood, suicide and homicide are the 2nd and 3rd causes of death in this population and occur at about twice the rates of the rest of the population. There may be significant underreporting of deaths of Native American children.

As many as 75% of Native American children have recurrent otitis media and high rates of hearing loss, resulting in learning problems. Tuberculosis and gastroenteritis, formerly much more common among Native Americans, now occur at about the national average. Psychosocial problems are more prevalent in these populations than in the general population: depression, alcoholism, drug abuse, out-of-wedlock teenage pregnancy, school failure and dropout, and child abuse and neglect.

Most other nations have indigenous populations who are subjected to discrimination, social and economic sanctions, and/or physical maltreatment and who demonstrate the poorest child health outcomes. An estimated 300 million indigenous persons live in 70 countries (50% in Asia) and speak ≈4,000 languages. Such children endure lower vaccination rates, lower school entry and higher dropout rates, higher rates of poverty, and lower access to justice. Indigenous children in Latin America account for 66% of the deaths of children younger than age 2 yr.

In the USA, existing programs for meeting child health problems are not available to all families in need, with gaps between eligibility for public support and parents' ability to pay for services. Needed services for immigrants are often either nonexistent or fragmented among programs, agencies, or policies. Programs are often poorly coordinated, and the data collection is inadequate.

Children of Migrant Workers

Families facing economic, social, or political hardship have been forced to leave their land and homes in search of better opportunities; such migrations are often within a country or between neighboring countries. Both industrialized and developing countries experience these migrations.

In the USA, there are an estimated 3-5 million migrant and seasonal farm workers and their families. The eastern migration is primarily from Florida, whereas the western migration comes from Texas, other border states, and Mexico. Many children travel with their parents and experience poor housing, frequent moves, and a socioeconomic system controlled by a crew boss who arranges the jobs, provides transportation, and often, together with the farm owners, provides food, alcohol, and drugs under a "company store" system that leaves migrant families with little money or in debt. Children often go without schooling; medical care is usually limited.

The medical problems of children of migrant farm workers are similar to those of children of homeless families: increased frequency of infections (including HIV), trauma, poor nutrition, poor dental care, low immunization rates, exposures to animals and toxic chemicals, anemia, and developmental delays.

Among the most substantial migrant populations in the world is China's "floating population," an estimated 100 million (almost 10% of China's population) of rural to urban migrants. The rapidly growing urban versus rural income gradient and a relaxation of restrictions on movement in the country has fueled this influx of rural residents who arrive in China's urban areas without health, education, or employment benefits for themselves or their children. Similar patterns are seen in many countries in Asia, Africa, and South America. In most of these countries there are few legal or social programs to aid the families or their children, spawning massive squatter settlements without provisions for water, sanitation, education, or basic health needs. Government policies vary worldwide, but in some instances their response to such communities is to bulldoze the settlements and imprison or deport the residents.

Homeless Children

Families with children are the fastest growing segment of the homeless population in the USA. Children make up over 35% of the homeless population, over 40% of whom are under age 5 yr, with an estimated 100,000 children living in shelters on a given night and about 500,000 homeless each year. Many homeless are not in shelters (living in the street or with extended families), and thus these figures are low estimates. The population of homeless children has been increasing as a consequence of more families with children living in poverty or near poverty, fewer available affordable dwellings for these families, decreasing public assistance programs for the non-elderly poor, and the rising prevalence of substance abuse.

Homeless children have an increased frequency of illness, including intestinal infections, anemia, neurologic disorders, seizures, behavioral disorders, mental illness, and dental problems, as well as increased frequency of trauma and substance abuse. Homeless children are admitted to U.S. hospitals at a much higher rate than the national average. They have higher school failure rates, and the likelihood of their being victims of abuse and neglect is much higher. In 1 study, 50% of such children were found to have psychosocial problems, such as developmental delays, severe depression, or learning disorders. The increased

frequency of maternal psychosocial problems, especially depression, in homeless households has a significant untoward impact on the mental and physical health of these children. Because families tend to break apart under the strain of poverty and homelessness, many homeless children end up in foster care. If their families remain intact, frequent moves make it very difficult for them to receive continuity of medical care.

Homelessness exists worldwide. There are an estimated 3 million people in the 15 countries of the European Union who do not have a permanent home while in Canada there are 200,000-300,000 homeless. In some nations in Latin America, Asia, and Africa, the distinction between rural-to-urban migrants and homelessness is blurred.

Provision of adequate housing, job retraining for the parents, and mental health and social services are necessary to prevent homelessness from occurring. Physicians can have an important role in motivating society to adopt the social policies that will prevent homelessness from occurring by educating policymakers that these homeless children are at greater risk of becoming burdens both to themselves and to society if their special health needs are not met.

Runaway and Thrown-Away Children

The number of runaway and thrown-away children and youths in the USA is estimated at about 500,000; several hundred thousand of these children have no secure and safe place to stay. Teenagers make up most of both groups. The usual definition of a runaway is a youth younger than 18 yr who is gone for at least 1 night from his or her home without parental permission. Most runaways leave home only once, stay overnight with friends, and have no contact with the police or other agencies. This group is no different from their "healthy" peers in psychologic status. A smaller but unknown number become multiple or permanent "runners" and are significantly different from the one-time runners.

Thrown-aways include children told directly to leave the household, children who have been away from home and are not allowed to return, abandoned or deserted children, and children who run away but whose caretakers make no effort to recover them or do not appear to care if they return. The same constellation of causes common to many of the other special-risk groups is characteristic of permanent runaways, including environmental problems (family dysfunction, abuse, poverty) and personal problems of the young person (poor impulse control, psychopathology, substance abuse, or school failure). Thrown-aways experience more violence and conflicts in their families.

In the USA, it is a minority of runaway youths who become homeless street people. These youths have a high frequency of problem behaviors, with 75% engaging in some type of criminal activity and 50% engaging in prostitution. A majority of permanent runaways have serious mental problems; more than 33% are the product of families who engage in repeated physical and sexual abuse (Chapter 37). These children also have a high frequency of medical problems, including hepatitis, sexually transmitted infections, and drug abuse. Although runaways often distrust most social agencies, they will come to and use medical services. Medical care may become the point of re-entry into mainstream society and the path to needed services. U.S. parents who seek a physician's advice about a runaway child should be asked about the child's history of running away, the presence of family dysfunction, and personal aspects of the child's development. If the youth contacts the physician, the latter should examine the youth and assess his or her health status, as well as willingness to return home. If it is not feasible for the youth to return home, foster care, a group home, or an independent living arrangement should be sought by referral to a social worker or a social agency. Although legal considerations involved in the treatment of homeless minor adolescents may be significant, most states, through their "Good Samaritan" laws and definitions of emancipated minors, authorize treatment of homeless youths. Legal barriers should not be used as an excuse to refuse medical care to runaway or thrown-away youths.

The issue of runaway youths is very complex in many developing nations, where in many instances the youth may be orphaned and/or leaving situations of forced sex or other abusive situations. It is estimated that there are tens of millions of such youth worldwide. Natural disasters such as the 2010 earthquake devastating Haiti also contribute to growing numbers of orphaned children. In 2007, there were an estimated 11-15 million HIV orphans in Africa; this number is estimated to grow to as high as 20 million by 2010. With school attendance <50% in many parts of sub-Saharan Africa, children who are orphaned are 17% less likely to attend school. Humanitarian and international organizations have begun to focus on this very vulnerable group of youths across the globe. Rates are often uncertain, and in many countries, these children have not even been recognized as an at-risk group, so great is the social chaos and so massive are the unmet needs.

Children Directly Affected By War (Chapter 36.2)

Since the end of the Second World War, there have been ~250 major wars (defined as armed combat with over 1,000 casualties), the majority of which have been civil wars. Many of these conflicts have lasted over a decade; Angola has been engaged in civil war for nearly 3 decades. Sixteen of the world's poorest 20 countries have endured a civil war in the past 15 yr. In modern wars, 70-80% of casualties are among women and children. Direct mortality and morbidity to children account for only a portion of war's destructive impact on children. In 1996 the United Nations commissioned a report addressing the full consequences of war on children entitled "Promotion and Protection of the Rights of Children: Impact of Armed Conflict on Children" including (1) the disruption of basic educational and child health pediatric care and services; (2) hardships endured as a result of refugee status; (3) the abuse of the 250,000 to 300,000 children under age 18 yr who are soldiers; and (4) the impact on children when 1 or both parents are deployed to serve.

Inherent Strengths in Vulnerable Children and Interventions

By age 20-30 yr, many children in the USA and other developed countries who were at special risk will have made moderate successes of their lives. Teenage mothers and children who were born prematurely or in poverty demonstrate that, by this age, the majority have made the transition to stable marriages and jobs and are accepted by their communities as responsible citizens. As the numbers of risk factors increases for an individual, however, the odds for a successful adulthood decline.

Certain biologic characteristics are associated with success, such as being born with an accepting temperament. Avoidance of additional social risks is even more important. Premature infants or preadolescent boys with conduct disorders and poor reading skills, who must also face a broken family, poverty, frequent moves, and family violence, are at much greater risk than children with only 1 of these risks. Perhaps most important are the protective buffers that have been found to enhance children's resilience because these can be aided by an effective health care system and community. Children generally do better if they can gain social support, either from family members or from a nonjudgmental adult outside the family, especially an older mentor or peer. Providers of medical services should develop ways to "prescribe" supportive "other" persons for children who are at risk. Promotion of self-esteem and self-efficacy is a central factor in protection against risks. It is essential to promote competence in some area of these children's lives. Prediction of the consequences of risk is never 100% accurate. However, the confidence that, even without aid, many such children will achieve a good outcome by age 30 yr does not justify ignoring or withholding services from them in early life.

A team is needed because it is rare for 1 individual to be able to provide the multiple services needed for high-risk children. Successful programs are characterized by at least 1 caring person who can make personal contact with these children and their families. Most successful programs are relatively small (or are large programs divided into small units) and nonbureaucratic but are intensive, comprehensive, and flexible. They work not only with the individual, but also with the family, school, community, and at broader societal levels. Generally, the earlier the programs are started, in terms of the age of the children involved, the better is the chance of success. It is also important for services to be continued over a long period.

The Challenge to Pediatricians

Concerns about the aforementioned problems of children throughout the world have generated 3 sets of goals. The *1st set* includes that all families have access to adequate perinatal, preschool, and family-planning services; that international and national governmental activities be effectively coordinated at the global, regional, national, and local levels; that services be so organized that they reach populations at special risk; that there be no insurmountable or inequitable financial barriers to adequate care; that the health care of children have continuity from prenatal through adolescent age periods; and that every family ultimately have access to all necessary services, including developmental, dental, genetic, and mental health services. A *2nd set* of goals addresses the need for reducing unintended injuries and environmental risks, for meeting nutritional needs, and for health education aimed at fostering health-promoting lifestyles. A *3rd set* of goals covers the need for research in biomedical and behavioral science, in fundamentals of bioscience and human biology, and in the particular problems of mothers and children.

The unfinished business in the quest for physical, mental, and social health in the community is illustrated by the disparities with which deaths due to disease, injuries, and violence are distributed among white, black, and Hispanic children in the USA and between and within nations. Homicide is a major cause of adolescent deaths and has increased in rate among the very young, in whom the increase may, in part, represent the more accurate identification of child abuse (Chapter 37). Among adolescents, homicide may reflect unresolved social tensions, substance abuse (cocaine, crack), and an unhealthy preoccupation with violence in our society (Part III and Chapters 36, 107, and 108).

PATTERNS OF HEALTH CARE

In 2005, children younger than 15 yr made ≈211 million patient visits to U.S. physicians' offices and hospital outpatient departments. This represents 34.8 visits per 100 children per year, up from 25.3 in 1995. Pediatricians report an average of 50 preventive care visits per week, 33% for infants. The visits average 17-20 min, increasing in length as children become adolescents. The principal diagnoses, accounting for ≈40% of these visits, are well child visits (15%), middle-ear infections (12%), and injuries (10%). Ambulatory visits by children and youth decrease with age. The opposite occurs with adults. Nonwhite children are more likely than white children to use hospital facilities (including the emergency room) for their ambulatory care; the number of well child visits annually is almost 80% higher among white infants than black infants. Children with private insurance are more likely than children with public insurance who, in turn, are more likely than uninsured children to receive non–emergency room care. Insurance coverage increases outpatient utilization and receipt of preventive care by approximately 1 visit per year for children.

In the USA, between 70 and 90 children per 1,000 children are hospitalized per year. White children are less likely to be hospitalized than black or Hispanic children, but more likely than Asian children. Poor children are nearly twice as likely as nonpoor children to be hospitalized. Insurance coverage also appears to reduce hospital admissions that are potentially manageable in an ambulatory setting.

Health care utilization differs significantly among nations. In most countries, however, hospitals are sources of both routine and intensive child care, with medical and surgical services that may range from immunization and developmental counseling to open heart surgery and renal transplantation. In most countries, clinical conditions and procedures requiring intensive care are also likely to be clustered in university-affiliated centers serving as regional resources—if these resources exist.

In the USA, the hospitalization rates for children (excluding newborn infants) are less than those of adults younger than 65 yr of age, except in the 1st yr of life. The rate of hospitalization and lengths of hospital stay have declined significantly for children and adults in the past decade. Children represent <7% of the total acute hospital discharges; in children's hospitals, ≈70% of admissions are for chronic conditions, and 10-12% of pediatric hospitalizations are related to birth defects and genetic diseases.

Patterns of health care vary widely around the globe, reflecting differences in the geography and wealth of the country, the priority placed on health care vs other competing needs and interests, philosophy regarding prevention vs curative care, and the balance between child health and adult health care needs. The significant declines in infant and child mortality enjoyed in many of the developing countries in the past 3 decades have occurred in the context of support from international agencies like UNICEF, WHO, and the World Bank; bilateral donors (the aid provided from 1 country to another); and nongovernmental agencies to develop integrated, universal primary pediatric care with an emphasis on primary (vaccination) and selected secondary (oral rehydration solution [ORS], treatment of pneumonia and malaria) prevention strategies.

PLANNING AND IMPLEMENTING A SYSTEM OF CARE

Through much of the 20th century, pediatricians were primarily focused on the treatment and prevention of physical illness and disorders. Currently, physicians caring for children, especially those in developed countries, have been increasingly called on to advise in the management of disturbed behavior of children and adolescents or problematic relationships between child and parent, child and school, or child and community. The medical problems of children are often intimately related to problems of mental and social health. There is also an increasing concern about disparities in how the benefits of what we know about child health reach various groups of children. In both developed and developing nations, the health of children lags far behind what it could be if the means and will to apply current knowledge were focused on the health of children. The children most at risk are disproportionately represented among ethnic minority groups. Pediatricians have a responsibility to address these problems aggressively.

Linked with these views of the broad scope of pediatric concern is the concept that access to at least a basic level of quality services to promote health and treat illness is a right of every person. Among children in the USA, having health insurance is strongly associated with access to primary care. The failure of health services and health benefits to reach all children who need them has led to re-examination of the design of health care systems in many countries, but unresolved problems remain in most health care systems, such as the maldistribution of physicians, institutional unresponsiveness to the perceived needs of the individual, failure of medical services to adjust to the need and convenience of patients, and deficiencies in health education. Efforts to make the delivery of health care more efficient and effective have led imaginative pediatricians to create new categories of health care providers, such as pediatric nurse

practitioners in industrialized nations and trained birth attendants in developing countries, and to participate in new organizations for providing care to children, such as various managed care arrangements.

New insights into the needs of children have reshaped the child health care system in other ways. Growing understanding of the need of infants for certain qualities of stimulation and care has led to revision of the care of newborn infants (Chapters 7 and 88) and of procedures leading to an adoption or to placement with foster families (Chapters 34 and 35). For handicapped children, the massive centralized institutions of past years are being replaced by community-centered arrangements offering a better opportunity for these children to achieve their maximum potential.

Without question, the U.S. Patient Protection and Affordable Care Act passed in 2010 will impact the organization of health care. In particular, the new relationships expected between physicians and hospital systems through Accountable Care Organizations (ACOs) should streamline patient access.

Health Services for At-Risk Populations

Adverse health outcomes are not evenly distributed among all children, but are concentrated in certain high-risk populations. At-risk populations may require additional, targeted, or special programs designed to be effective with unique populations. All nations, regardless of wealth and level of industrialization, have subgroups of children at particular risk, requiring additional services.

In the USA, the largest vulnerable group is children living in poverty, representing about 14% of U.S. children. Substantial proportions of children in other industrialized countries are also living in poverty. The approach to addressing the needs of this group in the USA has been the establishment of a targeted insurance program, Medicaid, which became law in 1965 as a jointly funded cooperative venture between the federal and state governments to assist states in the provision of adequate medical care to eligible needy persons. The federal statute identifies >25 different eligibility categories for which federal funds are available. These statutory categories can be classified into 5 broad coverage groups: children, pregnant women, adults in families with dependent children, individuals with disabilities, and individuals ≥65 yr old. Pediatric care in the USA is highly dependent on Medicaid; however, only a relatively small proportion of the Medicaid funds actually go to child health, with the remainder serving older adults. Following broad national guidelines, each state establishes its own eligibility standards; determines the type, amount, duration, and scope of services; sets the rate of payment for services; and administers its own program. Although Medicaid has made great strides in enrolling low-income children, significant numbers of children remain uninsured. From 1988 to 1998, the proportion of children insured through Medicaid increased from 15.6% to 19.8%, but the percentage of children without health insurance increased from 13.1% to 15.4%. Minority children were disproportionately among those without insurance. The Balanced Budget Act of 1997 created a new children's health insurance program called the State Children's Health Insurance Program (SCHIP). This program gave each state permission to offer health insurance for children, up to age 19 yr, who are not already insured. SCHIP is a state-administered program and each state sets its own guidelines regarding eligibility and services. There is great variation by state, but in many states, the SCHIP program has begun to reduce racial inequities in access to health care for children. In 2009, the percent of children without insurance had decreased to 9%.

Many industrialized nations have adapted different "safety net" systems to assure adequate coverage of all youth. Many of these programs provide health insurance for all children, regardless of income, hoping to avoid problems with children losing insurance coverage and access to health care due to changes in eligibility by providing a single form of insurance that all providers accept. The response of developing countries to the issue of universal access to care for children has been uneven, with some providing no safety net, but many having limited universal or safety net services.

To address the special needs of Native Americans in the USA, the Indian Health Service, established in 1954, has been the responsibility of the Public Health Service, but the 1975 Indian Self-Determination Act gave tribes the option of managing Native American health services in their communities. The Indian Health Service is managed through local administrative units, and some tribes contract outside the Indian Health Service for health care. Much of the emphasis is on adult services: treatment for alcoholism, nutrition and dietetic counseling, and public health nursing services. There are also >40 urban programs for Native Americans, with an emphasis on increasing access of this population to existing health services, providing special social services, and developing self-help groups. In an effort to accommodate traditional Western medical, psychologic, and social services to the Native American cultures, such programs include the "Talking Circle," the "Sweat Lodge," and other interventions based on Native American culture (Chapter 4). The efficacy of any of these programs, especially those to prevent and treat the sociopsychologic problems particular to Native Americans, has not been determined.

Recognizing the health needs of migrants in the USA, the U.S. Public Health Service initiated in 1964 the Migrant Health Program to provide funds for local groups to organize medical care for migrant families. Many migrant health projects that were initially staffed by part-time providers and were open for only part of the year have been transformed into community health care centers that provide services not only for migrants but also for other local residents. In 2001, the ≈400 Migrant Health Centers served >650,000 migrant and seasonal farm workers; >85% were people of color. Health services for migrant farm workers often need to be organized separately from existing primary care programs because the families are migratory. Special record-keeping systems that link the health care provided during winter months in the south with the care provided during the migratory season in the north are difficult to maintain in ordinary group practices or individual physicians' offices. Outreach programs that take medical care to the often remote farm sites are necessary, and specially organized Head Start, early education, and remedial education programs should also be provided. Approaches in other countries have also focused on business initiatives for migrant populations to enable them to overcome the cycle of financial dependency on their migratory lifestyle.

The USA has spent >$12 billion through the 1987 McKinney-Vento Act to provide emergency food, shelter, and health care; to finance help for young runaways; to aid homeless people in making their way back into the housing market; and to place homeless children in school. Mobile vans, with a team consisting of a physician, nurse, social worker, and welfare worker, have been shown to provide effective comprehensive care, ensure delivery of immunizations, link the children to school health services, and bring the children and their families into a stable relationship with the conventional medical system. Special record-keeping systems have been introduced to enhance continuity and to provide a record of care once the family has moved to a permanent location. Because of the high frequency of developmental delays in this group, linkage of preschool homeless children to Head Start programs is an especially important service. The Runaway Youth Act, Title III of the Juvenile Justice and Delinquency Prevention Act of 1974 (Public Law 93-414) and its amended version (Public Law 95-509) have supported shelters and provide a toll-free 24 hr telephone number (1-800-621-4000) for youths who wish to contact their parents or request help after having run away.

In Belgium, Finland, the Netherlands, Portugal, and Spain, the right to housing has been incorporated into the national

constitutions. The Finnish government has devised a multifaceted response to the problem, including house building, social welfare and health care services, and the obligation to provide a home of minimum standards for every homeless person. The number of homeless in Finland has been reduced by 50%.

COSTS OF HEALTH CARE

The growth of high technology, the increasing number of people older than 65 yr, the redesign of health institutions (particularly with respect to the needs for and the uses of personnel), the public's demand for medical services, the increase in administrative bureaucracies, and the manner in which the costs of health care are paid have driven the costs of health care in the USA up to a point at which they represent a significant proportion of the gross national product. Although children (0-18 yr) represent about 25% of the population, they account for only about 12% of the health care expenditures, or about 60% of adult per capita expenditures. Efforts to contain costs have led to revisions of the way in which physicians and hospitals are paid for services. Limits have been set on the fees for some services, capitated prepayment and various managed care systems flourish, a program of reimbursement (diagnosis-related groups [DRGs]) based on the diagnosis rather than on the particular services rendered to an individual patient has been implemented, and a relative value scale for varying rates of payment among different physician services has been instituted. These and other changes in the system of financing health services raise important ethical, quality of care, and professional issues for pediatricians to address (Chapter 3).

Health care costs have been better contained in most other industrialized nations, the majority of which also enjoy lower childhood mortality rates than does the USA.

Evaluation of Health Care

The shaping of health care systems to meet the needs of children and their families requires accurate statistical data and difficult decisions in setting priorities. Along with growing concerns about the design and cost of health care systems and the ability to distribute health services equitably has come increasing concern about the quality of health care and about its efficiency and effectiveness. There are large local and regional variations among similar populations of children in the rates of use of procedures and technology and of hospital admissions. These variations require continuing evaluation and explanation in terms of the actual impact of medical and surgical services on health status and the outcome of illness.

The Institute of Medicine (IOM) issued a report, "Crossing the Quality Chasm: A New Health System for the 21st Century" in 2001. This report, challenging American physicians to renew efforts to focus not just on access and cost, but also on quality of care, has been furthered in several pediatric initiatives, including but not limited to: specific initiatives for monitoring child health outlined in the IOM report "Children's Health, the Nation's Wealth"; challenge/demonstration grants funded by the Robert Wood Johnson Foundation; and the National Initiative for Children's Healthcare Quality. Importantly, each of these initiatives is calling for the establishment of measurable standards for assessment of quality of care and for the establishment of routine plans for periodic reassessment thereof. Efforts have been initiated at some medical centers to establish evidence-based clinical pathways for disorders (such as asthma) where there exists sound evidence to advise these guidelines. Pediatricians have developed tools to evaluate the content and delivery of pediatric preventive "anticipatory guidance," the cornerstone of modern pediatrics (Chapter 5).

Consistent with the increased focus on quality and lifelong learning, the Residency Review and Redesign in Pediatrics (R3P) project involving a broad-based pediatric constituency led by the American Board of Pediatrics, was undertaken to ensure that pediatric residency training meets the health care and well-being needs of children in the 21st century. The R3P and the follow-on program, the Initiative for Innovation in Pediatric Education (IIPE), are calling for a transformation of residency training that focuses on continuous evaluation, adaptation to the differing and changing needs of children, and the recognition that continued training throughout a pediatrician's professional career will be necessary if the field of pediatrics is to best meet the needs of children. Increased attention is also being focused on the importance of providing pediatricians with the skills to communicate effectively with parents and patients and understanding the responsibilities of professionalism. These efforts are having an impact, with evidence that 66% of children are receiving good or excellent preventive care with no disparities according to race or income level. The increased focus on quality improvement in pediatric practice is reflected in the pediatric residency training competency requirements of practice-based learning and improvement and system-based practice.

THE INFORMATION EXPLOSION OF THE 21ST CENTURY

Currently there are over 5,000 journals and 1 million papers listed on PubMed. With globalization, pediatricians in settings around the world must be familiar with health and disease and health practices across the globe. In earlier years, new information in any field of medicine was easily accessible through a relatively small number of journals, texts, or monographs. Today, relevant information is so widely dispersed among the many journals that elaborate electronic data systems are necessary to make it accessible. To access 100% of the randomized clinical trials published each year requires access to over 2,000 journals.

The Internet is revolutionizing access to medical knowledge in developing and transitional countries. Previously, medical schools in these settings were highly dependent on slow and often unpredictable mail systems to connect them with medical advances, new directions in medical practice, and medical colleagues in general. Now, many of the same schools have immediate access to hundreds of journals and their professional counterparts across the globe.

There is no touchstone through which physicians can ensure that the process of their own continuing education will keep them abreast of advancing knowledge in the field, but they must find a way to base their decisions on the best available scientific evidence if they are to discharge their responsibility to their patients. An essential element of this process may be for physicians to take an active role, such as participating in medical student and resident education. Efforts in continuing self-education will also be fostered if clinical problems can be made a stimulus for a review of standard literature, alone or in consultation with an appropriate colleague or consultant. This continuing review will do much to identify those inconsistencies or contradictions that will indicate, in the ultimate best interest of patients that things are not what they seem or have been said to be. These difficulties may be exacerbated by commercially sponsored education programs and research projects that may, on occasion, put profit before the patient's best interests. Physicians still learn most from their patients, but this will not be the case if they fall into the easy habit of accepting their patients' problems casually or at face value because the problems appear to be simple.

The tools that physicians must use in dealing with the problems of children and their families fall into 3 main categories: *cognitive* (up-to-date factual information about diagnostic and therapeutic issues, available on recall or easily found in readily accessible sources, and the ability to relate this information to the pathophysiology of their patients in the context of individual biologic variability); *interpersonal* or *manual* (the ability to carry out a productive interview, execute a reliable physical examination, perform a deft venipuncture, or manage cardiac arrest or resuscitation of a depressed newborn infant); and *attitudinal* (the

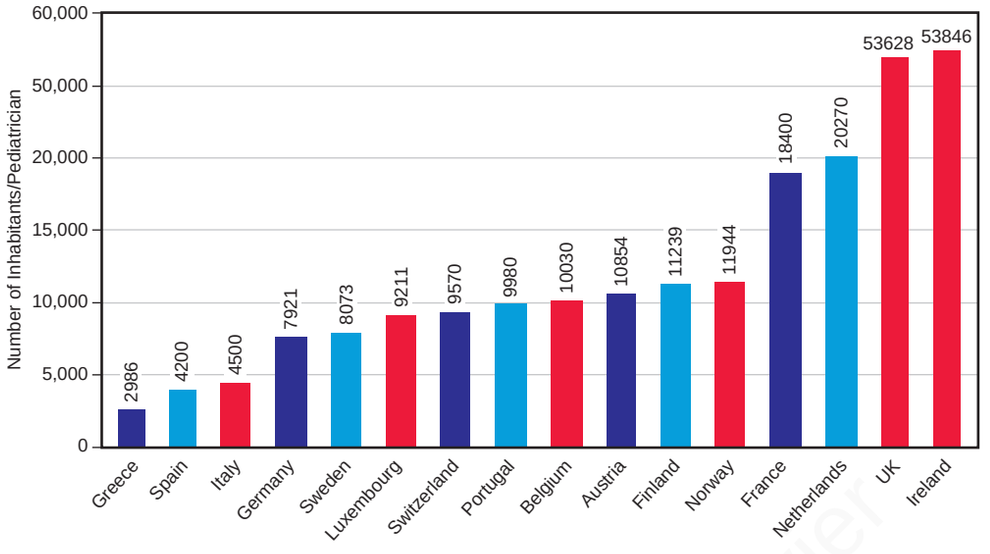

Figure 1-3 European differences in health care delivery system: numbers of inhabitants per pediatrician. (Courtesy of Alfred Tenore, President, European Board of Pediatrics.)

physician's unselfish commitment to the fullest possible implementation of knowledge and skills on behalf of children and their families in an atmosphere of empathic sensitivity and concern). With regard to this last category, it is important that children participate with their families in informed decision-making about their own health care in a manner appropriate to their stage of development and the nature of the particular health problem.

The workaday needs of professional persons for knowledge and skills in care of children vary widely. Primary care physicians need depth in developmental concepts and in the ability to organize an effective system for achieving quality and continuity in assessing and planning for health care during the entire period of growth. They may often have little or no need for immediate recall of esoterica. On the other hand, consultants or subspecialists not only need a comfortable grasp of both common and uncommon facts within their field and perhaps within related fields, but also must be able to cope with controversial issues with flexibility that will permit adaptation of various points of view to the best interest of their unique patient.

At whatever level of care (primary, secondary, or tertiary) or in whatever position (student, pediatric nurse practitioner, resident pediatrician, practitioner of pediatrics or family medicine, or pediatric or other subspecialists), professional persons dealing with children must be able to identify their roles of the moment and their levels of engagement with a child's problem; each must determine whether his or her experience and other resources at hand are adequate to deal with this problem and must be ready to seek other help when they are not. Among the necessary resources are general textbooks, more detailed monographs in subspecialty areas, selected journals, Internet materials, audiovisual aids, and, above all, colleagues with exceptional or complementary experience and expertise. The intercommunication of all these levels of engagement with medical and health problems of children offers the best hope of bringing us closer to the goal of providing the opportunity for all children to achieve their maximum potential.

ORGANIZATION OF THE PROFESSION AND THE GROWTH OF SPECIALIZATION

The 20th century witnessed the formation of professional societies of pediatricians around the globe. Some of these societies, such as the European Board of Pediatrics and the American Board of Pediatrics (ABP) and the, are concerned with education and the awarding of credentials certifying competence and the continuing maintenance of competence as a pediatrician and/or a pediatric subspecialist to the public. In 2010, the ABP reported that there were ≈96,514 board-certified pediatricians. Among those presenting for 1st time certification to the ABP in 2003, 80% were American Medical Graduates (20% were International Medical Graduates) and 63% were women. Other societies are primarily concerned with organizing members of the profession in their country or region to dedicate their efforts and resources toward children. In the USA, the American Academy of Pediatrics (AAP) currently has a membership of ≈60,000 child health specialists in both academic and private practice. Most general pediatricians in the USA enter private practice; ≈66% are in group practices, 5% enter solo practice, and 5% work in a health maintenance organization. There is an increasing shortage of primary care pediatricians, particularly those skilled to take care of children with chronic conditions and special needs. The AAP provides a variety of continuing educational services to pediatricians in multiple national and regional settings and tracks the professional activities and practices of its members. A comparable group in India, the Indian Academy of Pediatrics, was formed in 1963, and now has ~16,500 members and 16 subspecialty chapters. Likewise, the Pakistani Pediatrics Association was founded in 1967, the Malaysian Pediatric Association was started in 1985, and the Canadian Pediatric Society was founded in 1922. Established in 1974, the Asian Pacific Pediatric Association includes 20 member pediatric societies from throughout eastern Asia, and the International Pediatric Association established in 1910 includes 144 national pediatric societies from 139 countries, 10 regional pediatric societies, and 11 international pediatric specialty societies. The European Academy of Pediatrics is the pediatric specialist organization for the member countries of the European Union and the European Free Trade Association, and the Pediatric Council of the Arab Board of Medical Specializations is the comparable institution for 19 of the world's Arab nations These societies represent but a few of the many national and regional pediatric professional organizations around the world who seek to identify and bring treatments and approaches supporting child well-being to pediatricians worldwide.

The amount of information relevant to child health care is rapidly expanding, and no person can become master of it all. Physicians are increasingly dependent on one another for the highest quality of care for their patients. About 25% of pediatricians in the USA claim an area of special knowledge and skill, including 20,138 who have board certification in 1 of the 13 pediatric subspecialties with board certification. Each year about

10% of the ≈3,000 pediatric residents training in the USA are enrolled in a dual residency training program that will lead to eligibility for board certification in both pediatrics and internal medicine.

The growth of specialization within pediatrics has taken a number of different forms: interests in problems of age groups of children have created neonatology and adolescent medicine; interests in organ systems have created pediatric cardiology, neurology, child abuse, child development, allergy, hematology, nephrology, gastroenterology, child psychiatry, pulmonology, endocrinology, rheumatology, and specialization in metabolism and genetics; interests in the health care system have created pediatricians devoted to ambulatory care, emergency care, and intensive care; and, finally, multidisciplinary subspecialties have grown up around the problems of handicapped children, to which pediatrics, neurology, psychiatry, psychology, nursing, physical and occupational therapy, special education, speech therapy, audiology, and nutrition all make essential contributions. This growth of specialization has been most conspicuous in university-affiliated departments of pediatrics and medical centers for children. There is growing concern in the USA regarding the shortage of pediatric subspecialists in virtually all of the subspecialty areas and especially in rural states. This results in long waits for patients.

In the USA, most subspecialists practice in academic settings or children's hospitals. Likewise, specialists are growing in number in other industrialized countries and in developing nations that are becoming industrialized. Reflecting the diverse cultures, organization of medical care, economic circumstances and the history of medicine within each of the ~200 countries across the globe, is the great diversity in role of pediatricians within the health care delivery system to children in each country; Figure 1-3 illustrates the result variations in pediatricians per population among European nations.

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Please visit the Nelson Textbook of Pediatrics *website at www.expertconsult.com for the complete bibliography.*

Chapter 2
Quality and Safety in Health Care for Children

Ramesh C. Sachdeva

THE NEED FOR QUALITY IMPROVEMENT

There is a significant quality gap between known and recommended evidence-based care, and the actual care that is delivered. Adults receive recommended care slightly higher than 50% of the time and children receive recommended care only about 46% of the time. This quality gap exists due to a chasm between knowledge and practice—a chasm made wider by variations in practice and disparities in care from doctor to doctor, institution to institution, geographic region to geographic region, and socioeconomic group to socioeconomic group.

For the full continuation of this chapter, please visit the Nelson Textbook of Pediatrics *website at www.expertconsult.com.*

Chapter 3
Ethics in Pediatric Care

Eric Kodish and Kathryn Weise

Pediatric ethics is a branch of bioethics that analyzes moral aspects of decisions made relating to the health care of children. In general terms, the **autonomy** driven framework of adult medical ethics is replaced by a **beneficent** paternalism (or parentalism) in pediatrics. Pediatric ethics is distinctive because the pediatric clinician has an independent fiduciary obligation to act in a younger child's **best interest** that takes moral precedence over the wishes of the child's parent(s). For older children, the concept of **assent** suggests that the voice of the patient must be heard. These factors create the possibility of conflict among child, parent, and clinician. The approach to the ethical issues that arise in pediatric practice must include respect for parental responsibility and authority balanced with a child's developing capacity and autonomy. Heterogeneity of social, cultural, and religious views about the role of children adds complexity. Children are both vulnerable and resilient, and represent the future of our society.

For the full continuation of this chapter, please visit the Nelson Textbook of Pediatrics *website at www.expertconsult.com.*

Chapter 4
Cultural Issues in Pediatric Care

Linda Kaljee and Bonita F. Stanton

Pediatricians live and work in a multicultural world. Among the world's 6 billion people residing in >200 countries, >6,000 languages are spoken. As the global population becomes more mobile and integrated, ethnic and economic diversity increases in all countries; from 1970 to 2000, the foreign-born population in the USA increased 3-fold. In the 2000 U.S. census, 25-30% of Americans self-identified as belonging to an ethnic or racial minority group. One or both parents of approximately 17 million children in the USA are foreign-born; 1 of every 5 children lives in an immigrant family. Whereas in 1920, 97% of immigrant families in the USA were from Europe or Canada; in 2000, 84% of U.S. immigrant children were from Latin America or Asia. Nonwhite children are projected to outnumber white children in the USA by the year 2030. Increased migration and diversity in the migrant pool is not limited to the USA; immigrants account for over 15% of the population in >50 nations.

For the full continuation of this chapter, please visit the Nelson Textbook of Pediatrics *website at www.expertconsult.com.*

Chapter 5
Maximizing Children's Health: Screening, Anticipatory Guidance, and Counseling

Joseph F. Hagan, Jr. and Paula M. Duncan

The care of well infants, children, and adolescents is an essential prevention effort for children and youth worldwide. The constantly changing tableau of a child's development lends added value to regular and periodic encounters between children and their families and practitioners of pediatric health care. Health supervision visits from birth to age 21 yr are the platform for a young person's health care: well care is provided in the medical home, fostering strong relationships between clinic or practice and child and family, and assisting in the provision of appropriate surveillance, screening, and sick care.

The evolution of this preventive health care approach is derived from the long-standing view that the science of pediatrics is a science of health and development. To assure the optimal

Part II Growth, Development, and Behavior

Chapter 6
Overview and Assessment of Variability

Susan Feigelman

The goal of pediatric care is to optimize the growth and development of each child. Pediatricians need to understand normal growth, development, and behavior in order to monitor children's progress, identify delays or abnormalities in development, obtain needed services, and counsel parents. In addition to clinical experience and personal knowledge, effective practice requires familiarity with major theoretical perspectives and evidence-based strategies for optimizing growth and development. To target factors that increase or decrease risk, pediatricians need to understand how biologic and social forces interact within the parent-child relationship, within the family, and between the family and the larger society. Growth is an indicator of overall well-being, status of chronic disease, and interpersonal and psychologic stress. By monitoring children and families over time, pediatricians can observe the interrelationships between physical growth and cognitive, motor, and emotional development. Observation is enhanced by familiarity with developmental theory and understanding of developmental models which describe normal patterns of behavior and provide guidance for prevention of behavior problems. Effective pediatricians also recognize how they can work with families and children to bring about healthy behaviors and behavioral change.

BIOPSYCHOSOCIAL MODELS OF DEVELOPMENT

A biologic model of medicine presumes that a patient presents with signs and symptoms of a disease and a physician focuses of diseases of the body. This model neglects the psychologic aspect of a person who exists in the larger realm of the family and society. In a **biopsychosocial model,** higher-level systems are simultaneously considered with the lower-level systems that make up the person and the person's environment (Fig. 6-1). A patient's symptoms are examined and explained in the context of the patient's existence. This basic model can be used to understand health and both acute and chronic disease.

Critical to learning and remembering (and therefore development) is **neuronal plasticity,** which permits the central nervous system to reorganize neuronal networks in response to environmental stimulation, both positive and negative. Overproduction of neurons, by creating a reservoir of neurons upon which to draw in the case of injury or learning, appears to be adaptive. The brain comprises 100 billion neurons at birth, with each neuron developing on average 15,000 synapses by 3 yr of age. The number of synapses stays roughly constant through the first decade of life as the number of neurons declines. Synapses in frequently used pathways are preserved, whereas less-used ones atrophy, through neuronal "pruning." In addition to neuronal pruning, changes in the strength of synapses and reorganization of neuronal circuits also play important roles in brain plasticity. Increases or decreases in synaptic activity result in persistent increases or decreases in synaptic strength. Thus, experience (**environment**) has a direct effect on the physical properties of the brain (**genetics**). Children with different talents and temperaments (already a combination of genetics and environment) further elicit different stimuli from their (differing) environments.

Periods of behavioral development generally correlate with periods of great changes in synaptic numbers in relevant areas of the brain. Accordingly, sensory deprivation during the time when synaptic changes should be occurring has profound effects. Thus, the effects of strabismus leading to amblyopia in one eye may occur quickly during early childhood; likewise, patching an eye with good vision to reverse amblyopia in the other eye is less effective in late childhood. Early experience is particularly important because learning proceeds more efficiently along established synaptic pathways. Traumatic experiences also create enduring alterations in the neurotransmitter and endocrine systems that mediate the stress response, with effects noted later in life. Positive and negative experiences do not determine the total outcome, but shift the probabilities by influencing the child's ability to respond adaptively to future stimuli. Neurobiologic markers may predict morbidity following environmental changes. Certain genetic polymorphisms may be associated with later disease onset under certain circumstances. The plasticity of the brain continues into adolescence, with further development of the prefrontal cortex, which is important in decision-making, future planning, and emotional control; neurogenesis persists in adulthood in certain areas of the brain, including the subventricular zone of the lateral ventricles and in portions of the hippocampus.

Biologic Influences

Biologic influences on development include genetics, in utero exposure to teratogens, the long-term negative effects of low birthweight (increased rates of obesity, coronary heart disease, stroke, hypertension, and type-2 diabetes), postnatal illnesses, exposure to hazardous substances, and maturation. Adoption and twin studies consistently show that heredity accounts for approximately 50% of the variance in IQ and in other personality traits, such as sociability and desire for novelty. The specific genes underlying these traits have begun to be identified. The negative effects on development of prenatal exposure to teratogens, such as mercury and alcohol, and of postnatal insults, such as meningitis and traumatic brain injury, have been extensively studied. Any chronic illness can affect growth and development, either directly or through changes in nutrition, parenting, or peer interactions.

Physical and neurologic maturation propels children forward and sets lower limits for the emergence of most abilities. The age at which children walk independently is similar around the world, despite great variability in child-rearing practices. The attainment of other skills, such as the use of complex sentences, is less tightly bound to a maturational schedule. Maturational changes also generate behavioral challenges at predictable times. Decrements in growth rate and sleep requirements around 2 yr of age often generate concern about poor appetite and refusal to nap. Although it is possible to accelerate many developmental milestones (toilet training a 12 mo old or teaching a 3 yr old to read), the long-term benefits of such precocious accomplishments are questionable.

In addition to physical changes in size, body proportions, and strength, maturation brings about hormonal changes. Sexual differentiation, both somatic and neurologic, begins in utero. Behavioral effects of testosterone may be evident even in young children and continue to be salient throughout life. Correlations between testosterone levels and such traits as aggression or novelty seeking have not been consistently demonstrated.

Temperament describes the stable, early-appearing individual variations in behavioral dimensions including emotionality

(crying, laughing, sulking), activity level, attention, sociability, and persistence. The classic theory of Thomas and Chess proposes 9 dimensions of temperament (Table 6-1). These characteristics lead to 3 common constellations: (1) the easy, highly adaptable child, who has regular biologic cycles; (2) the difficult child, who withdraws from new stimuli and is easily frustrated; and (3) the slow-to-warm-up child, who needs extra time to adapt to new circumstances. Various combinations of these clusters also occur. Temperament has long been described as biologic or "inherited," largely based on parent reports (although confirmed by some independent observational studies) of twins. Monozygotic twins are consistently rated by their parents as temperamentally more similar as are dizygotic twins. Estimates of heritability suggest that genetic differences account for approximately 20-60% of the variability of temperament within a population. It was presumed that the remaining 80-40% of the variance is environmentally influenced because genetic influences tended to be viewed as static. We know that genes are dynamic, changing in the quantity and quality of their effects as a child ages and thus, like environment, may continue to change. Longitudinal twin studies of adult personality indicate that personality changes largely result from non-shared environmental influences, whereas stability of temperament appears to result from genetic factors. Although associations between specific genes and temperament have been noted (a 48-base pair repeat in exon 3 of *DRD4* has been associated with novelty seeking), such associations require replication studies before they can be viewed as causative.

The concept of temperament can help parents understand and accept the characteristics of their children without feeling responsible for having caused them. Children who have difficulty adjusting to change may have behavior problems when a new baby arrives or at the time of school entry. In addition, pointing out the child's temperament may allow for adjustment in parenting styles. Behavioral and emotional problems may develop when the temperamental characteristics of children and parents are in conflict.

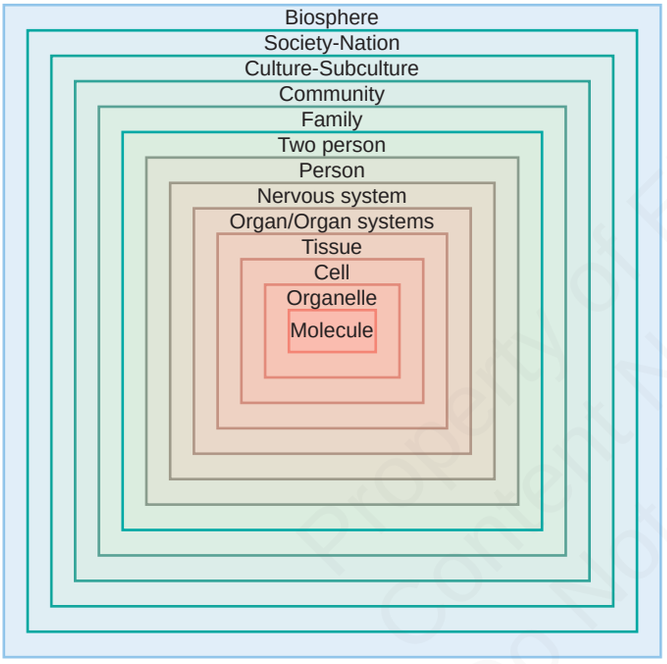

Figure 6-1 Continuum and hierarchy of natural systems in the biopsychosocial model. (From Engel GL: The clinical application of the biopsychosocial model, *Am J Psychiatry* 137:535–544, 1980.)

Psychologic Influences: Attachment and Contingency

The influence of the child-rearing environment dominates most current models of development. Infants in hospitals and orphanages, devoid of opportunities for attachment, have severe developmental deficits. **Attachment** refers to a biologically determined tendency of a young child to seek proximity to the parent during times of stress and also to the relationship that allows securely attached children to use their parents to re-establish a sense of well-being after a stressful experience. Insecure attachment may be predictive of later behavioral and learning problems.

At all stages of development, children progress optimally when they have adult caregivers who pay attention to their verbal and nonverbal cues and respond accordingly. In early infancy, such contingent responsiveness to signs of overarousal or underarousal helps maintain infants in a state of quiet alertness and fosters autonomic self-regulation. **Contingent responses** (reinforcement depending on the behavior of the other) to nonverbal gestures create the groundwork for the shared attention and reciprocity that are critical for later language and social development. Children learn best when new challenges are just slightly harder than what they have already mastered; a degree of difficulty dubbed the "zone of proximal development." Psychologic forces, such as attention problems or mood disorders, will have profound effects on many aspects of an older child's life.

Table 6-1 TEMPERAMENTAL CHARACTERISTICS: DESCRIPTIONS AND EXAMPLES*

CHARACTERISTIC	DESCRIPTION	EXAMPLES†
Activity level	Amount of gross motor movement	"She's constantly on the move." "He would rather sit still than run around."
Rhythmicity	Regularity of biologic cycles	"He's never hungry at the same time each day." "You could set a watch by her nap."
Approach and withdrawal	Initial response to new stimuli	"She rejects every new food at first." "He sleeps well in any place."
Adaptability	Ease of adaptation to novel stimulus	"Changes upset him." "She adjusts to new people quickly."
Threshold of responsiveness	Intensity of stimuli needed to evoke a response (e.g., touch, sound, light)	"He notices all the lumps in his food and objects to them." "She will eat anything, wear anything, do anything."
Intensity of reaction	Energy level of response	"She shouts when she is happy and wails when she is sad." "He never cries much."
Quality of mood	Usual disposition (e.g., pleasant, glum)	"He does not laugh much." "It seems like she is always happy."
Distractibility	How easily diverted from ongoing activity	"She is distracted at mealtime when other children are nearby." "He doesn't even hear me when he is playing."
Attention span and persistence	How long a child pays attention and sticks with difficult tasks	"He goes from toy to toy every minute." "She will keep at a puzzle until she has mastered it."

*Based on Chess S, Thomas A: *Temperament in clinical practice,* New York, 1986, Guilford.
†Typical statements of parents, reflecting the range for each characteristic from very little to very much.

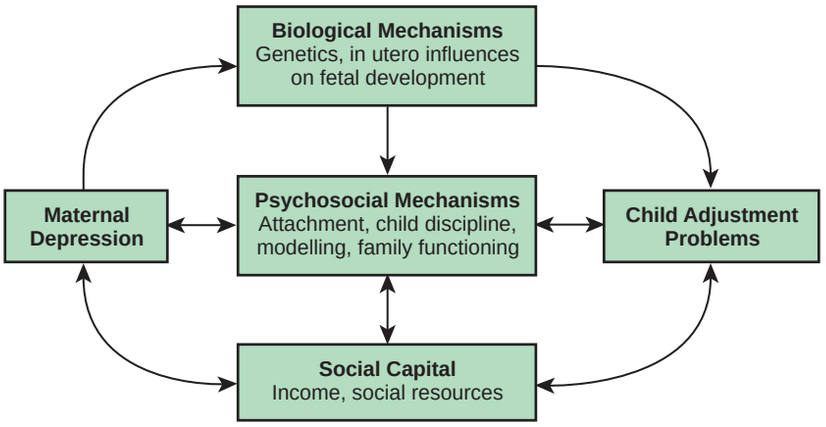

Figure 6-2 Theoretical model of mutual influences on maternal depression and child adjustment. (From Elgar FJ, McGrath PJ, Waschbusch DA, et al: Mutual influences on maternal depression and child adjustment problems, *Clin Psychol Rev* 24:441–459, 2004.)

Social Factors: Family Systems and the Ecologic Model

Contemporary models of child development recognize the critical importance of influences outside of the mother-child dyad. Fathers play critical roles, both in their direct relationships with their children and in supporting mothers. As traditional nuclear families become less dominant, the influence of other family members (grandparents, foster and adoptive parents, same-sex partners) becomes increasingly important. In addition, children are increasingly raised by unrelated caregivers while parents work or while they are in foster care.

Families function as systems, with internal and external boundaries, subsystems, roles, and rules for interaction. In families with rigidly defined parental subsystems, children may be denied any decision-making, exacerbating rebelliousness. In families with poorly defined parent-child boundaries, children may be required to take on responsibilities beyond their years, or may be recruited to play a spousal role.

Individuals within systems adopt implicit roles. For example, one child may be the troublemaker, whereas another is the negotiator and another is quiet. Birth order may have profound effects on personality development, through its influence on family roles and patterns of interaction. Families are also dynamic. Changes in one person's behavior affect every other member of the system; roles shift until a new equilibrium is found. The birth of a new child, attainment of developmental milestones such as independent walking, the onset of nighttime fears, and the death of a grandparent are all changes that require renegotiation of roles within the family and have the potential for healthy adaptation or dysfunction.

The family system, in turn, functions within the larger systems of extended family, subculture, culture, and society. Bronfenbrenner's ecologic model depicts these relationships as concentric circles, with the parent-child dyad at the center (with associated risks and protective factors) and the larger society at the periphery. Changes at any level are reflected in the levels above and below. The shift from an industrial economy to one based on service and information is an obvious example of societal change with profound effects on families and children.

Unifying Concepts: The Transactional Model, Risk, and Resilience

The **transactional model** proposes that a child's status at any point in time is a function of the interaction between biologic and social influences. The influences are bidirectional: Biologic factors, such as temperament and health status, both affect the child-rearing environment and are affected by it. A premature infant may cry little and sleep for long periods; the infant's depressed parent may welcome this good behavior, setting up a cycle that leads to poor nutrition and inadequate growth. The child's failure to thrive may reinforce the parent's sense of failure as a parent. At a later stage, impulsivity and inattention associated with early, prolonged undernutrition may lead to aggressive behavior. The cause of the aggression in this case is not the prematurity, the undernutrition, or the maternal depression, but the interaction of all these factors (Fig. 6-2). Conversely, children with biologic risk factors may nevertheless do well developmentally if the child-rearing environment is supportive. Premature infants with electroencephalographic evidence of neurologic immaturity may be at increased risk for cognitive delay. This risk may only be realized when the quality of parent-child interaction is poor. When parent-child interactions are optimal, prematurity carries a reduced risk of developmental disability.

Children growing up in poverty experience multiple levels of developmental risk: increased exposure to biologic risk factors, such as environmental lead and undernutrition, lack of stimulation in the home, and decreased access to interventional education and therapeutic experiences. As they respond by withdrawal or acting out, they further discourage positive stimulation from those around them. Children of adolescent mothers are also at risk. When early intervention programs provide timely, intensive, comprehensive, and prolonged services, at-risk children show marked and sustained upswings in their developmental trajectory. Early identification of children at developmental risk, along with early intervention to support parenting, is critically important.

An estimate of developmental risk can begin with a tally of risk factors, such as low income, limited parental education, and lack of neighborhood resources. There is a direct relationship between developmental outcome at age 13 yr and the number of social and family risk factors at age 4 yr (Fig. 6-3). Protective (resilience) factors must also be considered. These factors, like risk factors, may be either biologic (temperamental persistence, athletic talent) or social. The personal histories of children who overcome poverty often include at least one trusted adult (parent, grandparent, teacher) with whom the child has a special, supportive, close relationship.

Developmental Domains and Theories of Emotion and Cognition

Child development can also be tracked by the child's developmental progress in particular domains, such as gross motor, fine motor, social, emotional, language, and cognition. Within each of these categories are developmental lines or sequences of changes leading up to particular attainments. Developmental lines in the gross motor domain, leading from rolling to creeping to independent walking, are obvious. Others, such as the line leading to the development of conscience, are more subtle.

The concept of a developmental line implies that a child passes though successive stages. Several psychoanalytic theories are based on stages as qualitatively different epochs in the develop-

ment of emotion and cognition (Table 6-2). In contrast, behavioral theories rely less on qualitative change and more on the gradual modification of behavior and accumulation of competence.

PSYCHOANALYTIC THEORIES At the core of **Freudian theory** is the idea of body-centered (or, broadly, "sexual") drives. The focus of the drives shifts with maturation from oral satisfactions (sucking in the 1st yr of life), to anal sensations (holding on and letting go during the toddler years), oedipal drives (possessiveness toward a parent in the preschool years), and genital drives (in puberty and beyond) (see Table 6-2). At each stage, the child's drive can potentially conflict with the rules of society. Infants may want to suck longer than the mother wants to nurse, or toddlers may decide that they like making a mess. The emotional health of both the child and the adult depends on adequate resolution of these conflicts. Freud saw middle childhood as a period of latency, when the sexual drive is redirected (sublimated) to the achievement of social or external goals.

Freudian ideas have been challenged. Few believe that the manner of toilet training permanently shapes personality, and middle childhood is no longer seen as conflict-free. Moreover, the effectiveness of psychoanalytic therapy has been difficult to demonstrate empirically. Nonetheless, the Freudian legacy includes concepts that are central to an understanding of emotional development: the importance of a child's inner life and sexuality, the normative existence of emotional conflict during childhood, and the possibility that emotional disturbance can have early roots.

Erikson's chief contribution was to recast Freud's stages in terms of the emerging personality (see Table 6-2). The child's sense of basic trust develops through the successful negotiation of infantile needs, corresponding to Freud's oral period. As children progress through these psychosocial stages, different issues become salient. Thus, it is predictable that a toddler will be preoccupied with establishing a sense of autonomy, whereas a late adolescent may be more focused on establishing meaningful relationships and an occupational identity. Erikson recognized that these stages arise in the context of Western European societal expectations; in other cultures, the salient issues may be quite different.

Erikson's work calls attention to the intrapersonal challenges facing children at different ages in a way that facilitates professional intervention. Knowing that the salient issue for school-aged children is industry vs inferiority, pediatricians know to inquire about a child's experiences of mastery and failure and (if necessary) suggest ways to ensure adequate successes.

COGNITIVE THEORIES Cognitive development is best understood through the work of **Piaget**. A central tenet of Piaget's work is that cognition changes in quality, not just quantity (see Table 6-2). During the sensorimotor stage, an infant's thinking is tied to immediate sensations and a child's ability to manipulate objects. The concept of "in" is embodied in a child's act of putting a block into a cup. With the arrival of language, the nature of thinking changes dramatically; symbols increasingly take the place of objects and actions. Piaget described how children actively construct knowledge for themselves through the linked processes of assimilation (taking in new experiences according to existing schemata) and accommodation (creating new patterns of understanding to adapt to new information). In this way, children are continually and actively reorganizing cognitive processes.

Piaget's basic concepts have held up well. Challenges have included questions about the timing of various stages and the extent to which context may affect conclusions about cognitive stage. Children's understanding of cause and effect may be considerably more advanced in the context of sibling relationships than in the manipulation and perception of inanimate objects. In many children, logical thinking appears well before puberty, the age postulated by Piaget. Of undeniable importance are Piaget's focus on cognition as a subject of empirical study, the universality of the progression of cognitive stages, and the image of a child as actively and creatively interpreting the world.

Piaget's work is of special importance to pediatricians for 3 reasons: (1) It helps make sense of many puzzling behaviors of infancy, such as the common exacerbation of sleep problems at 9 and 18 mo of age. (2) Piaget's observations often lend themselves to quick replication in the office, with little special equipment. (3) Open-ended questioning, based on Piaget's work, can provide insights into children's understanding of illness and hospitalization.

Based on cognitive development, **Kohlberg** developed a theory of moral development in 6 stages from early childhood through adulthood. Preschoolers' earliest sense of right and wrong is egocentric, motivated by externally applied controls. In later stages, children perceive equality, fairness, and reciprocity in their understanding of interpersonal interactions through perspective-taking. Most youth will reach stage 4, conventional morality, by mid to late adolescence. The basic theory has been modified to distinguish morality from social conventions. Whereas moral thinking considers interpersonal interactions, justice, and human

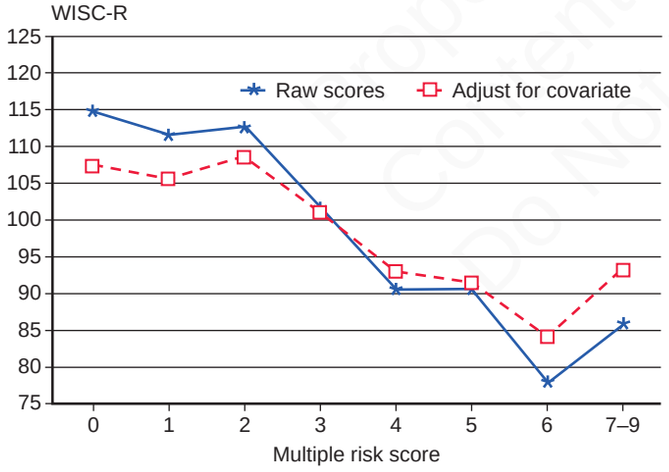

Figure 6-3 Relationship between mean IQ scores at 13 yr (both raw and adjusted for covariation of mother's IQ), as related to the number of risk factors. *WISC-R*, Wechstler Intelligence Scale-Revised. (From Sameroff AJ, Seifer R, Baldwin A, et al: Stability of intelligence from preschool to adolescence; the influence of social and family risk factors, *Child Dev* 64:80–97, 1993.)

Table 6-2 CLASSIC STAGE THEORIES

	INFANCY (0-1 YR)	TODDLERHOOD (2-3 YR)	PRESCHOOL (3-6 YR)	SCHOOL AGE (6-12 YR)	ADOLESCENCE (12-20 YR)
Freud: psychosexual	Oral	Anal	Phallic/oedipal	Latency	Genital
Erikson: psychosocial	Basic trust vs mistrust	Autonomy vs shame and doubt	Initiative vs guilt	Industry vs inferiority	Identity vs role diffusion
Piaget: cognitive	Sensorimotor	Sensorimotor	Preoperational	Concrete operations	Formal operations
Kohlberg: moral	—	Preconventional: avoid punishment/ obtain rewards (stages 1 and 2)	Conventional: conformity (stage 3)	Conventional: law and order (stage 4)	Postconventional: moral principles

welfare, social conventions are the agreed-on standards of behavior particular to a social or cultural group. Within each stage of development, children are guided by the basic precepts of moral behavior, but also may take into account local standards, such as dress code, classroom behavior, and dating expectations.

BEHAVIORAL THEORY This theoretical perspective distinguishes itself by its lack of concern with a child's inner experience. Its sole focus is on observable behaviors and measurable factors that either increase or decrease the frequency with which these behaviors occur. No stages are implied; children, adults, and indeed animals all respond in the same way. In its simplest form, the behaviorist orientation asserts that behaviors that are positively reinforced occur more frequently; behaviors that are negatively reinforced or ignored occur less frequently. The strengths of this position are its simplicity, wide applicability, and conduciveness to scientific verification. A behavioral approach lends itself to interventions for various common problems, such as temper tantrums and aggressive preschool behavior, in which behaviors are broken down into discrete units. In cognitively limited children and children with autism spectrum disorders, behavioral interventions using **applied behavior analysis** (ABA) approaches have demonstrated their ability to teach new, complex behaviors. ABA has been particularly useful in the treatment of early diagnosed autism (see Chapter 28.1). However, in cases in which misbehavior is symptomatic of an underlying emotional, perceptual, or family problem, an exclusive reliance on behavior therapy risks leaving the cause untreated. Behavioral approaches can be taught to parents to apply at home.

THEORIES COMMONLY EMPLOYED IN BEHAVIORAL INTERVENTIONS During the past few decades an increasing number of programs (within and outside of the physician's office) designed to influence behavior have been based on theoretical models of behavior. Some of these models are based on behavioral or cognitive theory or in cases have attributes of both. The most commonly employed models are the Health Belief Model, Theory of Reasoned Action, Theory of Planned Behavior, Social Cognitive Theory, and the Transtheoretical Model, also known as Stages of Change Theory. Pediatricians should be aware of these models; similarities and differences between these models are shown in Table 6-3. **Motivational interviewing** is less a theory of behavior and more a technique to bring about behavior change. The goal in using the technique is to enhance an individual's motivation to change behavior by exploring and removing ambivalence. This may be practiced by an individual practitioner and is being taught in some pediatric residency programs. Motivational interviewing emphasizes the importance of the therapist (pediatrician) understanding the client's perspective and displaying unconditional support. The therapist is a partner rather than an authority figure and recognizes that ultimately the patient has control over his or her choices.

Statistics Used in Describing Growth and Development
(See Also Chapters 13 and 14)

In everyday use, the term *normal* is synonymous with *healthy*. In a statistical sense, *normal* means that a set of values generates a normal (bell-shaped or gaussian) distribution. This is the case with anthropometric quantities, such as height and weight, and with many developmental milestones, such as the age of independent standing. For a **normally distributed measurement,** a histogram with the quantity (height, age) on the *x*-axis and the frequency (the number of children of that height, or the number who stand on their own at that age) on the *y*-axis generates a bell-shaped curve. In an ideal bell-shaped curve, the peak corresponds to the arithmetic mean (average) of the sample and to the median and the mode as well. The **median** is the value above and below which 50% of the observations lie; the mode is the value having the highest number of observations. Distributions are termed *skewed* if the mean, median, and mode are not the same number.

The extent to which observed values cluster near the mean determines the width of the bell and can be described mathematically by the **standard deviation (SD).** In the ideal normal curve, a range of values extending from 1 SD below the mean to 1 SD above the mean includes approximately 68% of the values, and each "tail" above and below that range contains 16% of the values. A range encompassing ±2 SD includes 95% of the values (with the upper and lower tails each comprising approximately 2.5% of the values), and ±3 SD encompasses 99.7% of the values (Table 6-4 and Fig. 6-4).

For any single measurement, its distance away from the mean can be expressed in terms of the number of SDs (also called a *z score*); one can then consult a table of the normal distribution to find out what percentage of measurements fall within that distance from the mean. Software to convert anthropometric data into z scores for epidemiologic purposes is available. A measurement that falls "outside the normal range"—arbitrarily defined as 2, or sometimes 3, SDs on either side of the mean—is atypical, but not necessarily indicative of illness. The further a measurement (say, height, weight, or IQ) falls from the mean, the greater the probability that it represents not simply normal variation, but rather a different, potentially pathologic, condition.

Another way of relating an individual to a group uses percentiles. The **percentile** is the percentage of individuals in the group who have achieved a certain measured quantity (e.g., a height of 95 cm) or a developmental milestone (e.g., walking independently). For anthropometric data, the percentile cutoffs can be calculated from the mean and SD. The 5th, 10th, and 25th percentiles correspond to −1.65 SD, −1.3 SD, and −0.7 SD, respectively. Figure 6-4 demonstrates how frequency distributions of a particular parameter (height) at different ages relate to the percentile lines on the growth curve.

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6.1 Assessment of Fetal Growth and Development

The most dramatic events in growth and development occur before birth and involve the transformation of a fertilized egg into an embryo and a fetus, the elaboration of the nervous system, and the emergence of behavior in utero. The psychologic changes occurring in the parents during the gestation profoundly impact the lives of all members of the family. The developing fetus is

Table 6-3 SIMILAR OR IDENTICAL ELEMENTS WITHIN FIVE HEALTH BEHAVIOR THEORIES

CONCEPT	GENERAL TENET OF THE CONCEPT "ENGAGING IN THE BEHAVIOR IS LIKELY IF …"	HEALTH BELIEF MODEL	THEORY OF REASONED ACTION	TPB	SCT	TTM
ATTITUDINAL BELIEFS						
Appraisal of the positive and negative aspects of the behavior and expected outcome of the behavior	The positive aspects outweigh the negative aspects	Benefits, barriers/ health motive	Behavioral beliefs and evaluation of those beliefs (attitudes)	Behavioral beliefs and evaluation of those beliefs (attitudes)	Outcome expectations/ expectancies	Pros, cons (decisional balance)
SELF-EFFICACY BELIEFS/BELIEFS ABOUT CONTROL OVER THE BEHAVIOR						
Belief in one's ability to perform the behavior; confidence	One believes in their ability to perform the behavior	Self-efficacy	—	Perceived behavioral control	Self-efficacy	Self-efficacy/ temptation
NORMATIVE AND NORM-RELATED BELIEFS AND ACTIVITIES						
Belief that others want you to engage in the behavior (and one's motivation to comply); may include actual support of others	One believes that people important to them want them to engage in the behavior; person has others' support	Cues from media, friends (cues to action)	Normative beliefs and motivation to comply (subjective norms)	Normative beliefs and motivation to comply (subjective norms)	Social support	Helping relationships (process of change)
Belief that others (e.g., peers) are engaging in the behavior	One believes that other people are engaging in the behavior	—	—	—	Social environment/ norms; modeling	Social liberation (process of change)
Responses to one's behavior that increase or decrease the likelihood one will engage in the behavior; may include reminders	One receives positive reinforcement from others or creates positive reinforcements for themselves	Cues from media, friends (cues to action)	—	—	Reinforcement	Reinforcement management/ stimulus control (processes of change)
RISK-RELATED BELIEFS AND EMOTIONAL RESPONSES						
Belief that one is at risk if one does not engage in the behavior, and that the consequences may be severe; may include actually experiencing negative emotions or symptoms and coping with them	One feels at risk with regard to a negative outcome or disease	Perceived susceptibility/severity (perceived threat)	—	—	Emotional coping responses/ expectancies about environmental cues	Dramatic relief (process of change)
INTENTION/COMMITMENT/PLANNING						
Intending or planning to perform the behavior; setting goals or making a commitment to perform the behavior	One has formed strong behavioral intentions to engage in the behavior; one has set realistic goals or made a firm commitment to engage in the behavior	—	Behavioral intentions	Behavioral intentions	Self-control/ self-regulation	Contemplation/ preparation (stages of change); self-liberation (process of change)

From Table 1 in Noar SM, Zimmerman RS: Health behavior theory and cumulative knowledge regarding health behaviors: are we moving in the right direction? *Health Educ Res* 20:275–290, 2005.
6 SCT, ••; TPB, ••; TTM, ••.

Table 6-4 RELATIONSHIP BETWEEN SD AND NORMAL RANGE FOR NORMALLY DISTRIBUTED QUANTITIES

OBSERVATIONS INCLUDED IN THE NORMAL RANGE		PROBABILITY OF A "NORMAL" MEASUREMENT DEVIATING FROM THE MEAN BY THIS AMOUNT	
SD	%	SD	%
±1	68 3	≥1	16.0
±2	95.4	≥2	2.3
±3	99.7	≥3	0.13

SD, standard deviation.

affected by such social and environmental influences as maternal undernutrition; alcohol, cigarette, and drug use (both legal and illicit); and psychologic trauma. The complex interplay between these forces and the somatic and neurologic transformations occurring in the fetus influence growth and behavior at birth, through infancy, and potentially throughout the individual's life.

SOMATIC DEVELOPMENT

Embryonic Period

Milestones of prenatal development are presented in Table 6-5. By 6 days postconceptual age, as implantation begins, the embryo consists of a spherical mass of cells with a central cavity (the

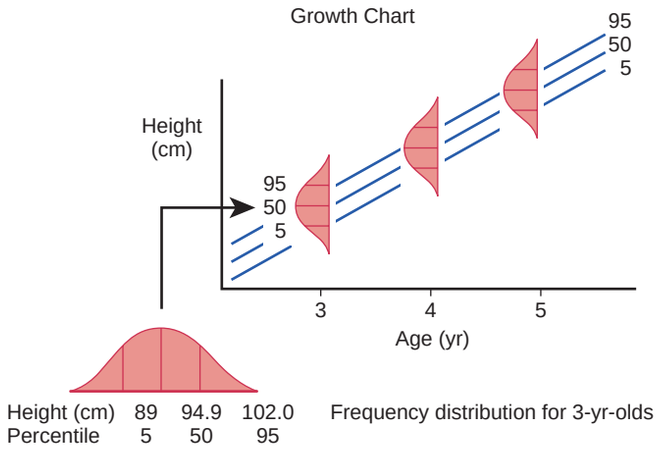

Figure 6-4 Relationship between percentile lines on the growth curve and frequency distributions of height at different ages.

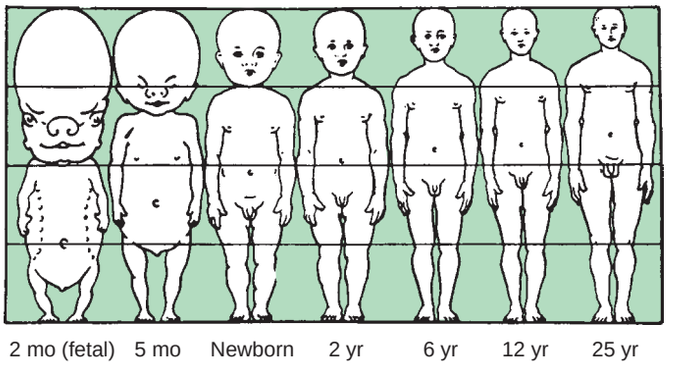

Figure 6-5 Changes in body proportions from the 2nd fetal mo to adulthood. (From Robbins WJ, Brody S, Hogan AG, et al: *Growth,* New Haven, CT, 1928, Yale University Press.)

Table 6-5 MILESTONES OF PRENATAL DEVELOPMENT

WK	DEVELOPMENTAL EVENTS
1	Fertilization and implantation; beginning of embryonic period
2	Endoderm and ectoderm appear (bilaminar embryo)
3	First missed menstrual period; mesoderm appears (trilaminar embryo); somites begin to form
4	Neural folds fuse; folding of embryo into human-like shape; arm and leg buds appear; crown-rump length 4-5 mm
5	Lens placodes, primitive mouth, digital rays on hands
6	Primitive nose, philtrum, primary palate
7	Eyelids begin; crown-rump length 2 cm
8	Ovaries and testes distinguishable
9	*Fetal* period begins; crown-rump length 5 cm; weight 8 g
12	External genitals distinguishable
20	Usual lower limit of viability; weight 460 g; length 19 cm
25	Third trimester begins; weight 900 g; length 24 cm
28	Eyes open; fetus turns head down; weight 1,000-1,300 g
38	Term

blastocyst). By 2 wk, implantation is complete and the uteroplacental circulation has begun; the embryo has 2 distinct layers, endoderm and ectoderm, and the amnion has begun to form. By 3 wk, the 3rd primary germ layer (mesoderm) has appeared, along with a primitive neural tube and blood vessels. Paired heart tubes have begun to pump.

During wk 4-8, lateral folding of the embryologic plate, followed by growth at the cranial and caudal ends and the budding of arms and legs, produces a human-like shape. Precursors of skeletal muscle and vertebrae (somites) appear, along with the branchial arches that will form the mandible, maxilla, palate, external ear, and other head and neck structures. Lens placodes appear, marking the site of future eyes; the brain grows rapidly. By the end of wk 8, as the embryonic period closes, the rudiments of all major organ systems have developed; the crown-rump length is 3 cm.

Fetal Period

From the 9th wk on (fetal period), somatic changes consist of rapid body growth as well as differentiation of tissues, organs, and organ systems. Changes in body proportion are depicted in Figure 6-5. By wk 10, the face is recognizably human. The midgut returns to the abdomen from the umbilical cord, rotating counterclockwise to bring the stomach, small intestine, and large intestine into their normal positions. By wk 12, the gender of the external genitals becomes clearly distinguishable. Lung development proceeds, with the budding of bronchi, bronchioles, and successively smaller divisions. By wk 20-24, primitive alveoli have formed and surfactant production has begun; before that time, the absence of alveoli renders the lungs useless as organs of gas exchange.

During the 3rd trimester, weight triples and length doubles as body stores of protein, fat, iron, and calcium increase.

NEUROLOGIC DEVELOPMENT

During the 3rd wk, a neural plate appears on the ectodermal surface of the trilaminar embryo. Infolding produces a neural tube that will become the central nervous system (CNS) and a neural crest that will become the peripheral nervous system. Neuroectodermal cells differentiate into neurons, astrocytes, oligodendrocytes, and ependymal cells, whereas microglial cells are derived from mesoderm. By the 5th wk, the 3 main subdivisions of forebrain, midbrain, and hindbrain are evident. The dorsal and ventral horns of the spinal cord have begun to form, along with the peripheral motor and sensory nerves. Myelinization begins at midgestation and continues through the 1st yr of life.

By the end of the embryonic period (wk 8), the gross structure of the nervous system has been established. On a cellular level, neurons migrate outward to form the 6 cortical layers. Migration is complete by the 6th mo, but differentiation continues. Axons and dendrites form synaptic connections at a rapid pace, making the CNS vulnerable to teratogenic or hypoxic influences throughout gestation. Rates of increase in DNA (a marker of cell number), overall brain weight, and cholesterol (a marker of myelinization) are shown in Figure 6-6. The prenatal and postnatal peaks of DNA probably represent rapid growth of neurons and glia, respectively. By the time of birth, the structure of the brain is complete. Synapses will be pruned back substantially and new connections will be made, largely as a result of experience.

BEHAVIORAL DEVELOPMENT

No behavioral evidence of neural function is detectable until the 3rd month. Reflexive responses to tactile stimulation develop in a craniocaudal sequence. By wk 13-14, breathing and swallowing motions appear. The grasp reflex appears at 17 wk and is well developed by 27 wk. Eye opening occurs around 26 wk. By midgestation, the full range of neonatal movements can be observed.

During the 3rd trimester, fetuses respond to external stimuli with heart rate elevation and body movements (see Chapter 96).

As with infants in the postnatal period, reactivity to auditory (vibroacoustic) and visual (bright light) stimuli vary depending on their behavioral state, which can be characterized as quiet sleep, active sleep, or awake. Individual differences in the level of fetal activity are commonly noted by mothers and have been observed ultrasonographically. Fetal behavior is affected by maternal medications and diet, increasing after ingestion of caffeine. Behavior may be entrained to the mother's diurnal rhythms: asleep during the day, active at night.

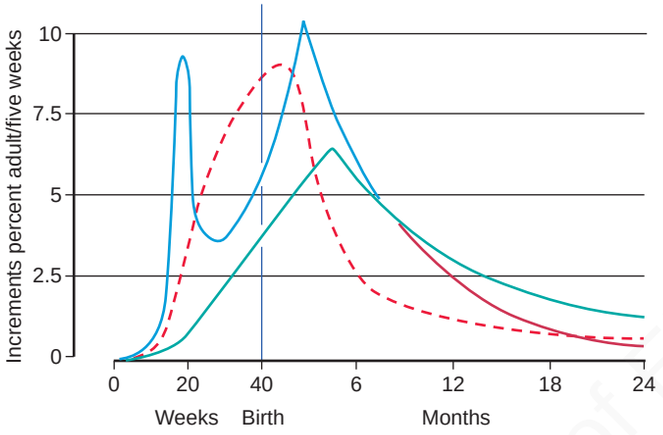

Figure 6-6 Velocity curves of the various components of human brain growth. *Solid line with two peaks*, DNA; *dashed line*, brain weight; *solid line with a single peak*, cholesterol. (From Brasel JA, Gruen RK. In Falkner F, Tanner JM, editors: *Human growth: a comprehensive treatise,* New York, 1986, Plenum Press, pp 78–95.)

Fetal movement increases in response to a sudden auditory tone, but decreases after several repetitions. This demonstrates **habituation,** a basic form of learning in which repeated stimulation results in a response decrement. If the tone changes in pitch, the movement increases again, evidence that the fetus distinguishes between a familiar, repeated tone and a novel one. Habituation improves in older fetuses, and decreases in neurologically impaired or physically stressed fetuses. Similar responses to visual and tactile stimuli have been observed.

PSYCHOLOGIC CHANGES IN PARENTS

Many psychologic changes occur during pregnancy. An unplanned pregnancy may be met with anger, denial, or depression. Ambivalent feelings are the norm, whether or not the pregnancy was planned. Elation at the thought of producing a baby and the wish to be the perfect parent compete with fears of inadequacy and of the lifestyle changes that mothering will impose. Old conflicts may resurface as a woman psychologically identifies with her own mother and with herself as a child. The father-to-be faces similar mixed feelings, and problems in the parental relationship may intensify.

Tangible evidence that a fetus exists as a separate being, whether as a result of ultrasonic visualization or awareness of fetal movements (at approximately 20 wk), often heightens a woman's feelings, both positive and negative. Parents worry about the fetus's healthy development and mentally rehearse what they will do if the child is malformed. Reassurances based on ultrasound examinations or amniocentesis may not completely allay these fears. Toward the end of pregnancy, a woman becomes aware of patterns of fetal activity and reactivity and begins to ascribe to her fetus an individual personality and an ability to survive independently. Appreciation of the psychologic vulnera-

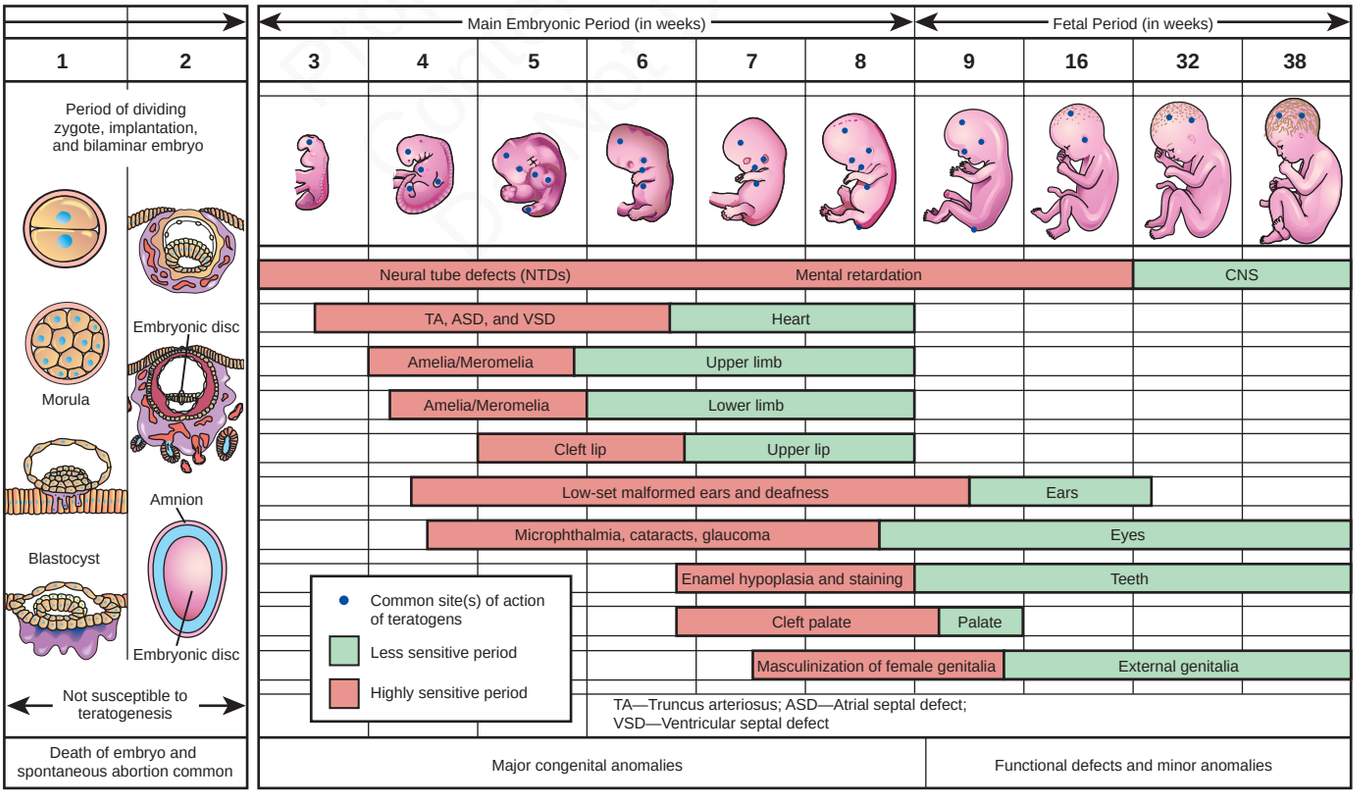

Figure 6-7 Critical periods in human prenatal development. (From Moore KL, Persaud TVN: *Before we are born: essentials of embryology and birth defects,* ed 7, Philadelphia, 2008, Saunders/Elsevier.)

bility of the expectant parents and of the powerful contribution of fetal behavior facilitates supportive clinical intervention.

THREATS TO FETAL DEVELOPMENT

Mortality and morbidity are highest during the prenatal period
4 (see Chapter 87). An estimated 50% of all pregnancies end in spontaneous abortion, including approximately 10-25% of all clinically recognized pregnancies. The vast majority occur in the 1st trimester. Some occur as a result of chromosomal or other abnormalities.

The association between an inadequate nutrient supply to the fetus with low birthweight has been recognized for decades; this adaptation on the part of the fetus to the inadequate supply presumably increases the likelihood that the fetus to survive until birth. Also recognized for decades is the fact that for any potential fetal insult, the extent and nature of its effects are determined by characteristics of the host as well as the dose and timing of the exposure. Inherited differences in the metabolism of ethanol may predispose certain individuals or groups to fetal alcohol syndrome. Organ systems are most vulnerable during periods of maximum growth and differentiation, generally during the 1st trimester (organogenesis). Figure 6-7 depicts sensitive periods during gestation for various organ systems. (See also *http://www.criticalwindows.com/go_display.php* for a more detailed listing of critical periods and specific developmental abnormalities.)

Fetal adaptations or responses to an adverse situation in utero (referred to as *fetal programming* or *developmental plasticity*) have lifelong implications for the individual. Fetal programming may prepare the fetus for an environment that matches that experienced in utero. Fetal programming in response to some environmental and nutritional signals in utero increase the risk of cardiovascular, metabolic, and behavioral diseases in later life. These adverse long-term effects appear to represent a mismatch between fetal and neonatal environmental conditions and the conditions that the individual will confront later in life; a fetus deprived of adequate calories may or may not as a child or teenager face famine. One proposed mechanism for fetal programming is epigenetic imprinting, in which two genes are inherited but one is turned off through epigenetic modification (see Chapter
5 75). Imprinted genes play a critical role in fetal growth and thus may be responsible for the subsequent lifelong effects on growth and related disorders.

Teratogens associated with gross physical and mental abnormalities include various infectious agents (toxoplasmosis, rubella, syphilis); chemical agents (mercury, thalidomide, antiepileptic medications, and ethanol), high temperature, and radiation (see Chapters 90 and 699).

Teratogenic effects may include not only gross physical malformation but also decreased growth and cognitive or behavioral deficits that only become apparent later in life. Prenatal exposure to cigarette smoke is associated with lower birthweight, shorter length, and smaller head circumference, as well as decreased IQ and increased rates of learning disabilities. The effects of prenatal exposure to cocaine remain controversial and may be less dramatic than popularly believed. The effects include direct neurotoxic effects and effects mediated by reduced placental blood flow; associated risk factors include other prenatal exposures (alcohol and cigarettes used in large amounts by many cocaine-addicted women) as well as "toxic" postnatal environments frequently characterized by instability, multiple caregivers, and abuse and neglect (see Chapter 36).

Psychologic distress during pregnancy can have serious consequences on the developing fetus through both maternal behaviors, including substance use, diminished appetite, or sleep disorder, and physiological changes involving the hypothalamic-pituitary-adrenal (HPA) axis and the autonomic nervous system (ANS). Dysregulation of the HPA axis and ANS may explain the associations observed in some but not all studies between maternal distress and identified negative infant outcomes, including low birthweight, spontaneous abortion, prematurity, and decreased head circumference. Infants born to mothers experiencing high rates of depression or stress have been found to have delays in motor or mental development, or both, and in some studies higher levels of escape behaviors. Maternal anxiety between wk 12 and 22 but not wk 30 to 40 has been associated with increased rates of attention deficit hyperactivity disorder (see Chapter 30), suggesting that there may be critical periods in fetal development especially sensitive to maternal stress. Although the mechanisms of the effect of maternal stress remain to be elucidated, the attributable load of emotional and behavioral problems in the infant due to antenatal stress, anxiety, or both is estimated to be about 15%.

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Chapter 7
The Newborn

John Olsson

The **newborn (neonatal) period** begins at birth (regardless of gestational age) and includes the 1st mo of life. During this time, marked physiologic transitions occur in all organ systems, and the infant learns to respond to many forms of external stimuli. Because infants thrive physically and psychologically only in the context of their social relationships, any description of the newborn's developmental status has to include consideration of the parents' role as well.

PARENTAL ROLE IN MATERNAL-INFANT ATTACHMENT

Parenting a newborn infant requires dedication because a newborn's needs are urgent, continuous, and often unclear. Parents must attend to an infant's signals and respond empathically. Many factors influence parents' ability to assume this role.

Prenatal Factors

Pregnancy is a period of psychologic preparation for the profound demands of parenting. Women may experience ambivalence, particularly (but not exclusively) if the pregnancy was unplanned. If financial worries, physical illness, prior miscarriages or stillbirths, or other crises interfere with psychologic

Table 7-1 PRENATAL RISK FACTORS FOR ATTACHMENT

Recent death of a loved one
Previous loss of or serious illness in another child
Prior removal of a child
History of depression or serious mental illness
History of infertility or pregnancy loss
Troubled relationship with parents
Financial stress or job loss
Marital discord or poor relationship with the other parent
Recent move or no community ties
No friends or social network
Unwanted pregnancy
No good parenting model
Experience of poor parenting
Drug and/or alcohol abuse
Extreme immaturity

From Dixon SD, Stein MT: *Encounters with children: pediatric behavior and development,* ed 3, St Louis, 2000, Mosby, p 74.

preparation, the neonate may not be welcomed. For adolescent mothers, the demand that they relinquish their own developmental agenda, such as an active social life, may be especially burdensome.

The early experience of being mothered may establish unconsciously held expectations about nurturing relationships that permit mothers to "tune in" to their infants. These expectations are linked with the quality of later infant-parent interactions. Mothers whose early childhoods were marked by traumatic separations, abuse, or neglect may find it especially difficult to provide consistent, responsive care. Instead, they may reenact their childhood experiences with their own infants as if unable to conceive of the mother-child relationship in any other way. Bonding may be adversely affected by several risk factors during pregnancy and in the postpartum period, which undermine the mother-child relationship and may threaten the infant's cognitive and emotional development (Table 7-1).

Social support during pregnancy, particularly support from the father and close family members, is also important. Conversely, conflict with or abandonment by the father during pregnancy may diminish the mother's ability to become absorbed with her infant. Anticipation of an early return to work may make some women reluctant to fall in love with their babies due to anticipated separation. Returning to work should be delayed at least until after 6 wk, when feeding and basic behavioral adjustments have been established.

Many decisions have to be made by parents in anticipation of the birth of their child. The most important choice is that of how the infant will be nourished. Among the important benefits of breast-feeding is the role of promoting bonding. Providing breast-feeding education for the parents at the prenatal visit by the pediatrician and by the obstetrician during prenatal care can increase maternal confidence in breast-feeding after delivery and reduce stress during the newborn period (see Chapter 42). 1

Peripartum and Postpartum Influences

The continuous presence during labor of a woman trained to offer friendly support and encouragement (a **doula**) results in shorter labor, fewer obstetric complications (including cesarean section), and reduced postpartum hospital stays. Early skin-to-skin contact between mothers and infants immediately after birth may correlate with an increased rate and longer duration of breast-feeding. Most new parents value even a brief period of uninterrupted time in which to get to know their new infant, and increased mother-infant contact over the first days of life may improve long-term mother-child interactions. Nonetheless, early separation, although predictably very stressful, does not inevitably impair a mother's ability to bond with her infant. Early discharge home from the maternity ward may undermine bonding, particularly when a new mother is required to resume full responsibility for a busy household.

Postpartum depression may occur in the 1st week (up to 6 mo) after delivery and can adversely affect neonatal growth and development. Screening methods are available for use during neonatal and infant visits to the pediatric provider. Referral for care will greatly accelerate recovery (see later).

THE INFANT'S ROLE IN MATERNAL-INFANT ATTACHMENT

The in utero environment contributes greatly but not completely to the future growth and development of the fetus. Abnormalities in maternal-fetal placental circulation and maternal glucose metabolism or the presence of maternal infection can result in abnormal fetal growth. Infants may be small or large for gestational age as a result. These abnormal growth patterns not only predispose infants to an increased requirement for medical intervention but also may affect their ability to respond behaviorally to their parents.

Physical Examination

Examination of the newborn should include an evaluation of growth and an observation of behavior. The average term newborn weighs approximately 3.4 kg (7½ lb); boys are slightly heavier than girls are. Average weight does vary by ethnicity and SES. The average length and head circumference are about 50 cm (20 in) and 35 cm (14 in), respectively, in term infants. Each newborn's growth parameters should be plotted on growth curves specific for that infant's gestational age to determine the appropriateness of size. Likewise specific growth charts for conditions associated with variations in growth patterns have also been developed. The infant's response to being examined may be useful in assessing its vigor, alertness, and tone. Observing how the parents handle their infant, their comfort and affection, is also important. The order of the physical examination should be from the least to the most intrusive maneuver. Assessing visual tracking and response to sound and noting changes of tone with level of activity and alertness are very helpful. Performing this examination and sharing impression with parents is an important opportunity to facilitate bonding (see Chapter 94). 2 3

Interactional Abilities

Soon after birth, neonates are alert and ready to interact and nurse. This first alert-awake period may be affected by maternal analgesics and anesthetics or fetal hypoxia. Neonates are nearsighted, having a fixed focal length of 8-12 in, approximately the distance from the breast to the mother's face, as well as an inborn visual preference for faces. Hearing is well developed, and infants preferentially turn toward a female voice. These innate abilities and predilections increase the likelihood that when a mother gazes at her newborn, the baby will gaze back. The initial period of social interaction, usually lasting about 40 min, is followed by a period of somnolence. After that, briefer periods of alertness or excitation alternate with sleep. If a mother misses her baby's first alert-awake period, she may not experience as long a period of social interaction for several days. Neuroimaging studies indicate that the hypothalamic-midbrain-limbic-paralimbic-cortical circuit of the parents interact to support responses to the infants that are critical for effective parenting (e.g., emotion, attention, motivation, empathy, and decision-making).

Modulation of Arousal

Adaptation to extrauterine life requires rapid and profound physiologic changes, including aeration of the lungs, rerouting of the circulation, and activation of the intestinal tract. The necessary behavioral changes are no less profound. To obtain nourishment, to avoid hypo- and hyperthermia, and to ensure safety, neonates must react appropriately to an expanded range of sensory stimuli. Infants must become aroused in response to stimulation, but not

so overaroused that their behavior becomes disorganized. Underaroused infants are not able to feed and interact; overaroused infants show signs of **autonomic instability,** including flushing or mottling, perioral pallor, hiccupping, vomiting, uncontrolled limb movements, and inconsolable crying.

Behavioral States

The organization of infant behavior into discrete behavioral states may reflect an infant's inborn ability to regulate arousal. Six states have been described: quiet sleep, active sleep, drowsy, alert, fussy, and crying. In the **alert state,** infants visually fixate on objects or faces and follow them horizontally and (within a month) vertically; they also reliably turn toward a novel sound, as if searching for its source. When overstimulated, they may calm themselves by looking away, yawning, or sucking on their lips or hands, thereby increasing parasympathetic activity and reducing sympathetic nervous activity. The behavioral state determines an infant's muscle tone, spontaneous movement, electroencephalogram pattern, and response to stimuli. In **active sleep,** an infant may show progressively less reaction to a repeated heel stick (habituation), whereas in the **drowsy state,** the same stimulus may push a child into fussing or crying.

Mutual Regulation

Parents actively participate in an infant's state regulation, alternately stimulating and soothing. In turn, they are regulated by

Table 7-2 EDINBURGH POSTNATAL DEPRESSION SCALE

INSTRUCTIONS FOR USERS

1. The mother is asked to underline the response that comes closest to how she has been feeling in the previous 7 days.
2. All 10 items must be completed.
3. Care should be taken to avoid the possibility of the mother discussing her answers with others.
4. The mother should complete the scale herself, unless she has limited English or has difficulty with reading.
5. The Edinburgh Postnatal Depression Scale may be used at 6-8 weeks to screen postnatal women. The child health clinic, a postnatal checkup, or a home visit may provide a suitable opportunity for its completion.

Edinburgh Postnatal Depression Scale
Name:
Address:
Baby's age:

Because you have recently had a baby, we would like to know how you are feeling. Please underline the answer that comes closest to how you have felt in the past 7 days, not just how you feel today.

Here is an example, already completed.
I have felt happy:
Yes, all the time
Yes, most of the time
No, not very often
No, not at all
This would mean: "I have felt happy most of the time" during the past week. Please complete the other questions in the same way.

In the past 7 days:

1. I have been able to laugh and see the funny side of things
   As much as I always could
   Not quite so much now
   Definitely not so much now
   Not at all
2. I have looked forward with enjoyment to things
   As much as I ever did
   Rather less than I used to
   Definitely less than I used to
   Hardly at all

*3. I have blamed myself unnecessarily when things went wrong
   Yes, most of the time
   Yes, some of the time
   Not very often
   No, never

4. I have been anxious or worried for no good reason
   No, not at all
   Hardly ever
   Yes, sometimes
   Yes, very often

*5. I have felt scared or panicky for no very good reason
   Yes, quite a lot
   Yes, sometimes
   No, not much
   No, not at all

*6. Things have been getting on top of me
   Yes, most of the time I haven t been able to cope at all
   Yes, sometimes I haven't been coping as well as usual
   No, most of the time I have coped quite well
   No, I have been coping as well as ever

*7. I have been so unhappy that I have had difficulty sleeping
   Yes, most of the time
   Yes, sometimes
   Not very often
   No, not at all

*8. I have felt sad or miserable
   Yes, most of the time
   Yes, quite often
   Not very often
   No, not at all

*9. I have been so unhappy that I have been crying
   Yes, most of the time
   Yes, quite often
   Only occasionally
   No, never

*10. The thought of harming myself has occurred to me
   Yes, quite often
   Sometimes
   Hardly ever
   Never

Response categories are scored 0, 1, 2, and 3 according to increased severity of the symptom. Items marked with an asterisk (*) are reverse scored (i.e., 3, 2, 1, and 0). The total score is calculated by adding the scores for each of the 10 items. Users may reproduce the scale without further permission providing they respect copyright (which remains with the *British Journal of Psychiatry*) by quoting the names of the authors, the title, and the source of the paper in all reproduced copies.
From Currie ML, Rademacher R: The pediatrician's role in recognizing and intervening in postpartum depression, *Pediatr Clin North Am* 51:785–801, 2004.

the infant's signals, responding to cries of hunger with a letdown of milk (or with a bottle). Such interactions constitute a system directed toward furthering the infant's physiologic homeostasis and physical growth. At the same time, they form the basis for the emerging psychologic relationship between parent and child. Infants come to associate the presence of the parent with the pleasurable reduction of tension (as in feeding) and show this preference by calming more quickly for their mother than for a stranger. This response, in turn, strengthens a mother's sense of efficacy and her connection with her baby.

IMPLICATIONS FOR THE PEDIATRICIAN

The pediatrician can support healthy newborn development in several ways.

Optimal Practices

A prenatal pediatric visit allows pediatricians to assess potential threats to bonding (a tense spousal relationship) and sources of social support. Supportive hospital policies include the use of birthing rooms rather than operating suites and delivery rooms; encouragement for the father or a trusted relative or friend to remain with the mother during labor or the provision of a professional doula; the practice of giving the newborn infant to the mother immediately after drying and a brief assessment; placement of the newborn in the mother's room rather than in a central nursery; and avoiding in-hospital distribution of infant formula. Such policies (Baby Friendly Hospital) have been shown to significantly increase breast-feeding rates (see Chapter 94). After discharge, home visits by nurses and lactation counselors can reduce early feeding problems and identify emerging medical conditions in either mother or baby. Infants requiring transport to another hospital should be brought to see the mother first, if at all possible. On discharge home, fathers can shield mothers from unnecessary visits and calls and take over household duties, allowing mothers and infants time to get to know each other without distractions. The first office visit should occur during the first 2 wk after discharge to determine how smoothly the mother and infant are making the transition to life at home. Babies who are discharged early, those who are breast-feeding, and those who are at risk for jaundice should be seen 1 to 3 days after discharge.

Assessing Parent-Infant Interactions

During a feeding or when infants are alert and face-to-face with their parents, it is normal for them to appear absorbed in one another. Infants who become overstimulated by the mother's voice or activity may turn away or close their eyes, leading to a premature termination of the encounter. Alternatively, the infant may be ready to interact, whereas the mother may appear preoccupied. Asking a new mother about her own emotional state, and inquiring specifically about a history of depression, facilitates referral for therapy, which may provide long-term benefits to the child. Pediatricians may detect **postpartum depression** using the Edinburgh Postnatal Depression Scale (EPDS) at well child visits during the first year (Table 7-2).

Teaching About Individual Competencies

The Newborn Behavior Assessment Scale (NBAS) provides a formal measure of an infant's neurodevelopmental competencies, including state control, autonomic reactivity, reflexes, habituation, and orientation toward auditory and visual stimuli. This examination can also be used to demonstrate to parents an infant's capabilities and vulnerabilities. Parents might learn that they need to undress their infant to increase the level of arousal or to swaddle the infant to reduce overstimulation by containing random arm movements. The NBAS can be used to support the development of positive early parent-infant relationships. Demonstration of the NBAS to parents in the 1st wk of life has been shown to correlate with improvements in the caretaking environment months later.

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Chapter 8
The First Year

Susan Feigelman

Advances in imaging permit us to understand the anatomic and physiologic correlates of the physical growth, maturation, acquisition of competence, and psychologic reorganization that characterizes infancy and radically change the infant's behavior and social relationships. Some activities previously thought to be "primitive" or "reflexive" result from complex systems. Swallowing, rather than a simple reflex, results from a complex highly coordinated process involving multiple levels of neural control distributed among several physiologic systems whose nature and relationships mature throughout the 1st year of life. Substantial learning of the basic tools of language (phonology, word segmentation) occurs during infancy. Speech processing in older individuals requires defined and precise neuronal networks; imaging studies have revealed that the infant brain possesses a structural and functional organization similar to that of adults, leading to the belief that structural neurologic processing of speech may guide infants to discover the properties of his or her native language. Myelination of the cortex begins at 8 mo gestation and is nearly complete by age 2 yr; much of this process occurs during infancy. Given the importance of iron and other nutrients in myelination, adequate stores throughout infancy are critical (see Chapter 42). Inadequate dietary intake, insufficient interactions with caregivers, or both may alter experience-dependent processes that are critical to brain structure development and function during infancy. Although some of these processes may be delayed, as the periods of plasticity close during the rapid developmental changes occurring in infancy, more permanent deficits may result.

The infant acquires new competences in all developmental domains. The concept of developmental trajectories recognizes that complex skills build on simpler ones; it is also important to realize how development in each domain affects functioning in

all of the others. Physical growth parameters and normal ranges for attainable weight, length, and head circumference are found in the Centers for Disease Control and Prevention growth charts
2 (see Figs. 9-1 and 9-2 on website). Table 8-1 presents an overview of key milestones by domain; Table 8-2 presents similar information arranged by age. Parents often seek information about "normal development" during this period and should be directed to reliable sources, including the American Academy of Pediatrics website.

AGE 0-2 MONTHS

At birth in the full-term infant, myelination is present in the cerebellar hemisphere, the internal capsule, the corpus callosum, and parts of the subcortical white matter of the parietal, poste-
3 rior, frontal, temporal, and calcarine cortex. In this period, the infant experiences tremendous growth. Physiologic changes allow the establishment of effective feeding routines and a predictable sleep-wake cycle. The social interactions that occur as parents and infants accomplish these tasks lay the foundation for cognitive and emotional development.

Physical Development

A newborn's weight may initially decrease 10% below birthweight in the 1st wk as a result of excretion of excess extravascular fluid and limited nutritional intake. Nutrition improves as colostrum is replaced by higher-fat breast milk, as infants learn to latch on and suck more efficiently, and as mothers become more comfortable with feeding techniques. Infants regain or exceed birthweight by 2 wk of age and should grow at approxi-
4 mately 30 g (1 oz)/day during the 1st mo (see Table 13-1). This is the period of fastest postnatal growth. Limb movements consist largely of uncontrolled writhing, with apparently purposeless opening and closing of the hands. Smiling occurs involuntarily. Eye gaze, head turning, and sucking are under better control and thus can be used to demonstrate infant perception and cognition. An infant's preferential turning toward the mother's voice is evidence of recognition memory.

5 Six behavioral states have been described (see Chapter 7). Initially, sleep and wakefulness are evenly distributed throughout the 24-hr day (Fig. 8-1). Neurologic maturation accounts for the consolidation of sleep into blocks of 5 or 6 hr at night, with brief awake, feeding periods. Learning also occurs; infants whose parents are consistently more interactive and stimulating during the day learn to concentrate their sleeping during the night.

Cognitive Development

Infants can differentiate among patterns, colors, and consonants. They can recognize facial expressions (smiles) as similar, even when they appear on different faces. They also can match abstract properties of stimuli, such as contour, intensity, or temporal pattern, across sensory modalities. Infants at 2 mo of age can discriminate rhythmic patterns in native vs non-native language. Infants appear to seek stimuli actively, as though satisfying an innate need to make sense of the world. These phenomena point to the integration of sensory inputs in the central nervous system. Caretaking activities provide visual, tactile, olfactory, and auditory stimuli; all of these support the development of cognition. Infants habituate to the familiar, attending less to repeated stimuli and increasing their attention to novel stimuli.

Emotional Development

The infant is dependent on the environment to meet his or her needs. The consistent availability of a trusted adult to meet the infant's urgent needs creates the conditions for secure attachment. Basic trust vs mistrust, the first of Erikson's psychosocial stages, depends on attachment and reciprocal maternal bonding. Crying occurs in response to stimuli that may be obvious (a soiled diaper), but are often obscure. Infants who are consistently

Table 8-1 DEVELOPMENTAL MILESTONES IN THE FIRST 2 YR OF LIFE

MILESTONE	AVERAGE AGE OF ATTAINMENT (MO)	DEVELOPMENTAL IMPLICATIONS
GROSS MOTOR		
Holds head steady while sitting	2	Allows more visual interaction
Pulls to sit, with no head lag	3	Muscle tone
Brings hands together in midline	3	Self-discovery of hands
Asymmetric tonic neck reflex gone	4	Can inspect hands in midline
Sits without support	6	Increasing exploration
Rolls back to stomach	6.5	Truncal flexion, risk of falls
Walks alone	12	Exploration, control of proximity to parents
Runs	16	Supervision more difficult
FINE MOTOR		
Grasps rattle	3.5	Object use
Reaches for objects	4	Visuomotor coordination
Palmar grasp gone	4	Voluntary release
Transfers object hand to hand	5.5	Comparison of objects
Thumb-finger grasp	8	Able to explore small objects
Turns pages of book	12	Increasing autonomy during book time
Scribbles	13	Visuomotor coordination
Builds tower of 2 cubes	15	Uses objects in combination
Builds tower of 6 cubes	22	Requires visual, gross, and fine motor coordination
COMMUNICATION AND LANGUAGE		
Smiles in response to face, voice	1.5	More active social participant
Monosyllabic babble	6	Experimentation with sound, tactile sense
Inhibits to "no"	7	Response to tone (nonverbal)
Follows one-step command with gesture	7	Nonverbal communication
Follows one-step command without gesture	10	Verbal receptive language (e.g., "Give it to me")
Says "mama" or "dada"	10	Expressive language
Points to objects	10	Interactive communication
Speaks first real word	12	Beginning of labeling
Speaks 4-6 words	15	Acquisition of object and personal names
Speaks 10-15 words	18	Acquisition of object and personal names
Speaks 2-word sentences (e.g., "Mommy shoe")	19	Beginning grammaticization, corresponds with 50 word vocabulary
COGNITIVE		
Stares momentarily at spot where object disappeared	2	Lack of object permanence (out of sight, out of mind [e.g., yarn ball dropped])
Stares at own hand	4	Self-discovery, cause and effect
Bangs 2 cubes	8	Active comparison of objects
Uncovers toy (after seeing it hidden)	8	Object permanence
Egocentric symbolic play (e.g., pretends to drink from cup)	12	Beginning symbolic thought
Uses stick to reach toy	17	Able to link actions to solve problems
Pretend play with doll (e.g., gives doll bottle)	17	Symbolic thought

Table 8-2 EMERGING PATTERNS OF BEHAVIOR DURING THE 1ST YEAR OF LIFE*

NEONATAL PERIOD (1ST 4 WK)	
Prone:	Lies in flexed attitude; turns head from side to side; head sags on ventral suspension
Supine:	Generally flexed and a little stiff
Visual:	May fixate face on light in line of vision; "doll's-eye" movement of eyes on turning of the body
Reflex:	Moro response active; stepping and placing reflexes; grasp reflex active
Social:	Visual preference for human face
AT 1 MO	
Prone:	Legs more extended; holds chin up; turns head; head lifted momentarily to plane of body on ventral suspension
Supine:	Tonic neck posture predominates; supple and relaxed; head lags when pulled to sitting position
Visual:	Watches person; follows moving object
Social:	Body movements in cadence with voice of other in social contact; beginning to smile
AT 2 MO	
Prone:	Raises head slightly farther; head sustained in plane of body on ventral suspension
Supine:	Tonic neck posture predominates; head lags when pulled to sitting position
Visual:	Follows moving object 180 degrees
Social:	Smiles on social contact; listens to voice and coos
AT 3 MO	
Prone:	Lifts head and chest with arms extended; head above plane of body on ventral suspension
Supine:	Tonic neck posture predominates; reaches toward and misses objects; waves at toy
Sitting:	Head lag partially compensated when pulled to sitting position; early head control with bobbing motion; back rounded
Reflex:	Typical Moro response has not persisted; makes defensive movements or selective withdrawal reactions
Social:	Sustained social contact; listens to music; says "aah, ngah"
AT 4 MO	
Prone:	Lifts head and chest, with head in approximately vertical axis; legs extended
Supine:	Symmetric posture predominates, hands in midline; reaches and grasps objects and brings them to mouth
Sitting:	No head lag when pulled to sitting position; head steady, tipped forward; enjoys sitting with full truncal support
Standing:	When held erect, pushes with feet
Adaptive:	Sees pellet, but makes no move to reach for it
Social:	Laughs out loud; may show displeasure if social contact is broken; excited at sight of food
AT 7 MO	
Prone:	Rolls over; pivots; crawls or creep-crawls (Knobloch)
Supine:	Lifts head; rolls over; squirms
Sitting:	Sits briefly, with support of pelvis; leans forward on hands; back rounded
Standing:	May support most of weight; bounces actively
Adaptive:	Reaches out for and grasps large object; transfers objects from hand to hand; grasp uses radial palm; rakes at pellet
Language:	Forms polysyllabic vowel sounds
Social:	Prefers mother; babbles; enjoys mirror; responds to changes in emotional content of social contact
AT 10 MO	
Sitting:	Sits up alone and indefinitely without support, with back straight
Standing:	Pulls to standing position; "cruises" or walks holding on to furniture
Motor:	Creeps or crawls
Adaptive:	Grasps objects with thumb and forefinger; pokes at things with forefinger; picks up pellet with assisted pincer movement; uncovers hidden toy; attempts to retrieve dropped object; releases object grasped by other person
Language:	Repetitive consonant sounds ("mama," "dada")
Social:	Responds to sound of name; plays peek-a-boo or pat-a-cake; waves bye-bye
AT 1 YR	
Motor:	Walks with one hand held (48 wk); rises independently, takes several steps (Knobloch)
Adaptive:	Picks up pellet with unassisted pincer movement of forefinger and thumb; releases object to other person on request or gesture
Language:	Says a few words besides "mama," "dada"
Social:	Plays simple ball game; makes postural adjustment to dressing

*Data are derived from those of Gesell (as revised by Knobloch), Shirley, Provence, Wolf, Bailey, and others.
Knobloch H, Stevens F, Malone AF: *Manual of developmental diagnosis,* Hagerstown, MD, 1980, Harper & Row.

picked up and held in response to distress cry less at 1 yr and show less aggressive behavior at 2 yr. Cross-cultural studies show that in societies in which infants are carried close to the mother, babies cry less than in societies in which babies are only periodically carried. Crying normally peaks at about 6 wk of age, when healthy infants may cry up to 3 hr/day, then decreases to 1 hr or less by 3 mo.

The emotional significance of any experience depends on both the individual child's temperament and the parent's responses (see Table 6-1); differing feeding schedules produce differing 6
reactions. Hunger generates increasing tension; as the urgency peaks, the infant cries, the parent offers the breast or bottle and the tension dissipates. Infants fed "on demand" consistently experience this link between their distress, the arrival of the

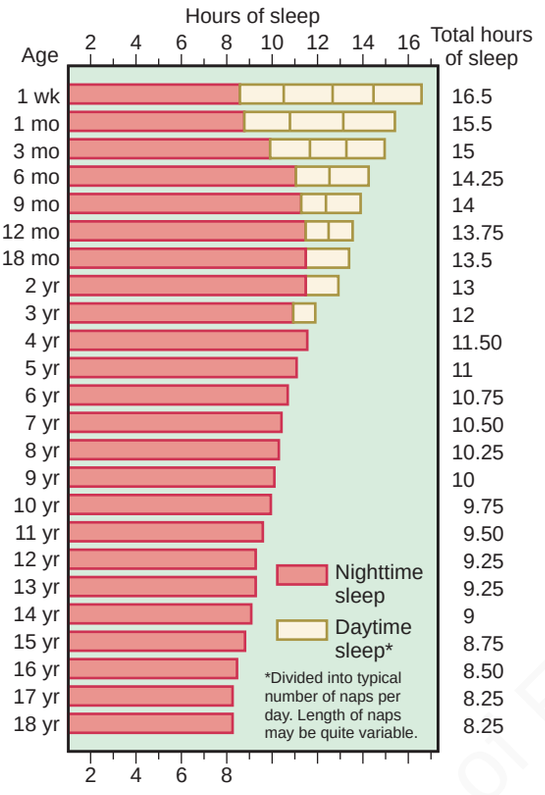

Figure 8-1 Typical sleep requirements in children. (From Ferber R: *Solve your child's sleep problems,* New York, 1985, Simon & Schuster.)

parent, and relief from hunger. Most infants fed on a fixed schedule quickly adapt their hunger cycle to the schedule. Those who cannot because they are temperamentally prone to irregular biologic rhythms experience periods of unrelieved hunger as well as unwanted feedings when they already feel full. Similarly, infants who are fed at the parents' convenience, with neither attention to the infant's hunger cues nor a fixed schedule may not consistently experience feeding as the pleasurable reduction of tension. These infants often show increased irritability and physiologic instability (spitting, diarrhea, poor weight gain) as well as later behavioral problems.

Implications for Parents and Pediatricians

Success or failure in establishing feeding and sleep cycles determines parents' feelings of efficacy. When things go well, the parents' anxiety and ambivalence, as well as the exhaustion of the early weeks, decrease. Infant issues (colic) or familial conflict will prevent this from occurring. With physical recovery from delivery and endocrinologic normalization, the mild postpartum depression that affects many mothers passes. If the mother continues to feel sad, overwhelmed, and anxious, the possibility of moderate to severe postpartum depression, found in 10% of postpartum women, needs to be considered. Major **depression** that arises during pregnancy or in the postpartum period threatens the mother-child relationship and is a risk factor for later cognitive and behavioral problems. The pediatrician may be the first professional to encounter the depressed mother and should be instrumental in assisting her in seeking treatment (see 7 Chapter 7).

AGE 2-6 MONTHS

At about 2 mo, the emergence of voluntary (social) smiles and increasing eye contact mark a change in the parent-child relationship, heightening the parents' sense of being loved reciprocally. During the next months, an infant's range of motor and social control and cognitive engagement increases dramatically. Mutual regulation takes the form of complex social interchanges, resulting in strong mutual attachment and enjoyment. Parents are less fatigued.

Physical Development

Between 3 and 4 mo of age, the rate of growth slows to approximately 20 g/day (see Table 13-1 and Figs. 9-1 and 9-2). By 4 mo, 8 birthweight is doubled. Early reflexes that limited voluntary movement recede. Disappearance of the asymmetric tonic neck reflex means that infants can begin to examine objects in the midline and manipulate them with both hands (see Chapter 584). Waning of the early grasp reflex allows infants both to hold objects and to let them go voluntarily. A novel object may elicit purposeful, although inefficient, reaching. The quality of spontaneous movements also changes, from larger writhing to smaller, circular movements that have been described as "fidgety." Abnormal or absent fidgety movements may constitute a risk factor for later neurologic abnormalities.

Increasing control of truncal flexion makes intentional rolling possible. Once infants can hold their heads steady while sitting, they can gaze across at things rather than merely looking up at them, and can begin taking food from a spoon. At the same time, maturation of the visual system allows greater depth perception.

In this period, infants achieve stable state regulation and regular sleep-wake cycles. Total sleep requirements are approximately 14-16 hr/24 hr, with about 9-10 hr concentrated at night and 2 naps/day. About 70% of infants sleep for a 6-8 hr stretch by age 6 mo (see Fig. 8-1). By 4-6 mo, the sleep electroencephalogram shows a mature pattern, with demarcation of rapid eye movement (REM) and 4 stages of non-REM sleep. The sleep cycle remains shorter than in adults (50-60 min vs approximately 90 min). As a result, infants arouse to light sleep or wake frequently during the night, setting the stage for behavioral sleep problems (see Chapter 17).

Cognitive Development

The overall effect of these developments is a qualitative change. At 4 mo of age, infants are described as "hatching" socially, becoming interested in a wider world. During feeding, infants no longer focus exclusively on the mother, but become distracted. In the mother's arms, the infant may literally turn around, preferring to face outward.

Infants at this age also explore their own bodies, staring intently at their hands, vocalizing, blowing bubbles, and touching their ears, cheeks, and genitals. These explorations represent an early stage in the understanding of cause and effect as infants learn that voluntary muscle movements generate predictable tactile and visual sensations. They also have a role in the emergence of a sense of self, separate from the mother. This is the first stage of personality development. Infants come to associate certain sensations through frequent repetition. The proprioceptive feeling of holding up the hand and wiggling the fingers always accompanies the sight of the fingers moving. Such self sensations are consistently linked and reproducible at will. In contrast, sensations that are associated with "other" occur with less regularity and in varying combinations. The sound, smell, and feel of the mother sometimes appear promptly in response to crying, but sometimes do not. The satisfaction that the mother or another loving adult provides continues the process of attachment.

Emotional Development and Communication

Babies interact with increasing sophistication and range. The primary emotions of anger, joy, interest, fear, disgust, and surprise appear in appropriate contexts as distinct facial expressions.

Table 8-3 TIME OF APPEARANCE IN X-RAYS OF CENTERS OF OSSIFICATION IN INFANCY AND CHILDHOOD

BOYS—AGE AT APPEARANCE*	BONES AND EPIPHYSEAL CENTERS	GIRLS—AGE AT APPEARANCE*
HUMERUS, HEAD		
3 wk		3 wk
CARPAL BONES		
2 mo ± 2 mo	Capitate	2 mo ± 2 mo
3 mo ± 2 mo	Hamate	2 mo ± 2 mo
30 mo ± 16 mo	Triangular†	21 mo ± 14 mo
42 mo ± 19 mo	Lunate†	34 mo ± 13 mo
67 mo ± 19 mo	Trapezium†	47 mo ± 14 mo
69 mo ± 15 mo	Trapezoid†	49 mo ± 12 mo
66 mo ± 15 mo	Scaphoid†	51 mo ± 12 mo
No standards available	Pisiform†	No standards available
METACARPAL BONES		
18 mo ± 5 mo	II	12 mo ± 3 mo
20 mo ± 5 mo	III	13 mo ± 3 mo
23 mo ± 6 mo	IV	15 mo ± 4 mo
26 mo ± 7 mo	V	16 mo ± 5 mo
32 mo ± 9 mo	I	18 mo ± 5 mo
FINGERS (EPIPHYSES)		
16 mo ± 4 mo	Proximal phalanx, 3rd finger	10 mo ± 3 mo
16 mo ± 4 mo	Proximal phalanx, 2nd finger	11 mo ± 3 mo
17 mo ± 5 mo	Proximal phalanx, 4th finger	11 mo ± 3 mo
19 mo ± 7 mo	Distal phalanx, 1st finger	12 mo ± 4 mo
21 mo ± 5 mo	Proximal phalanx, 5th finger	14 mo ± 4 mo
24 mo ± 6 mo	Middle phalanx, 3rd finger	15 mo ± 5 mo
24 mo ± 6 mo	Middle phalanx, 4th finger	15 mo ± 5 mo
26 mo ± 6 mo	Middle phalanx, 2nd finger	16 mo ± 5 mo
28 mo ± 6 mo	Distal phalanx, 3rd finger	18 mo ± 4 mo
28 mo ± 6 mo	Distal phalanx, 4th finger	18 mo ± 5 mo
32 mo ± 7 mo	Proximal phalanx, 1st finger	20 mo ± 5 mo
37 mo ± 9 mo	Distal phalanx, 5th finger	23 mo ± 6 mo
37 mo ± 8 mo	Distal phalanx, 2nd finger	23 mo ± 6 mo
39 mo ± 10 mo	Middle phalanx, 5th finger	22 mo ± 7 mo
152 mo ± 18 mo	Sesamoid (adductor pollicis)	121 mo ± 13 mo
HIP AND KNEE		
Usually present at birth	Femur, distal	Usually present at birth
Usually present at birth	Tibia, proximal	Usually present at birth
4 mo ± 2 mo	Femur, head	4 mo ± 2 mo
46 mo ± 11 mo	Patella	29 mo ± 7 mo
FOOT AND ANKLE‡		

Values represent mean ± standard deviation, when applicable.
*To nearest month.
†Except for the capitate and hamate bones, the variability of carpal centers is too great to make them very useful clinically.
‡Standards for the foot are available, but normal variation is wide, including some familial variants, so this area is of little clinical use.
The norms present a composite of published data from the Fels Research Institute, Yellow Springs, OH (Pyle SI, Sontag L: *AJR Am J Roentgenol* 49:102, 1943), and unpublished data from the Brush Foundation, Case Western Reserve University, Cleveland, OH, and the Harvard School of Public Health, Boston, MA. Compiled by Lieb, Buehl, and Pyle.

When face-to-face, the infant and a trusted adult can match affective expressions (smiling or surprise) about 30% of the time. Initiating games (facial imitation, singing, hand games) increases social development. Such face-to-face behavior reveals the infant's ability to share emotional states, the first step in the development of communication. Infants of depressed parents show a different pattern, spending less time in coordinated movement with their parents and making fewer efforts to re-engage. Rather than anger, they show sadness and a loss of energy when the parents continue to be unavailable.

Implications for Parents and Pediatricians

Motor and sensory maturation makes infants at 3-6 mo exciting and interactive. Some parents experience their 4 mo old child's outward turning as a rejection, secretly fearing that their infants no longer love them. For most parents, this is a happy period. Most parents excitedly report that they can hold conversations with their infants, taking turns vocalizing and listening. Pediatricians share in the enjoyment, as the baby coos, makes eye contact, and moves rhythmically. If this visit does not feel joyful and relaxed, causes such as social stress, family dysfunction, parental mental illness, or problems in the infant-parent relationship should be considered. Parents can be reassured that responding to an infant's emotional needs cannot spoil him or her. Giving vaccines and drawing blood while the child is seated on the parent's lap or nursing at the breast increases pain tolerance.

AGE 6-12 MONTHS

With achievement of the sitting position, increased mobility, and new skills to explore the world around them, 6-12 mo old infants show advances in cognitive understanding and communication, and there are new tensions around the themes of attachment and separation. Infants develop will and intentions, characteristics that most parents welcome, but still find challenging to manage.

Physical Development

Growth slows more (see Table 13-1 and Figs. 9-1 and 9-2). By 9
the 1st birthday, birthweight has tripled, length has increased by 50%, and head circumference has increased by 10 cm. The ability to sit unsupported (6-7 mo) and to pivot while sitting (around 9-10 mo) provides increasing opportunities to manipulate several objects at a time and to experiment with novel combinations of objects. These explorations are aided by the emergence of a thumb-finger grasp (8-9 mo) and a neat pincer grasp by 12 mo. Many infants begin crawling and pulling to stand around 8 mo, followed by cruising. Some walk by 1 yr. Motor achievements correlate with increasing myelinization and cerebellar growth. These gross motor skills expand infants' exploratory range and create new physical dangers as well as opportunities for learning. Tooth eruption occurs, usually starting with the mandibular central incisors. Tooth development reflects skeletal maturation and bone age, although there is wide individual variation (see 10
Chapter 299).

Cognitive Development

The 6 mo old infant has discovered his hands and will soon learn to manipulate objects. At first, everything goes into the mouth. In time, novel objects are picked up, inspected, passed from hand to hand, banged, dropped, and then mouthed. Each action represents a nonverbal idea about what things are for (in Piagetian terms, a *schema*). The complexity of an infant's play, how many different schemata are brought to bear, is a useful index of cognitive development at this age. The pleasure, persistence, and energy with which infants tackle these challenges suggest the existence of an intrinsic drive or mastery motivation. Mastery behavior occurs when infants feel secure; those with less secure attachments show limited experimentation and less competence.

A major milestone is the achievement at about 9 mo of **object permanence** (constancy), the understanding that objects continue to exist, even when not seen. At 4-7 mo of age, infants look down for a yarn ball that has been dropped but quickly give up if it is not seen. With object constancy, infants persist in searching. They will find objects hidden under a cloth or behind the examiner's back. Peek-a-boo brings unlimited pleasure as the child magically brings back the other player. Events seem to occur as a result of the child's own activities.

Emotional Development

The advent of object permanence corresponds with qualitative changes in social and communicative development. Infants look back and forth between an approaching stranger and a parent, and may cling or cry anxiously, demonstrating **stranger anxiety**. Separations often become more difficult. Infants who have been sleeping through the night for months begin to awaken regularly and cry, as though remembering that the parents are in the next room.

A new demand for autonomy also emerges. Poor weight gain at this age often reflects a struggle between an infant's emerging independence and parent's control of the feeding situation. Use of the 2-spoon method of feeding (1 for the child and 1 for the parent), finger foods, and a high chair with a tray table can avert potential problems. Tantrums make their first appearance as the drives for autonomy and mastery come in conflict with parental controls and the infants' still-limited abilities.

Communication

Infants at 7 mo of age are adept at nonverbal communication, expressing a range of emotions and responding to vocal tone and facial expressions. Around 9 mo of age, infants become aware that emotions can be shared between people; they show parents toys as a way of sharing their happy feelings. Between 8 and 10 mo of age, babbling takes on a new complexity, with many syllables ("ba-da-ma") and inflections that mimic the native language. Infants now lose the ability to distinguish between vocal sounds that are undifferentiated in their native language. Social interaction (attentive adults taking turns vocalizing with the infant) profoundly influences the acquisition and production of new sounds. The first true word (i.e., a sound used consistently to refer to a specific object or person) appears in concert with an infant's discovery of object permanence. Picture books now provide an ideal context for verbal language acquisition. With a familiar book as a shared focus of attention, a parent and child engage in repeated cycles of pointing and labeling, with elaboration and feedback by the parent.

Implications for Parents and Pediatricians

With the developmental reorganization that occurs around 9 mo of age, previously resolved issues of feeding and sleeping re-emerge. Pediatricians can prepare parents at the 6 mo visit so that these problems can be understood as the result of developmental progress and not regression. Parents should be encouraged to plan ahead for necessary, and inevitable, separations (e.g., baby sitter, daycare). Routine preparations may make these separations easier. Introduction of a **transitional object** may allow the infant to self-comfort in the parents' absence. The object cannot have any potential for asphyxiation or strangulation.

Infants' wariness of strangers often makes the 9 mo examination difficult, particularly if the infant is temperamentally prone to react negatively to unfamiliar situations. Initially, the pediatrician should avoid direct eye contact with the child. Time spent talking with the parent and introducing the child to a small, washable toy will be rewarded with more cooperation. The examination can be continued on the parent's lap when feasible.

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Chapter 9
The Second Year

Susan Feigelman

The child's sense of self and others are shaped by the skills emerging in the 2nd yr of life. Although the ability to walk allows separation and newly found independence; the child continues to need secure attachment to the parents. At approximately 18 mo of age, the emergence of symbolic thought and language causes a reorganization of behavior, with implications across many developmental domains.

AGE 12-18 MONTHS

Physical Development

Toddlers have relatively short legs and long torsos, with exaggerated lumbar lordosis and protruding abdomens. Although slower than in the 1st yr, considerable brain growth occurs in the 2nd yr; this growth and continuing myelinization, results in an increase in head circumference of 2 cm over the year.

Most children begin to walk independently near their 1st birthday; some do not walk until 15 mo of age. Early walking is not associated with advanced development in other domains. Infants initially toddle with a wide-based gait, with the knees bent and the arms flexed at the elbow; the entire torso rotates with each stride; the toes may point in or out, and the feet strike the floor flat. The appearance is that of genu varus (bowleg). Subsequent refinement leads to greater steadiness and energy efficiency. After several months of practice, the center of gravity shifts back and the torso stays more stable, while the knees extend and the arms swing at the sides for balance. The feet are held in better alignment, and the child is able to stop, pivot, and stoop without toppling over (see Chapters 664 and 665).

Cognitive Development

Exploration of the environment increases in parallel with improved dexterity (reaching, grasping, releasing) and mobility. Learning follows the precepts of Piaget's sensory-motor stage. Toddlers manipulate objects in novel ways to create interesting effects, such as stacking blocks or putting things into a computer disk drive. Playthings are also more likely to be used for their

intended purposes (combs for hair, cups for drinking). Imitation of parents and older children is an important mode of learning. Make-believe (symbolic) play centers on the child's own body (pretending to drink from an empty cup) (Table 9-1; also see Table 8-1).

Emotional Development

Infants who are approaching the developmental milestone of taking their first steps may be irritable. Once they start walking, their predominant mood changes markedly. Toddlers are described as "intoxicated" or "giddy" with their new ability and with the power to control the distance between themselves and their parents. Exploring toddlers orbit around their parents, moving away and then returning for a reassuring touch before moving away again. A securely attached child will use the parent as a secure base from which to explore independently. Proud of her or his accomplishments, the child illustrates Erikson's stage of autonomy and separation. The toddler who is overly controlled and discouraged from active exploration will feel doubt, shame, anger, and insecurity. All children will experience tantrums, reflecting their inability to delay gratification, suppress or displace anger, or verbally communicate their emotional states. The quality of the maternal-child relationship may moderate negative effects of child care arrangements when parents work.

Linguistic Development

Receptive language precedes expressive language. By the time infants speak their first words around 12 mo of age, they already respond appropriately to several simple statements, such as "no," "bye-bye," and "give me." By 15 mo, the average child points to major body parts and uses 4-6 words spontaneously and correctly. Toddlers also enjoy **polysyllabic** jargoning (see Tables 8-1 and 9-1), but do not seem upset that no one understands. Most communication of wants and ideas continues to be nonverbal.

Implications for Parents and Pediatricians

Parents may express concern about poor intake as growth slows. The growth chart should provide reassurance. Parents who cannot recall any other milestone tend to remember when their child began to walk, perhaps because of the symbolic significance of walking as an act of independence. All toddlers should be encouraged to explore their environments; a child's ability to wander out of sight also increases the risks of injury and the need for supervision.

In the office setting, many toddlers are comfortable exploring the examination room, but cling to the parents under the stress of the examination. Performing most of the physical examination in the parent's lap may help allay fears of separation. Infants who become more, not less, distressed in their parents' arms or who avoid their parents at times of stress may be insecurely attached. Young children who, when distressed, turn to strangers rather than parents for comfort are particularly worrisome. The conflicts between independence and security manifest in issues of discipline, temper tantrums, toilet training, and changing feeding behaviors. Parents should be counseled on these matters within the framework of normal development.

AGE 18-24 MONTHS

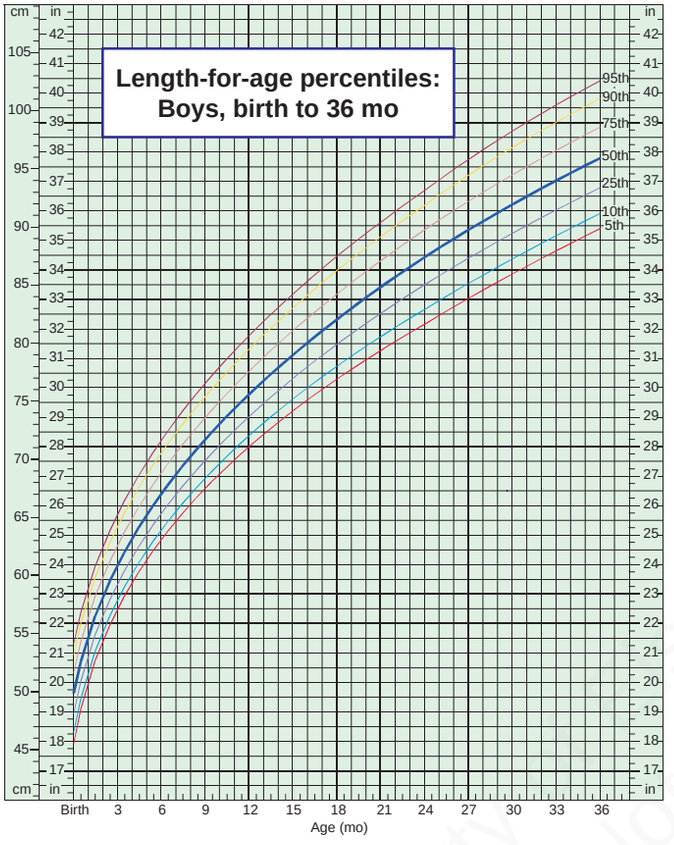
Physical Development

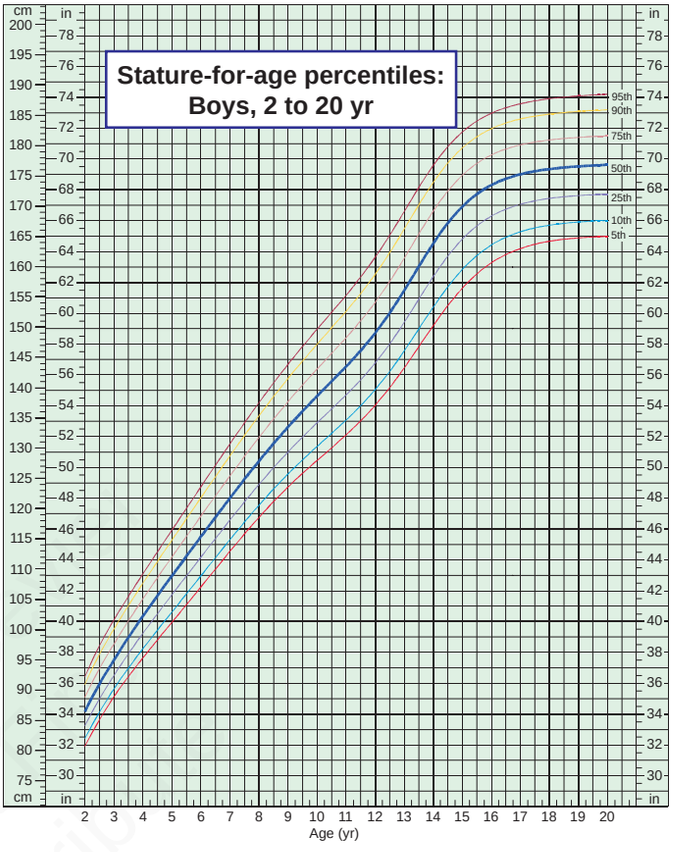
Motor development is incremental at this age, with improvements in balance and agility and the emergence of running and stair climbing. Height and weight increase at a steady rate during this year, with a gain of 5 in and 5 lb. By 24 mo, children are about ½ of their ultimate adult height. Head growth slows slightly (Figs. 9-1 and 9-2; see also Table 13-1). Ninety percent of adult head circumference is achieved by age 2 yr, with just an additional 5 cm gain over the next few years.

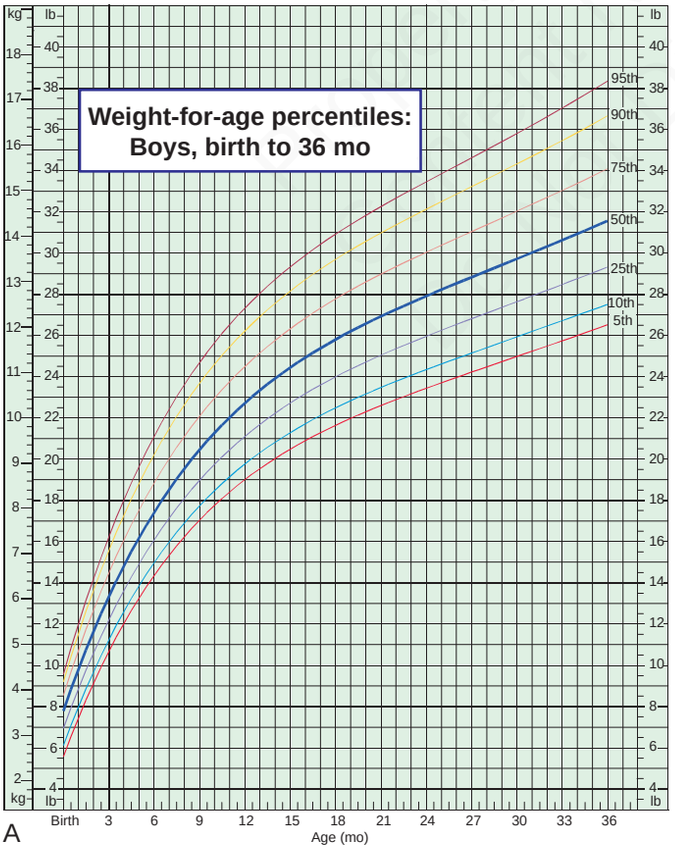
Table 9-1 EMERGING PATTERNS OF BEHAVIOR FROM 1 TO 5 YR OF AGE*

15 MO	
Motor:	Walks alone; crawls up stairs
Adaptive:	Makes tower of 3 cubes; makes a line with crayon; inserts raisin in bottle
Language:	Jargon; follows simple commands; may name a familiar object (e.g., ball); responds to his/her name
Social:	Indicates some desires or needs by pointing; hugs parents
18 MO	
Motor:	Runs stiffly; sits on small chair; walks up stairs with one hand held; explores drawers and wastebaskets
Adaptive:	Makes tower of 4 cubes; imitates scribbling; imitates vertical stroke; dumps raisin from bottle
Language:	10 words (average); names pictures; identifies one or more parts of body
Social:	Feeds self; seeks help when in trouble; may complain when wet or soiled; kisses parent with pucker
24 MO	
Motor:	Runs well, walks up and down stairs, one step at a time; opens doors; climbs on furniture; jumps
Adaptive:	Makes tower of 7 cubes (6 at 21 mo); scribbles in circular pattern; imitates horizontal stroke; folds paper once imitatively
Language:	Puts 3 words together (subject, verb, object)
Social:	Handles spoon well; often tells about immediate experiences; helps to undress; listens to stories when shown pictures
30 MO	
Motor:	Goes up stairs alternating feet
Adaptive:	Makes tower of 9 cubes; makes vertical and horizontal strokes, but generally will not join them to make cross; imitates circular stroke, forming closed figure
Language:	Refers to self by pronoun "I"; knows full name
Social:	Helps put things away; pretends in play
36 MO	
Motor:	Rides tricycle; stands momentarily on one foot
Adaptive:	Makes tower of 10 cubes; imitates construction of "bridge" of 3 cubes; copies circle; imitates cross
Language:	Knows age and sex; counts 3 objects correctly; repeats 3 numbers or a sentence of 6 syllables; most of speech intelligible to strangers
Social:	Plays simple games (in "parallel" with other children); helps in dressing (unbuttons clothing and puts on shoes); washes hands
48 MO	
Motor:	Hops on one foot; throws ball overhand; uses scissors to cut out pictures; climbs well
Adaptive:	Copies bridge from model; imitates construction of "gate" of 5 cubes; copies cross and square; draws man with 2 to 4 parts besides head; identifies longer of 2 lines
Language:	Counts 4 pennies accurately; tells story
Social:	Plays with several children, with beginning of social interaction and role-playing; goes to toilet alone
60 MO	
Motor:	Skips
Adaptive:	Draws triangle from copy; names heavier of 2 weights
Language:	Names 4 colors; repeats sentence of 10 syllables; counts 10 pennies correctly
Social:	Dresses and undresses; asks questions about meaning of words; engages in domestic role-playing

*Data derived from those of Gesell (as revised by Knobloch), Shirley, Provence, Wolf, Bailey, and others. After 5 yr, the Stanford-Binet, Wechsler-Bellevue, and other scales offer the most precise estimates of developmental level. To have their greatest value, they should be administered only by an experienced and qualified person.







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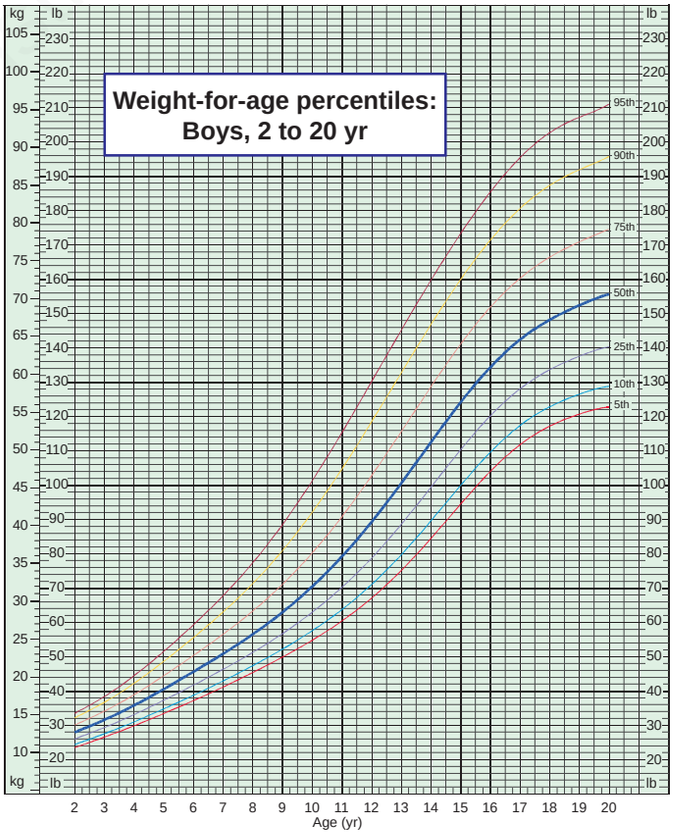

6 **Figure 9-1** Percentile curves for weight and length/stature by age for boys *(A)* and girls *(B)* birth to 20 yr of age. (Official 2000 Centers for Disease Control and Prevention [CDC] growth charts, created by the National Center for Health Statistics [NCHS; see Chapter 14]. Infant length was measured lying; older children's stature was measured standing. Additional information and technical reports available at *www.cdc.gov/nchs*.)

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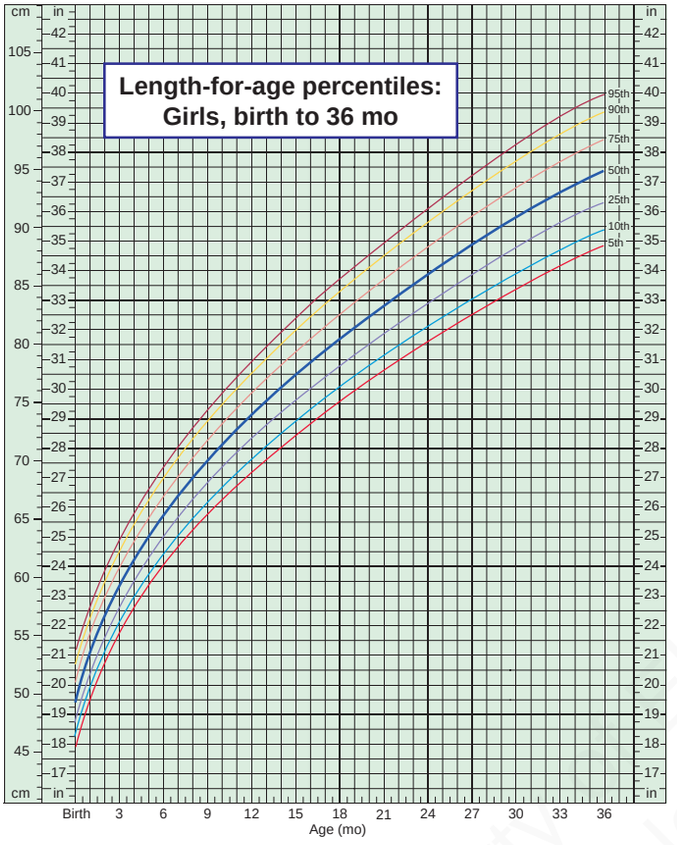

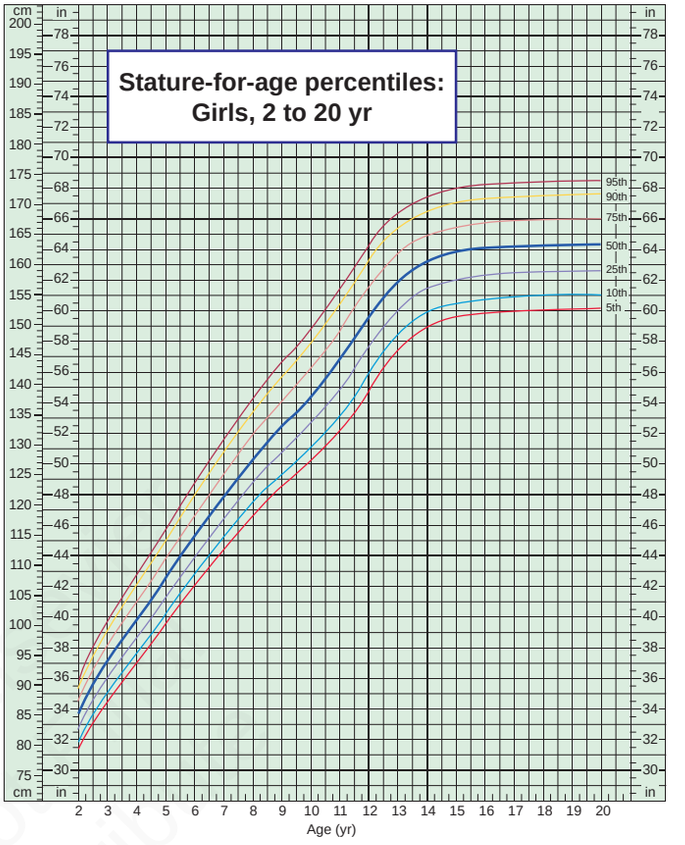

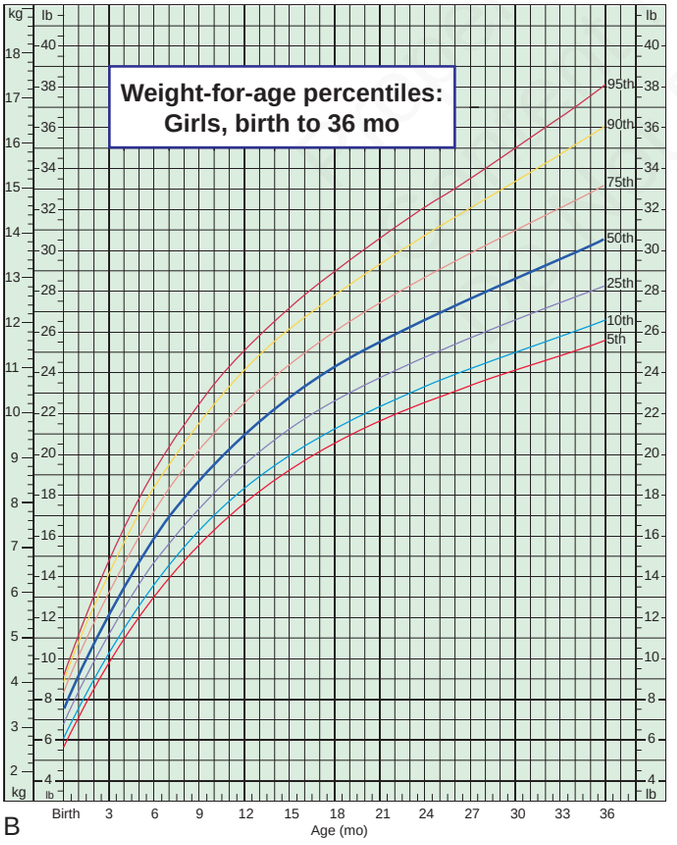

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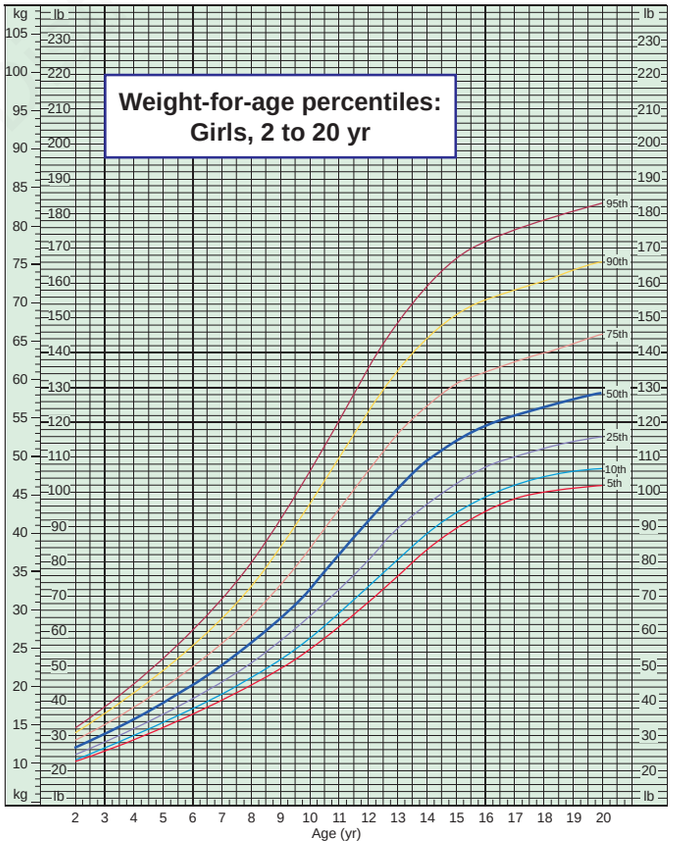

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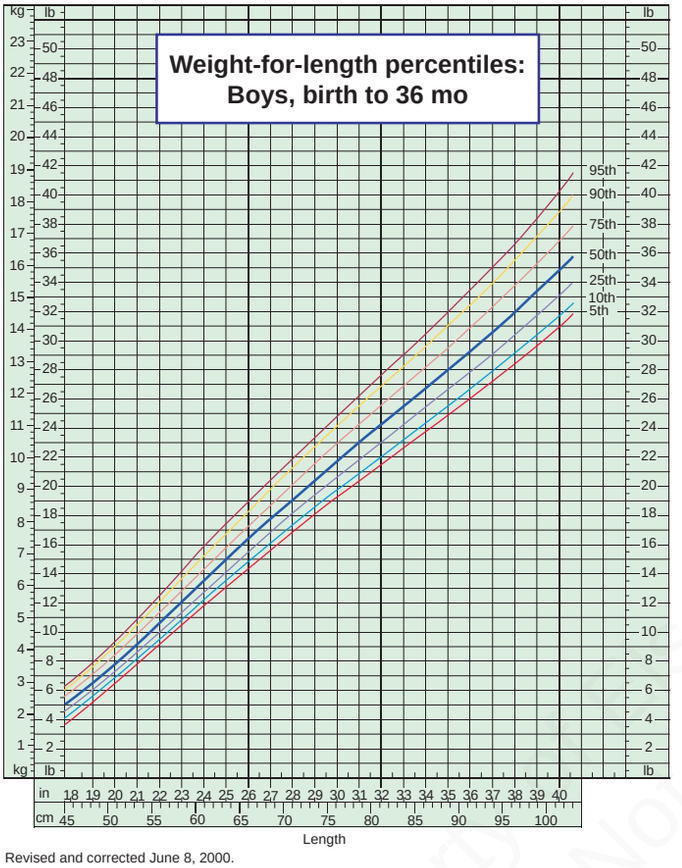

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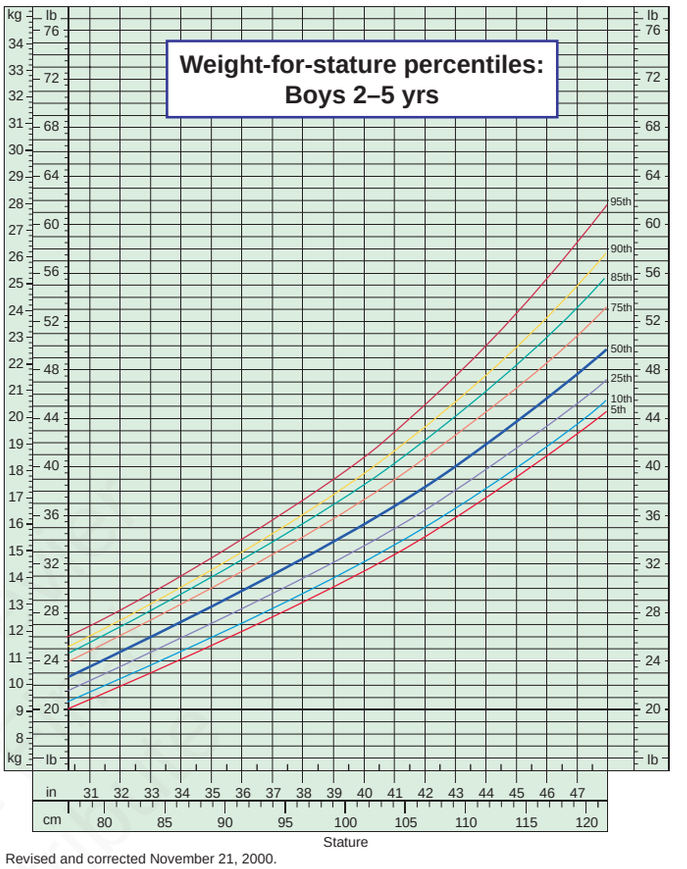

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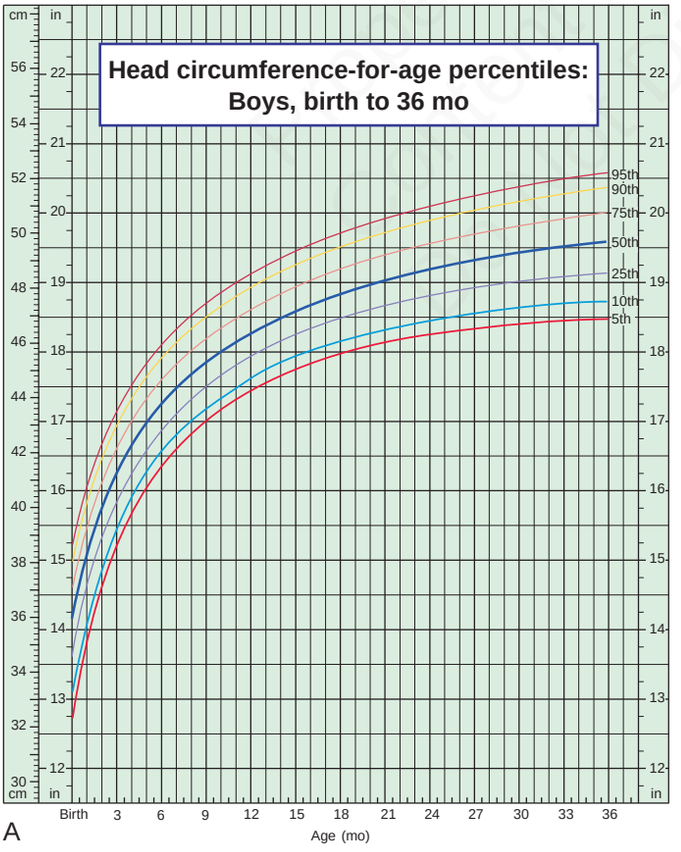

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Figure 9-2 Head circumference and length/stature by weight for boys *(A)* and girls *(B)*. (Official 2000 Centers for Disease Control and Prevention [CDC] growth charts, created by the National Center for Health Statistics [NCHS; see Chapter 14]. Additional information and technical reports are available at *www.cdc.gov/nchs*.)

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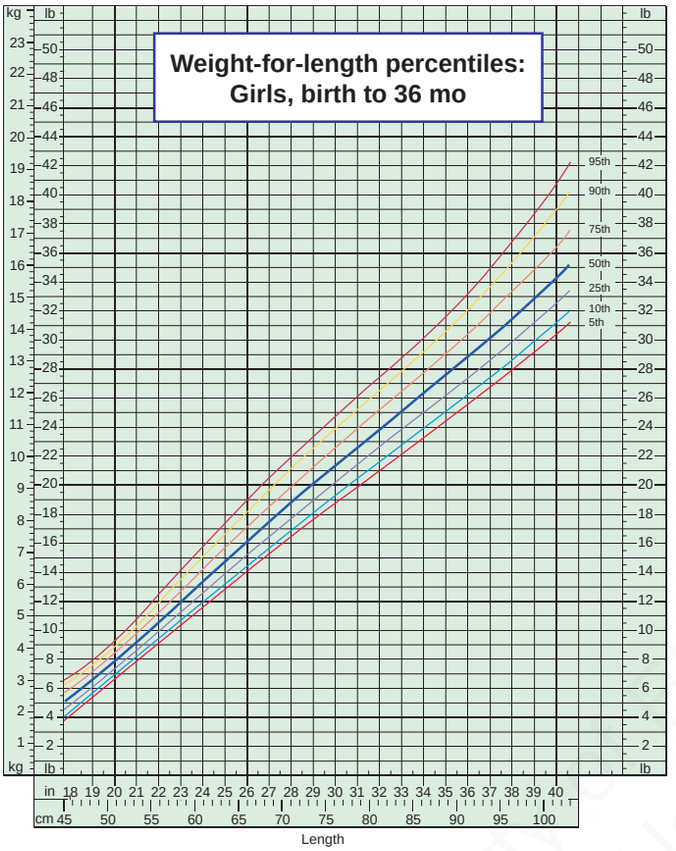

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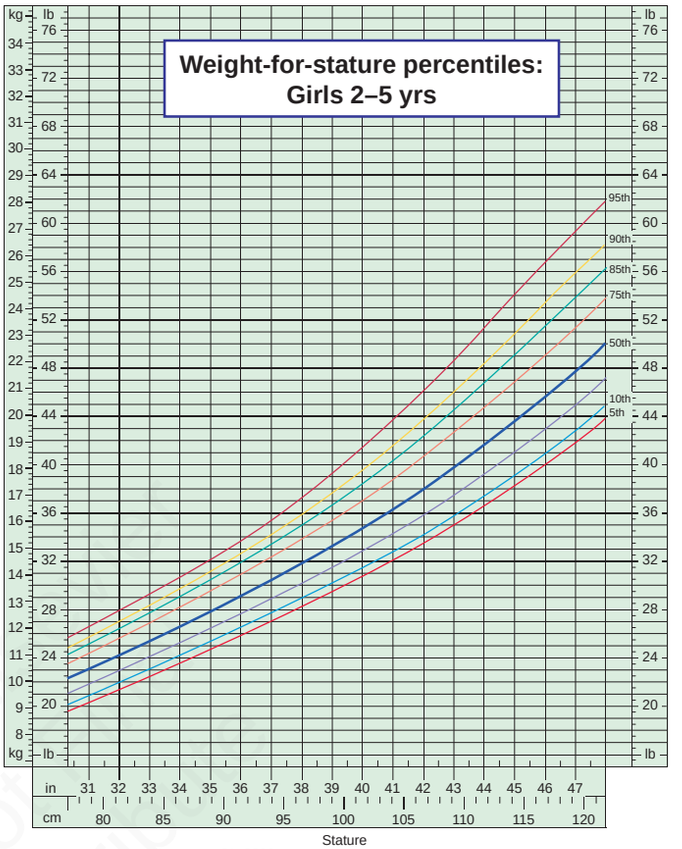

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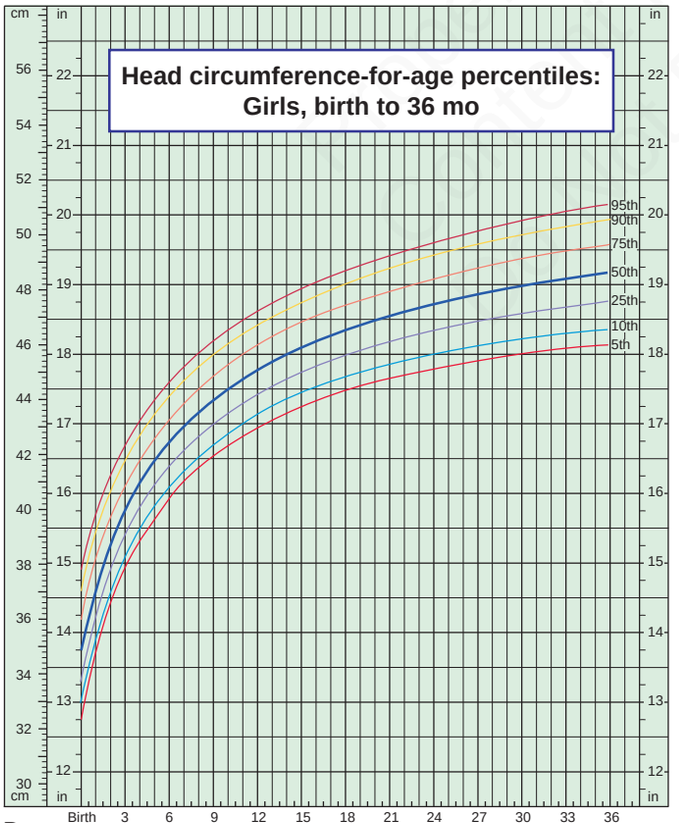

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Figure 9-2, cont'd.

Cognitive Development

At approximately 18 mo of age, several cognitive changes come together to mark the conclusion of the sensory-motor period. These can be observed during self-initiated play. Object permanence is firmly established; toddlers anticipate where an object will end up, even though the object was not visible while it was being moved. Cause and effect are better understood, and toddlers demonstrate flexibility in problem solving (e.g., using a stick to obtain a toy that is out of reach, figuring out how to wind a mechanical toy). Symbolic transformations in play are no longer tied to the toddler's own body, so that a doll can be "fed" from an empty plate. Like the reorganization that occurs at 9 mo, the cognitive changes at 18 mo correlate with important changes in the emotional and linguistic domains (see Table 9-1).

Emotional Development

In many children, the relative independence of the preceding period gives way to increased clinginess around 18 mo. This stage, described as "rapprochement," may be a reaction to growing awareness of the possibility of separation. Many parents report that they cannot go anywhere without having a small child attached to them. **Separation anxiety** will be manifest at bedtime. Many children use a special blanket or stuffed toy as a **transitional object,** which functions as a symbol of the absent parent. The transitional object remains important until the transition to symbolic thought has been completed and the symbolic presence of the parent has been fully internalized. Despite the attachment to the parent, the child's use of "no" is a way of declaring independence. Individual differences in temperament, in both the child and the parents play a critical role in determining the balance of conflict vs cooperation in the parent-child relationship. As effective language emerges, conflicts become less frequent.

Self-conscious awareness and internalized standards of behavior first appear at this age. Toddlers looking in a mirror will, for the first time, reach for their own face rather than the mirror image if they notice something unusual on their nose. They begin to recognize when toys are broken and may hand them to their parents to fix. When tempted to touch a forbidden object, they may tell themselves "no, no." Language becomes a means of impulse control, early reasoning, and connection between ideas. This is the very beginning of the formation of a conscience. The fact that they often go on to touch the object anyway demonstrates the relative weakness of internalized inhibitions at this stage.

Linguistic Development

Perhaps the most dramatic developments in this period are linguistic. Labeling of objects coincides with the advent of symbolic thought. After the realization that words can stand for things occurs, a child's vocabulary balloons from 10-15 words at 18 mo to between 50 and 100 at 2 yr. After acquiring a vocabulary of about 50 words, toddlers begin to combine them to make simple sentences, the beginning of grammar. At this stage, toddlers understand **2-step commands,** such as "Give me the ball and then get your shoes." Language also gives the toddler a sense of control over the surroundings, as in "night-night" or "bye-bye." The emergence of verbal language marks the end of the sensory-motor period. As toddlers learn to use symbols to express ideas and solve problems, the need for cognition based on direct sensation and motor manipulation wanes.

Implications for Parents and Pediatricians

With children's increasing mobility, physical limits on their explorations become less effective; words become increasingly important for behavior control as well as cognition. Children with delayed language acquisition often have greater behavior problems and frustrations due to problems with communication. Language development is facilitated when parents and caregivers use clear, simple sentences; ask questions; and respond to children's incomplete sentences and gestural communication with the appropriate words. Television viewing decreases parent-child verbal interactions, whereas looking at picture books together provides an ideal context for language development.

In the office setting, certain procedures may lessen the child's **stranger anxiety.** Avoid direct eye contact initially. Perform as much of the examination as feasible with the child on the parent's lap. Pediatricians can help parents understand the resurgence of problems with separation and the appearance of a treasured blanket or teddy bear as a developmental phenomenon. Parents must understand the importance of exploration. Rather than limiting movement, parents should place toddlers in safe environments or substitute 1 activity for another. Methods of discipline, including corporal punishment, should be discussed; effective alternatives will usually be appreciated. Helping parents to understand and adapt to their children's different temperamental styles can constitute an important intervention (see Table 6-1). 5
Developing daily routines is helpful to all children at this age. Rigidity in those routines reflects a need for mastery over a changing environment.

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Chapter 10
The Preschool Years

Susan Feigelman

The critical milestones for children ages 2 to 5 yr are the emergence of language and exposure of children to an expanding social sphere. As toddlers, children learn to walk away and come back to the secure adult or parent. As preschoolers, they explore emotional separation, alternating between stubborn opposition and cheerful compliance, between bold exploration and clinging dependence. Increasing time spent in classrooms and playgrounds challenges a child's ability to adapt to new rules and relationships. Preschool children know that they can do more than ever before, but they also are increasingly cognizant of the constraints imposed on them by the adult world and their own limited abilities.

PHYSICAL DEVELOPMENT

Somatic and brain growth slows by the end of the 2nd yr of life, with corresponding decreases in nutritional requirements and appetite, and the emergence of "picky" eating habits (see Table 15-1). Increases of ~2 kg (4-5 lb) in weight and 7-8 cm (2-3 in) 1
in height per yr are expected. Birthweight quadruples by 2½ yr of age. An average 4 yr old weighs 40 lb and is 40 in tall. The

head will grow only an additional 5 cm between ages 3 and 18 yr. Current growth charts, with growth parameters, can be found on the Centers for Disease Control and Prevention website (*www.cdc.gov/nchs*) and in Chapter 15. Children with early adiposity rebound (increase in body mass index) are at increased risk for adult obesity.

Growth of sexual organs is commensurate with somatic growth. The preschooler has genu valgum (knock-knees) and mild pes planus (flatfoot). The torso slims as the legs lengthen. Physical energy peaks, and the need for sleep declines to 11-13 hr/24 hr, with the child eventually dropping the nap (see Fig. 8-1). Visual acuity reaches 20/30 by age 3 yr and 20/20 by age 4 yr. All 20 primary teeth have erupted by 3 yr of age (see Table 8-3).

Most children walk with a mature gait and run steadily before the end of their 3rd yr (see Table 9-1). Beyond this basic level, there is wide variation in ability as the range of motor activities expands to include throwing, catching, and kicking balls; riding on bicycles; climbing on playground structures; dancing; and other complex pattern behaviors. Stylistic features of gross motor activity, such as tempo, intensity, and cautiousness, also vary significantly. Although toddlers may walk with different styles, toe walking should not persist.

The effects of such individual differences on cognitive and emotional development depend in part on the demands of the social environment. Energetic, coordinated children may thrive emotionally with parents or teachers who encourage physical activity; lower-energy, more cerebral children may thrive with adults who value quiet play.

Handedness is usually established by the 3rd yr. Frustration may result from attempts to change children's hand preference. Variations in fine motor development reflect both individual proclivities and different opportunities for learning. Children who are seldom allowed to use crayons, for example, develop a mature pencil grasp later.

Bowel and bladder control emerge during this period, with "readiness" for toileting having large individual and cultural variation. Girls tend to train faster and earlier than boys. Bedwetting is normal up to age 4 yr in girls and age 5 yr in boys (see Chapter 21.3). Many children master toileting with ease, particularly once they are able to verbalize their bodily needs. For others, toilet training can involve a protracted power struggle. Refusal to defecate in the toilet or potty is relatively common and can lead to constipation and parental frustration. Defusing the issue with a temporary cessation of training (and a return to diapers) often allows toilet mastery to proceed.

Implications for Parents and Pediatricians

The normal decrease in appetite at this age may cause parental concern about nutrition; growth charts should reassure parents that the child's intake is adequate. Children normally modulate their food intake to match their somatic needs according to feelings of hunger and satiety. Daily intake fluctuates, at times widely, but intake during the period of a week is relatively stable. Parents should provide a predictable eating schedule, with 3 meals and 2 snacks per day, allowing the child to choose how much to eat.

Highly active children face increased risks of injury, and parents should be counseled about safety precautions. Parental concerns about possible hyperactivity may reflect inappropriate expectations, heightened fears, or true overactivity. Children who engage in impulsive activity with no apparent regard for personal safety should be evaluated further.

LANGUAGE, COGNITION, AND PLAY

These three domains all involve symbolic function, a mode of dealing with the world that emerges during the preschool period.

Language

Language development occurs most rapidly between 2 and 5 yr of age. Vocabulary increases from 50-100 words to more than 2,000. Sentence structure advances from telegraphic phrases ("Baby cry") to sentences incorporating all of the major grammatical components. As a rule of thumb, between the ages of 2 and 5 yr, the number of words in a typical sentence equals the child's age (2 by age 2 yr, 3 by age 3 yr, and so on). By 21 mo to 2 yr, most children are using possessives ("My ball"), progressives (the "-ing" construction, as in "I playing"), questions, and negatives. By age 4 yr, most children can count to 4 and use the past tense; by age 5 yr, they can use the future tense. Children do not use figurative speech; they will only comprehend the literal meaning of words. Referring to an object as "light as a feather" may produce a quizzical look on a child.

It is important to distinguish between *speech* (the production of intelligible sounds) and *language,* which refers to the underlying mental act. Language includes both expressive and receptive functions. Receptive language (understanding) varies less in its rate of acquisition than does expressive language; therefore, it has greater prognostic importance (see Chapters 14 and 32). 2

Language acquisition depends critically on environmental input. Key determinants include the amount and variety of speech directed toward children and the frequency with which adults ask questions and encourage verbalization. Children raised in poverty typically perform lower on measures of language development compared to children from economically advantaged families.

Although experience influences the rate of language development, many linguists believe that the basic mechanism for language learning is "hard-wired" in the brain. Children do not simply imitate adult speech; they abstract the complex rules of grammar from the ambient language, generating implicit hypotheses. Evidence for the existence of such implicit rules comes from analysis of grammatical errors, such as the overgeneralized use of "-s" to signify the plural and "-ed" to signify the past ("We seed lots of mouses.").

Language is linked to both cognitive and emotional development. Language delays may be the first indication that a child has mental retardation, has an autism spectrum disorder, or has been maltreated. Language plays a critical part in the regulation of behavior through internalized "private speech" in which a child repeats adult prohibitions, first audibly and then mentally. Language also allows children to express feelings, such as anger or frustration, without acting them out; consequently, language-delayed children show higher rates of tantrums and other externalizing behaviors.

Preschool language development lays the foundation for later success in school. Approximately 35% of children in the USA may enter school lacking the language skills that are the prerequisites for acquiring literacy. Children from socially and economically disadvantaged backgrounds have an increased risk of school problems, making early detection, along with referral and enrichment, important. Although children typically learn to read and write in elementary school, critical foundations for literacy are established during the preschool years. Through repeated early exposure to written words, children learn about the uses of writing (telling stories or sending messages) and about its form (left to right, top to bottom). Early errors in writing, like errors in speaking, reveal that literacy acquisition is an active process involving the generation and revision of hypotheses. Programs such as Head Start are especially important for improving language skills for children from bilingual homes. (Such parents should be reassured that although bilingual children do initially lag behind their monolingual peers in acquiring language over time, they learn the differing rules governing both languages. Bilingual children do not follow the same course of language development as monolingual children, but create a different system of language cues. Several cognitive advantages have been

repeatedly demonstrated among bilingual compared to monolingual children.)

Picture books have a special role not only in familiarizing young children with the printed word but also in the development of verbal language. Children's vocabulary and receptive language improve when their parents consistently read to them. Reading aloud with a young child is an interactive process in which a parent repeatedly focuses the child's attention on a particular picture, asks questions, and then gives the child feedback. The elements of shared attention, active participation, immediate feedback, repetition, and graduated difficulty make such routines ideal for language learning. Programs in which physicians provide books to preschool children have shown improvement in language skills among the children.

The period of rapid language acquisition is also when **developmental dysfluency** and **stuttering** are most likely to emerge; these can be traced to activation of the cortical motor, sensory, and cerebellar areas. Common difficulties include pauses and repetitions of initial sounds. Stress or excitement exacerbates these difficulties, which generally resolve on their own. Although 5% of preschool children will stutter, it will resolve in 80% by age 8 yr. Children with stuttering should be referred for evaluation if it is severe, persistent, or associated with anxiety, or if parental concern is elicited. **Treatment** includes guidance to parents to reduce pressures associated with speaking.

Cognition

The preschool period corresponds to Piaget's preoperational (prelogical) stage, characterized by **magical thinking**, **egocentrism**, and **thinking that is dominated by perception**, not abstraction (see Table 6-2). Magical thinking includes confusing coincidence with causality, animism (attributing motivations to inanimate objects and events), and unrealistic beliefs about the power of wishes. A child might believe that people cause it to rain by carrying umbrellas, that the sun goes down because it is tired, or that feeling resentment toward a sibling can actually make that sibling sick. Egocentrism refers to a child's inability to take another's point of view and does not connote selfishness. A child might try to comfort an adult who is upset by bringing him or her a favorite stuffed animal. After 2 yr of age, the child develops a concept of herself or himself as an individual and senses the need to feel "whole."

Piaget demonstrated the dominance of perception over logic. In one experiment, water is poured back and forth between a tall, thin vase and a low, wide dish, and children are asked which container has more water. Invariably, they choose the one that looks larger (usually the tall vase), even when the examiner points out that no water has been added or taken away. Such misunderstandings reflect young children's developing hypotheses about the nature of the world as well as their difficulty in attending simultaneously to multiple aspects of a situation.

Recent work indicating that preschool children do have the ability to understand some causal relationships has modified our understanding of the ability of preschool children to engage in some abstract thinking.

Play

Maria Montessori considered play to be the work of childhood; she did not lend credence to the importance of fantasy and imagination (symbolic play). Play involves learning, physical activity, socialization with peers, and practicing adult roles. Play increases in complexity and imagination, from simple imitation of common experiences, such as shopping and putting baby to bed (2 or 3 yr of age), to more extended scenarios involving singular events, such as going to the zoo or going on a trip (3 or 4 yr of age), to the creation of scenarios that have only been imagined, such as flying to the moon (4 or 5 yr of age). By age 3 yr, cooperative play is seen in activities such as building a tower of blocks together; later, more structured role-play activity, as in playing house, is seen. Play also becomes increasingly governed by rules, from early rules about asking (rather than taking) and sharing (2 or 3 yr of age), to rules that change from moment to moment, according to the desires of the players (4 and 5 yr of age), to the beginning of the recognition of rules as relatively immutable (5 yr of age and beyond).

Play also allows for resolution of conflicts and anxiety and for creative outlets. Children can vent anger safely (spanking a doll), take on superpowers (dinosaur and superhero play), and obtain things that are denied in real life (a make-believe friend or stuffed animal). Creativity is particularly apparent in drawing, painting, and other artistic activities. Themes and emotions that emerge in a child's drawings often reflect the emotional issues of greatest importance for the child.

Difficulty distinguishing fantasy from reality colors a child's perception of what he or she views in the media, through programming and advertising. One fourth of young children have a television set in their bedroom and watch many hours of television per week, and much of what they view is violent. Attitudes about violence are formed early, and early exposure has been associated with later behavior problems.

Implications for Parents and Pediatricians

The significance of language as a target for assessment and intervention cannot be overestimated because of its central role as an indicator of cognitive and emotional development and a key factor in behavioral regulation and later school success. As language emerges, parents can support emotional development by using words that describe the child's feeling states ("You sound angry right now.") and urging the child to use words to express, rather than act out, feelings. Active imaginations will come into play when children offer explanations for misbehavior. A parent's best way of dealing with untruths is to address the event, not the child, and have the child participate in making things right.

Parents should have a regular time each day for reading or looking at books with their children. Programs such as Reach Out and Read, in which pediatricians give out picture books along with appropriate guidance during primary care visits, have been effective in increasing reading aloud and thereby promoting language development, particularly in lower-income families. Television and similar media should be limited to 2 hr/day of quality programming, and parents should be watching the programs with their children and debriefing their young children afterward. At-risk children, particularly those living in poverty, can better meet future school challenges if they have early high-quality experiences, such as Head Start.

Preoperational thinking constrains how children understand experiences of illness and treatment. Children begin to understand that bodies have "insides" and "outsides." Children should be given simple, concrete explanations for medical procedures and given some control over procedures if possible. Children should be reassured that they are not to blame when receiving a vaccine or venipuncture. An adhesive bandage will help to make the body whole again in a child's mind.

The active imagination that fuels play and the magical, animist thinking characteristic of preoperational cognition can also generate intense fears. More than 80% of parents report at least 1 fear in their preschool children. Refusal to take baths or to sit on the toilet may arise from the fear of being washed or flushed away, reflecting a child's immature appreciation of relative size. Attempts to demonstrate rationally that there are no monsters in the closet often fail, inasmuch as the fear arises from prerational thinking. However, this same thinking allows parents to be endowed with magical powers that can banish the monsters with "monster spray" or a night light. Parents should acknowledge the fears, offer reassurance and a sense of security, and give the child some sense of control over the situation. Use of the Draw-a-Person, in which a child is asked to draw the best person he or she can, may help elucidate a child's viewpoint.

EMOTIONAL AND MORAL DEVELOPMENT

Emotional challenges facing preschool children include accepting limits while maintaining a sense of self-direction, reining in aggressive and sexual impulses, and interacting with a widening circle of adults and peers. At 2 yr of age, behavioral limits are predominantly external; by 5 yr of age, these controls need to be internalized if a child is to function in a typical classroom. Success in achieving this goal relies on prior emotional development, particularly the ability to use internalized images of trusted adults to provide a secure environment in times of stress. The love a child feels for important adults is the main incentive for the development of self-control.

Children learn what behaviors are acceptable and how much power they wield vis-à-vis important adults by testing limits. Testing increases when it elicits attention, even though that attention is often negative, and when limits are inconsistent. Testing often arouses parental anger or inappropriate solicitude as a child struggles to separate, and it gives rise to a corresponding parental challenge: letting go. Excessively tight limits can undermine a child's sense of initiative, whereas overly loose limits can provoke anxiety in a child who feels that no one is in control.

Control is a central issue. Young children cannot control many aspects of their lives, including where they go, how long they stay, and what they take home from the store. They are also prone to lose internal control, that is, to have temper tantrums. Fear, overtiredness, inconsistent expectations, or physical discomfort can also evoke tantrums. Tantrums normally appear toward the end of the 1st yr of life and peak in prevalence between 2 and 4 yr of age. Tantrums lasting more than 15 min or regularly occurring more than 3 times/day may reflect underlying medical, emotional, or social problems.

Preschool children normally experience complicated feelings toward their parents that can include strong attachment and possessiveness toward the parent of the opposite sex, jealousy and resentment of the other parent, and fear that these negative feelings might lead to abandonment. These emotions, most of which are beyond a child's ability to comprehend or verbalize, often find expression in highly labile moods. The resolution of this crisis (a process extending over years) involves a child's unspoken decision to identify with the parents rather than compete with them. Play and language foster the development of emotional controls by allowing children to express emotions and role-play.

Curiosity about genitals and adult sexual organs is normal, as is masturbation. Excessive masturbation interfering with normal activity, acting out sexual intercourse, extreme modesty, or mimicry of adult seductive behavior all suggests the possibility of sexual abuse or inappropriate exposure. Modesty appears gradually between 4 and 6 yr of age, with wide variations among cultures and families. Parents should begin to teach children about "private" areas before school entry.

Moral thinking is constrained by a child's cognitive level and language abilities, but develops as the child continues her or his identity with the parents. Beginning before the 2nd birthday, the child's sense of right and wrong stems from the desire to earn approval from the parents and avoid negative consequences. The child's impulses are tempered by external forces; she or he has not yet internalized societal rules or a sense of justice and fairness. Over time, as the child internalizes parental admonitions, words are substituted for aggressive behaviors. Finally, the child accepts personal responsibility. Actions will be viewed by damage caused, not by intent. Empathic responses to others' distress arise during the 2nd yr of life, but the ability to consider another child's point of view remains limited throughout this period. In keeping with a child's inability to focus on more than 1 aspect of a situation at a time, fairness is taken to mean equal treatment, regardless of circumstance. A 4 yr old will acknowledge the importance of taking turns, but will complain if he didn't get enough time. Rules tend to be absolute, with guilt assigned for bad outcomes, regardless of intentions.

Implications for Parents and Pediatricians

The importance of the preschooler's sense of control over his or her body and surroundings has implications for practice. Preparing the patient by letting the child know how the visit will proceed is reassuring. Tell the child what will happen, but don't ask permission unless you are willing to deal with a "no" answer. A brief introduction to "private parts" is warranted before the genital examination.

The visit of the 4 or 5 yr old should be entertaining, because of the child's ability to communicate, as well as his or her natural curiosity. Physicians should realize that all children are occasionally difficult. Guidance emphasizing appropriate expectations for behavioral and emotional development and acknowledging normal parental feelings of anger, guilt, and confusion should be part of all visits at this time. Parents should be queried about daily routines and their expectations of child behavior. Providing children with choices (all options being acceptable to the parent) and encouraging independence in self-care activities (feeding, dressing, and bathing) will reduce conflicts.

Although some cultures condone the use of corporal punishment for disciplining of young children, it is not an effective means of behavioral control. As children habituate to repeated spanking, parents have to spank ever harder to get the desired response, increasing the risk of serious injury. Sufficiently harsh punishment may inhibit undesired behaviors, but at great psychologic cost. Children mimic the corporal punishment that they receive, and it is common for preschool children to strike their parents or other children. Whereas spanking is the use of force, externally applied, to produce behavior change, **discipline** is the process that allows the child to internalize controls on behavior. Alternative discipline strategies should be offered, such as the "countdown," along with consistent limit setting, clear communication of rules, and frequent approval. Discipline should be immediate, specific to the behavior, and time-limited. Time-out for approximately 1 min/yr of age is very effective. A kitchen timer allows the parent to step back from the situation; the child is free when the timer rings.

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Chapter 11
Middle Childhood

Susan Feigelman

Middle childhood (6-11 yr of age), previously referred to as *latency*, is the period during which children increasingly separate from parents and seek acceptance from teachers, other adults, and peers. Self-esteem becomes a central issue, as children develop the cognitive ability to consider their own self-evaluations and their perception of how others see them. For the first time, they are judged according to their ability to produce socially valued outputs, such as getting good grades, playing a musical instrument, or hitting home runs. Children are under pressure to conform to the style and ideals of the peer group.

PHYSICAL DEVELOPMENT

Growth during the period averages 3-3.5 kg (7 lb) and 6-7 cm (2.5 in) per year (see Figs. 9-1 and 9-2). Growth occurs **discontinuously,** in 3-6 irregularly timed spurts each year, but varies both within and among individuals. The head grows only 2-3 cm in circumference throughout the entire period, reflecting a slowing of brain growth. Myelinization is complete by 7 yr of age. Body habitus is more erect than previously, with long legs compared with the torso.

Growth of the midface and lower face occurs gradually. Loss of deciduous (baby) teeth is a more dramatic sign of maturation, beginning around 6 yr of age. Replacement with adult teeth occurs at a rate of about 4 per year, so that by age 9 yr, children will have 8 permanent incisors and 4 permanent molars. Premolars erupt by 11-12 yr of age. Lymphoid tissues hypertrophy, often giving rise to impressive tonsils and adenoids.

Muscular strength, coordination, and stamina increase progressively, as does the ability to perform complex movements, such as dancing or shooting baskets. Such higher-order motor skills are the result of both maturation and training; the degree of accomplishment reflects wide variability in innate skill, interest, and opportunity.

There has been a general decline in physical fitness among school-aged children. Sedentary habits at this age are associated with increased lifetime risk of obesity and cardiovascular disease (see Chapter 44). The number of overweight children and the degree of overweight are both increasing; although the proportion of overweight children of all ages has increased over the last half century, this rate has increased over four-fold among children ages 6-11 yr (Table 11-1). Only 8% of middle and junior high schools require daily physical education class. One quarter of youth do not engage in any free-time physical activity, whereas the recommendation is for 1 hr of physical activity per day.

Perceptions of body image develop early during this period; children as young as 5 and 6 yr express dissatisfaction with their body image; by ages 8 and 9 yr many of these youth report trying to diet, often using ill-advised regimens. Loss of control (binge) eating occurs among approximately 6% of children of this age.

Prior to puberty, the sensitivity of the hypothalamus and the pituitary changes, leading to increased gonadotropin synthesis. For most children, the sexual organs remain physically immature, but interest in gender differences and sexual behavior remains active in many children and increases progressively until puberty. Although this is a period when sexual drives are limited, masturbation is common, and children may be interested in differences between genders. Though still somewhat controversial, there is growing consensus that breast development and menarche are occurring at an earlier age among girls in the USA. Rates of maturation differ by geography, ethnicity, and country. These differences in maturation have implications for differing expectations of others about them based on sexual maturation.

Implications for Parents and Pediatricians

Middle childhood is generally a time of excellent health. However, children have variable sizes, shapes, and abilities. Children of this age compare themselves with others, eliciting feelings about their physical attributes and abilities. Fears of being "defective" can lead to avoidance of situations in which physical differences might be revealed, such as gym class or medical examinations. Children with actual physical disabilities may face special stresses. Medical, social, and psychologic risks tend to occur together.

Children should be asked about regular physical activity. Participation in organized sports or other organized activities can foster skill, teamwork, and fitness, as well as a sense of accomplishment, but pressure to compete when the activity is no longer enjoyable has negative effects. Prepubertal children should not engage in high-stress, high-impact sports, such as power lifting or tackle football, because skeletal immaturity increases the risk of injury.

COGNITIVE DEVELOPMENT

The thinking of early elementary school-aged children differs qualitatively from that of preschool children. In place of magical, egocentric, and perception-bound cognition, school-aged children increasingly apply rules based on observable phenomena, factor in multiple dimensions and points of view, and interpret their perceptions using physical laws. Piaget documented this shift from *"preoperational"* to *"concrete logical operations."* When 5 yr olds watch a ball of clay being rolled into a snake, they might insist that the snake has "more" because it is longer. In contrast, 7 yr olds typically reply that the ball and the snake must weigh the same because nothing has been added or taken away or because the snake is both longer and thinner. This cognitive reorganization occurs at different rates in different contexts.

Table 11-1 PREVALENCE OF OVERWEIGHT AMONG CHILDREN AND ADOLESCENTS AGES 2-19 YEARS, FOR SELECTED YEARS 1963-1965 THROUGH 1999-2002

AGE (YEARS)[1]	NHANES 1963-1965 1966-1970[2]	NHANES 1971-1974	NHANES 1976-1980	NHANES 1988-1994	NHANES 1999-2000	NHANES 2001-2002	NHANES 2003-2004
2-5	—	5	5	7.2	10.3	10.6	13.9
6-11	4.2	4	6.5	11.3	15.1	16.3	18.8
12-19	4.6	6.1	5	10.5	14.8	16.7	17.4

From National Center for Health Statistic and Monitoring the Nation's Health: *Fact sheet, Table 1* (website). http://www.cdc.gov/nchs/products/pubs/pubd/hestats/overweight/overwght_child_03.htm#Table%201.

Table 11-2 SELECTED PERCEPTUAL, COGNITIVE, AND LANGUAGE PROCESSES REQUIRED FOR ELEMENTARY SCHOOL SUCCESS

PROCESS	DESCRIPTION	ASSOCIATED PROBLEMS
PERCEPTUAL		
Visual analysis	Ability to break a complex figure into components and understand their spatial relationships	Persistent letter confusion (e.g., between *b*, *d*, and *g*); difficulty with basic reading and writing and limited "sight" vocabulary
Proprioception and motor control	Ability to obtain information about body position by feel and unconsciously program complex movements	Poor handwriting, requiring inordinate effort, often with overly tight pencil grasp; special difficulty with timed tasks
Phonologic processing	Ability to perceive differences between similar sounding words and to break down words into constituent sounds	Delayed receptive language skill; attention and behavior problems secondary to not understanding directions; delayed acquisition of letter-sound correlations (phonetics)
COGNITIVE		
Long-term memory, both storage and recall	Ability to acquire skills that are "automatic" (i.e., accessible without conscious thought)	Delayed mastery of the alphabet (reading and writing letters); slow handwriting; inability to progress beyond basic mathematics
Selective attention	Ability to attend to important stimuli and ignore distractions	Difficulty following multistep instructions, completing assignments, and behaving well; problems with peer interaction
Sequencing	Ability to remember things in order; facility with time concepts	Difficulty organizing assignments, planning, spelling, and telling time
LANGUAGE		
Receptive language	Ability to comprehend complex constructions, function words (e.g., if, when, only, except), nuances of speech, and extended blocks of language (e.g., paragraphs)	Difficulty following directions; wandering attention during lessons and stories; problems with reading comprehension; problems with peer relationships
Expressive language	Ability to recall required words effortlessly (word finding), control meanings by varying position and word endings, and construct meaningful paragraphs and stories	Difficulty expressing feelings and using words for self-defense, with resulting frustration and physical acting out; struggling during "circle time" and in language-based subjects (e.g., English)

In the context of social interactions with siblings, young children often demonstrate an ability to understand alternate points of view long before they demonstrate that ability in their thinking about the physical world. Understanding time and space constructs occurs in the later part of this period.

The concept of **"school readiness"** is controversial. There is no consensus on whether there is a defined set of skills needed for success on school entry, and whether certain skills predict later achievement. By age 5 yr, most children have the ability to learn in a school setting, as long as the setting is sufficiently flexible to support children with a variety of developmental achievements. Rather than delaying school entry, high quality early education programs may be the key to ultimate school success. Separation anxiety, or school refusal, is common in the early school years.

School makes increasing cognitive demands on the child. Mastery of the elementary curriculum requires that a large number of perceptual, cognitive, and language processes work efficiently (Table 11-2), and children are expected to attend to many inputs at once. The first 2 to 3 yr of elementary school is devoted to acquiring the fundamentals: reading, writing, and basic mathematics skills. By 3rd grade, children need to be able to sustain attention through a 45 min period and the curriculum requires more complex tasks. The goal of reading a paragraph is no longer to decode the words, but to understand the content; the goal of writing is no longer spelling or penmanship, but composition. The volume of work increases along with the complexity.

Cognitive abilities interact with a wide array of attitudinal and emotional factors in determining classroom performance. These factors include external rewards (eagerness to please adults and approval from peers) and internal rewards (competitiveness, willingness to work for a delayed reward, belief in one's abilities, and ability to risk trying when success is not ensured). Success predisposes to success, whereas failure impacts self-esteem and reduces self-efficacy, diminishing a child's ability to take future risks.

Children's intellectual activity extends beyond the classroom. Beginning in the 3rd or 4th grade, children increasingly enjoy strategy games and wordplay (puns and insults) that exercise their growing cognitive and linguistic mastery. Many become experts on subjects of their own choosing, such as sports trivia, or develop hobbies, such as special card collections. Others become avid readers or take on artistic pursuits. Whereas board and card games were once the usual leisure time activity of youth, video and computer games currently fill this need.

Implications for Parents and Pediatricians

Concrete operations allow children to understand simple explanations for illnesses and necessary treatments, although they may revert to prelogical thinking when under stress. A child with pneumonia may be able to explain about white cells fighting the "germs" in the lungs, but still secretly harbors the belief that the sickness is a punishment for disobedience.

As children are faced with more abstract concepts, academic and classroom behavior problems emerge and come to the pediatrician's attention. Referrals may be made to the school for remediation or to community resources (medical or psychologic) when appropriate. The causes may be one or more of the following: deficits in perception (vision and hearing); specific learning disabilities; global cognitive delay (mental retardation); primary attention deficit; and attention deficits secondary to family dysfunction, depression, anxiety, or chronic illness (see Chapters 14 and 29). Children whose learning style does not fit the classroom culture may have academic difficulties and need assessment before failure sets in. Simply having a child repeat a failed grade rarely has any beneficial effect and often seriously undercuts the child's self-esteem. In addition to finding the problem areas, identifying each child's strengths is important. Educational approaches that value a wide range of talents ("multiple intelligences") beyond the traditional ones of reading, writing, and mathematics may allow more children to succeed.

The change in cognition allows the child to understand "if/when" clauses. Increased responsibilities and expectations accompany increased rights and privileges. Discipline strategies should move toward negotiation and a clear understanding of consequences, including removal of privileges for infringements.

SOCIAL, EMOTIONAL, AND MORAL DEVELOPMENT

Social and Emotional Development

In this period energy is directed toward creativity and productivity. The central Ericksonian psychosocial issue, the crisis between industry and inferiority, guides social and emotional development. Changes occur in three spheres: the home, the school, and the neighborhood. Of these, the home and family remain the most influential. Increasing independence is marked by the 1st sleepover at a friend's house and the 1st time at overnight camp. Parents should make demands for effort in school and extracurricular activities, celebrate successes, and offer unconditional acceptance when failures occur. Regular chores, associated with an allowance, provide an opportunity for children to contribute to family functioning and learn the value of money. These responsibilities may be a testing ground for psychologic separation, leading to conflict. Siblings have critical roles as competitors, loyal supporters, and role models.

The beginning of school coincides with a child's further separation from the family and the increasing importance of teacher and peer relationships. Social groups tend to be same-sex, with frequent changing of membership, contributing to a child's growing social development and competence. Popularity, a central ingredient of self-esteem, may be won through possessions (having the latest electronic gadgets or the right clothes) as well as through personal attractiveness, accomplishments, and actual social skills. Children are aware of racial differences and are beginning to form opinions about racial groups that impact their relationships.

Some children conform readily to the peer norms and enjoy easy social success. Those who adopt individualistic styles or have visible differences may be teased. Such children may be painfully aware that they are different, or they may be puzzled by their lack of popularity. Children with deficits in social skills may go to extreme lengths to win acceptance, only to meet with repeated failure. Attributions conferred by peers, such as funny, stupid, bad, or fat, may become incorporated into a child's self-image and affect the child's personality, as well as school performance. Parents may have their greatest effect indirectly, through actions that change the peer group (moving to a new community or insisting on involvement in structured after-school activities).

In the neighborhood, real dangers, such as busy streets, bullies, and strangers, tax school-aged children's common sense and resourcefulness. Interactions with peers without close adult supervision call on increasing conflict resolution or pugilistic skills. Media exposure to adult materialism, sexuality, and violence may be frightening, reinforcing children's feeling of powerlessness in the larger world. Compensatory fantasies of being powerful may fuel the fascination with heroes and superheroes. A balance between fantasy and an appropriate ability to negotiate real-world challenges indicates healthy emotional development.

Moral Development

By the age of 5 or 6 yr, the child has developed a conscience, meaning that he or she has internalized the rules of the society. She or he can distinguish right from wrong, but may take context and motivation into account. Children will adopt family and community values, seeking approval of peers, parents, and other adult role models. Social conventions are important, even though the reason behind some rules may not be understood. Initially, children have a rigid sense of morality, relying on clear rules for themselves and others. By age 10 yr, most children understand fairness as reciprocity (treat others as you wish to be treated).

Implications for Parents and Pediatricians

Children need unconditional support as well as realistic demands as they venture into a world that is often frightening. A daily query from parents over the dinner table or at bedtime about the good and bad things that happened during the child's day may uncover problems early. Parents may have difficulty allowing the child independence or may exert excessive pressure on their children to achieve academic or competitive success. Children who struggle to meet such expectations may have behavior problems or psychosomatic complaints.

Many children face stressors that exceed the normal challenges of separation and success in school and the neighborhood. Divorce affects nearly 50% of children. Domestic violence, parental substance abuse, and other mental health problems may also impair a child's ability to use home as a secure base for refueling emotional energies. In many neighborhoods, random violence makes the normal development of independence extremely dangerous. Older children may join gangs as a means of self-protection and a way to attain recognition and belong to a cohesive group. Children who bully others, and/or are victims of bullying, should be evaluated, since this behavior is associated with mood disorders, family problems, and school adjustment problems. Parents should reduce exposure to hazards where possible. Due to the risk of unintentional firearm injuries to children, parents should be encouraged to ask parents of playmates whether a gun is kept in their home and, if so, how it is secured. The high prevalence of adjustment disorders among school-aged children attests to the effects of such overwhelming stressors on development.

Pediatrician visits are infrequent in this period; therefore, each visit is an opportunity to assess children's functioning in all contexts (home, school, neighborhood). Maladaptive behaviors, both internalizing and externalizing, occur when stress in any of these environments overwhelms the child's coping responses. Due to continuous exposure and the strong influence of media (programming and advertisements) on children's beliefs and attitudes, parents must be alert to exposures from the television and Internet. An average American youth spends over 6 hr/day with a variety of media, and ⅔ of these children have a television in their bedrooms. Parents should be advised to remove the television from their children's rooms, limit viewing to 2 hr/day, and monitor what programs children watch. The Draw-a-Person (for ages 3-10 yr, with instructions to "draw a complete person") and Kinetic Family Drawing (beginning at age 5 yr, with instructions to "draw a picture of everyone in your family doing something") are useful office tools to assess a child's functioning.

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Chapter 12
Adolesence

See Part XIII, Chapter 104 on Adolescent Development.

Chapter 13
Assessment of Growth

Virginia Keane

A critical component of pediatric health surveillance is the assessment of a child's growth. Growth results from the interaction of genetics, health, and nutrition. Many biophysiologic and psychosocial problems can adversely affect growth, and aberrant growth may be the first sign of an underlying problem. The most powerful tool in growth assessment is the growth chart (see Figs. 9-1 and 9-2) used in combination with accurate measurements of height, weight, head circumference, and calculation of the body mass index (BMI).

PROCEDURES FOR ACCURATE MEASUREMENT

Accurate measurement is a critical component of growth assessment. Weight, in pounds or kilograms, must be determined using an accurate scale. For infants and toddlers, weight, length, and head circumference are obtained. These measures should be performed with the infant naked, and ideally, repeated measures should be performed on the same equipment. Head circumference is determined using a flexible tape measure run from the supraorbital ridge to the occiput in the path that leads to the largest possible measurement. Length is most accurately measured by two examiners (one to position the child), with the child supine on a measuring board. For older children, the measure is stature or height, taken without shoes, using a stadiometer. Measurements obtained in alternative manners, such as marking examination paper at the foot and head of a supine infant, or using a simple wall growth chart with a book or ruler on the head can lead to inaccuracy that may render the measurement useless. It is essential to compare measurements with previous growth trends, repeat any that are inconsistent, and plot results longitudinally.

DERIVATION AND INTERPRETATION OF GROWTH CHARTS

In 2000, the Centers for Disease Control and Prevention (CDC) published new growth charts, replacing the 1977 version. Modifications since then have not changed the data points. Set 1 includes the 5th to 95th percentiles; set 2, the 3rd to 97th percentiles. These charts contain data from national surveys conducted by the National Center for Health Statistics between 1963 and 1994. Data are representative of the U.S. population, both demographically and in terms of breast-feeding prevalence. Methodological steps have assured that the increase in the prevalence of obesity has not unduly raised the upper limits of normal. Several deficiencies of the older charts have been corrected, such as the over-representation of bottle-fed infants and the reliance on a local data set for the infant charts. The disjunction between length and height, when moving from the infant curves to those for older children, no longer exists. The charts include curves for plotting BMI for ages 2-20 yr rather than weight for height, facilitating identification of obesity.

The data are presented in 5 standard gender-specific charts: (1) weight for age; (2) height (length and stature) for age; (3) head circumference for age; (4) weight for height (length and stature) for infants; and (5) BMI for age for children over 2 yr of age (Fig. 13-1; also see Figs. 9-1 and 9-2). The charts are available at *www.cdc.gov/growthcharts/*.

Each chart is composed of percentile curves, representing the cross-sectional distribution of weight, length, stature, head circumference, weight for length, or BMI at each age. The percentile curve indicates the percentage of children at a given age on the *x*-axis whose measured value falls below the corresponding value on the *y*-axis. On the weight chart for boys 0-36 mo of age (see Fig. 9-1*A*), the 9 mo age line intersects the 25th percentile curve at 8.6 kg, indicating that 25% of the 9 mo old boys in the National Center for Health Statistics sample weigh less than 8.6 kg (75% weigh more). Similarly, a 9 mo old boy weighing more than 11.2 kg is heavier than 95% of his peers. The median or 50th percentile is also termed the *standard value,* in the sense that the standard height for a 7 mo old girl is 67 cm (see Fig. 9-1*B*). The weight-for-height charts (see Fig. 9-2) are constructed in an analogous fashion, with length or stature in place of age on the *x*-axis; the median or standard weight for a girl measuring 110 cm is 18.6 kg.

For infants, the revised charts represent observed but not necessarily optimal growth because they still incorporate data from many bottle-fed infants. Rates of initiation of breast-feeding in the USA have more than doubled from 26% in 1970 to 74% in 2005, but only 12% of infants are exclusively breast-fed for 6 mo and only 21% of infants receive breast milk for a yr. Compared with current standards, an exclusively breast-fed infant would be expected to plot higher for weight in the first 6 mo, but relatively lower in the second half of the 1st yr. Awareness of this growth difference should prevent overidentification of growth problems in breast-fed infants.

In an effort to set an internationally usable standard for optimal growth in young children, in 2006 the World Health Organization released growth charts based on the Multicenter Growth Reference Study (MGRS). Rather than describing the growth of typical children, the MGRS describes the growth of children who are predominantly breast-fed and raised under optimal conditions. Six study sites representing 5 continents were included: USA, Brazil, Norway, Ghana, Oman, and India. Use of the new charts in developing nations results in identification of many more children as malnourished and eligible for therapeutic feeding programs. Their use in the USA results in many fewer infants being identified as underweight (comparison of curves shown in Fig. 13-2). Charts are available online at *www.who.int/childgrowth/standards/en/*.

For adolescents, caution must be used in applying cross-sectional charts. Growth during adolescence is linked temporally to the onset of puberty, which varies widely. By using cross-sectional data based on chronological age, the charts combine youth who are at different stages of maturation. Normal variations in the timing of the growth spurt can lead to misdiagnosis of growth abnormalities. The data for 12 yr old boys include both early-maturing boys who are at the peak of their growth spurts and late-maturing ones who are still growing at their prepubertal rate. The net result is to artificially level off the growth peak, making it appear that adolescents grow more gradually and for a longer period than they do. When additional precision is necessary, growth charts derived from longitudinal

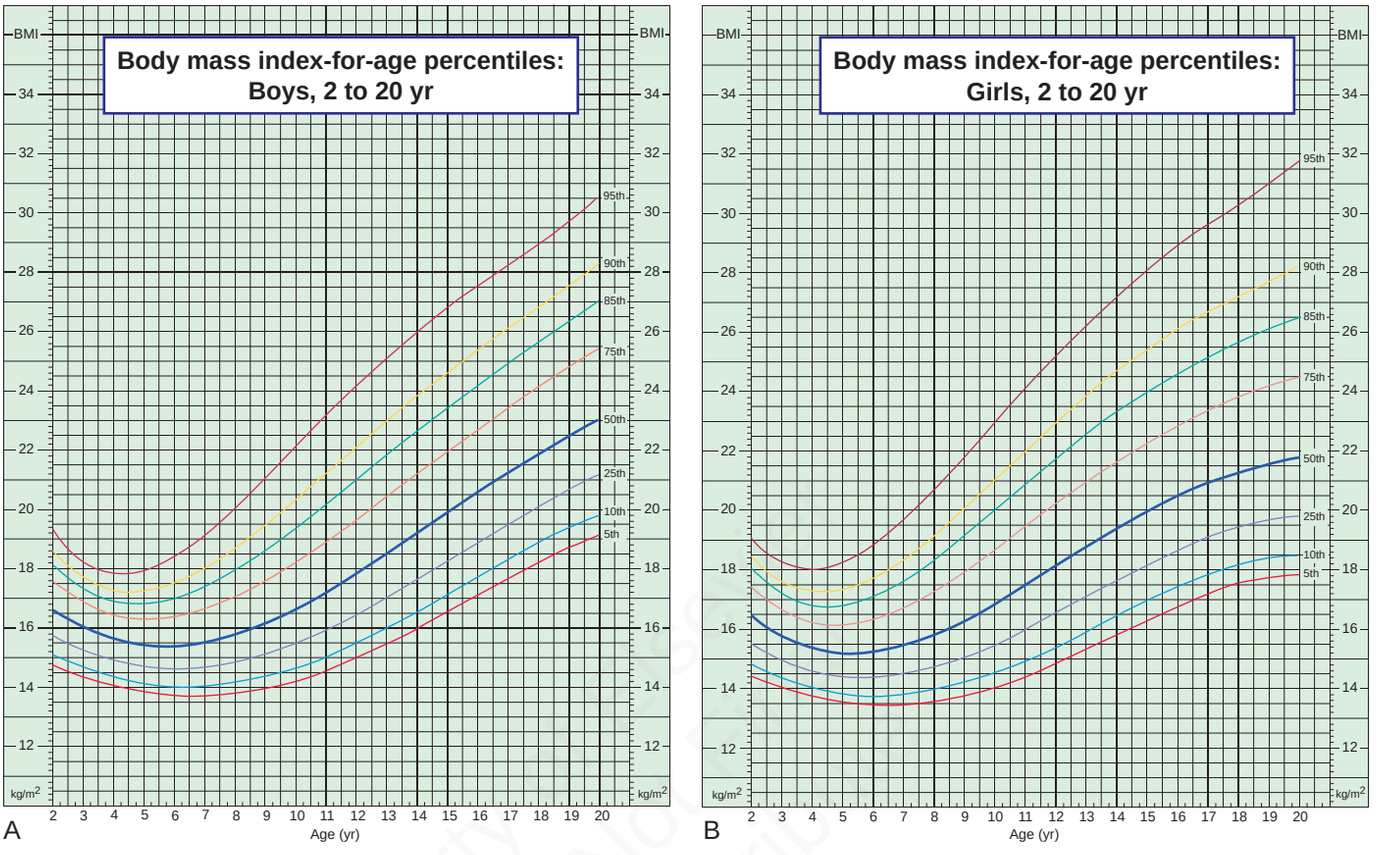

Figure 13-1 Body mass index (BMI) percentiles for boys (*A*) and girls (*B*) age 2-20 yr. (Official Centers for Disease Control [CDC] growth charts, as described in this chapter. The 85th to 95th percentile is at risk for overweight; >95th percentile is overweight; <5th percentile is underweight. Technical information and interpretation and management guides are available at *www.cdc.gov/nchs*.)

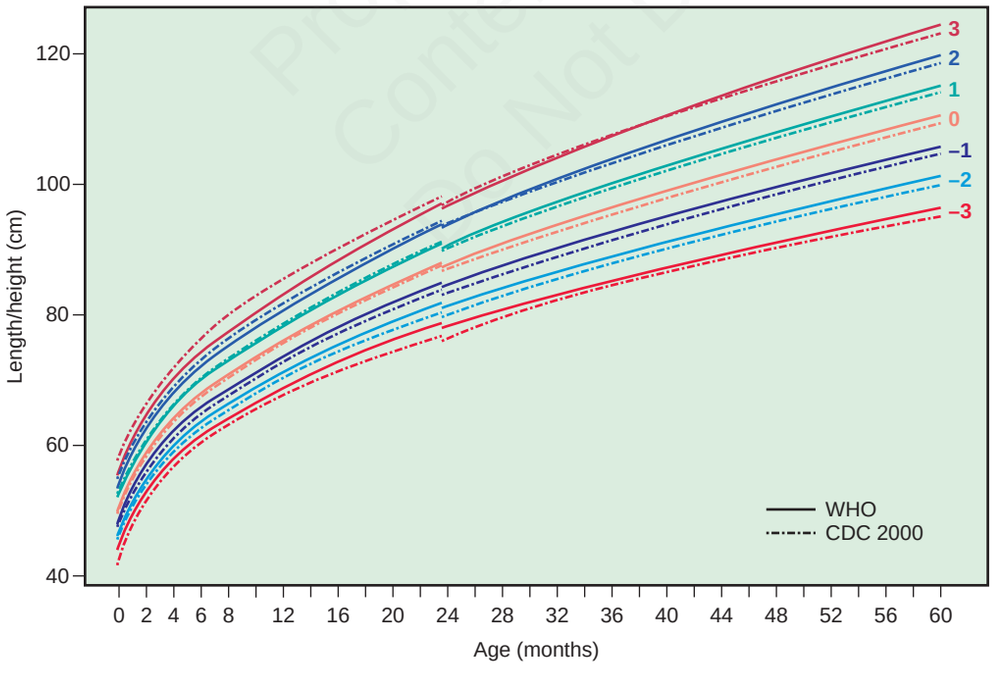

Figure 13-2 Comparison of the WHO and CDC length/height-for-age *z* score curves for boys. (From de Onis M, Garza C, Onyango AW, et al: Comparison of the WHO child growth standards and the CDC 2000 growth charts, *J Nutr* 137[1]:144–148, 2007.)

data, such as the height velocity charts of Tanner and colleagues, are recommended.

Specialized charts have been developed for U.S. children with various conditions, including very low birthweight and prematurity; Down, Turner, and Klinefelter syndromes; cerebral palsy; and achondroplasia. In addition, growth charts for children of distinct ethnic groups or nationalities may be found on the World Wide Web.

Body mass index for age complements the standard growth charts for children over 2 yr of age. BMI can be calculated as

weight in kilograms/(height in meters)^2 or weight in pounds/(height in inches)^2 × 703, with fractions of pounds and inches expressed as decimals. Values may be plotted on standard BMI charts (see Fig. 13-1). These calculations can be easily performed electronically using a variety of desktop and hand-held devices. BMI percentile varies with age over childhood: a 6 yr old girl with a BMI of 21 is overweight, whereas a 16 yr old girl with the same BMI is just above the 50th percentile.

Height velocity charts, which evaluate the rate of growth per yr, are considered by many to give a more sensitive and specific indicator of abnormal growth. They are used primarily by pediatric endocrinologists.

Although many parents think it is important to see growth charts, a recent study shows they often misinterpret their meaning. Clinicians are cautioned to provide clear interpretation when using growth charts as visual aids.

ANALYSIS OF GROWTH PATTERNS

Growth is a process rather than a static quality. An infant at the 5th percentile of weight for age may be growing normally, may be failing to grow, or may be recovering from growth failure, depending on the trajectory of the growth curve. Infants may lose up to 10% of their birth weight in the 1st wk of life and regain it by the end of the 2nd wk. They will then gain steadily at a rate of 20-30 g/day for the first 3 mo. Table 13-1 gives typical growth and calorie requirements for children through age 6 yr. Formulas are available for the estimation of average height and weight and height for children of various ages, but given their complexity and the easy availability of growth charts, use of the latter is preferable.

Despite the facts that the National Center for Health Statistics (NCHS) charts represent cross-sectional rather than longitudinal data and that children tend to grow in spurts, most children tend to track along a percentile, referred to as "following the curve." A normal exception commonly occurs between 6 and 18 mo of life. For full-term infants, size at birth reflects the influence of the uterine environment; however, size at 2 yr correlates with mean parental height, reflecting the influence of genes. Between 6 and 18 mo of age, infants may shift percentiles upward or downward toward their genetic potential. Thereafter, most children will track along a growth percentile, with variation within two large percentile bands (a small infant might track between the 5th and 25th percentiles, a large one between the 75th and 95th). This tracking often represents the mid-parental height and a corresponding weight, where **mid-parental height** is calculated in inches as follows:

- Boys: [(maternal height + 5) + paternal height]/2
- Girls: [maternal height + (paternal height – 5)]/2
- 13 cm (instead of ± 5 in) if using metric units

It is important to correct for various factors in plotting and interpreting growth charts. For premature infants, overdiagnosis of growth failure can be avoided by using growth charts developed specifically for this population. A cruder method, subtracting the weeks of prematurity from the postnatal age when plotting growth parameters, does not capture the variability in growth velocity that very low birthweight (VLBW) infants demonstrate. While VLBW infants may continue to show catch-up growth through early school age, most achieve weight catch-up during the 2nd yr and height catch-up by 2.5 yr, barring medical complications (see Chapter 91). For children with particularly tall or short parents, there is a risk of overdiagnosing growth disorders if parental height is not taken into account or, conversely, of underdiagnosing growth disorders if parental height is accepted uncritically as the explanation. 3

The analysis of growth patterns and the detection of aberrant growth patterns provide critical information for the detection of pathologic conditions. Calculation of daily and monthly growth, such as weight gain in g/day (see Table 13-1), allows more precise comparison of growth rate to the norm. Weight loss, or failure to gain normally, is often the first sign of pathology.

The diagnosis of failure to thrive (see Chapter 38), usually a diagnosis of children under 3 yr of age, is considered if a child's weight is below the 5th percentile, if it drops down more than 2 major percentile lines, or if weight for height is less than the 5th percentile. Weight for height below the 5th percentile remains the single best growth chart indicator of acute undernutrition. A BMI less than the 5th percentile also indicates that a child is underweight. Brief periods of weight loss or poor weight gain are usually rapidly corrected and do not permanently affect size. Children who have been chronically malnourished may be short (stunted) as well as thin, so that their weight-for-height curves may appear relatively normal. Chronic, severe undernutrition in infancy may depress head growth, which may be an ominous predictor of later cognitive disability. Low weight for age or height or weight loss may be referred to as wasting. 4

When growth parameters fall below the 5th percentile, values can be expressed as percentages of the median, or standard, value. A 12 mo old girl weighing 7.1 kg is at 75% of the median weight (9.5 kg) for her age.

Another way to evaluate weight is to determine the ideal body weight for height and compare the current weight to the ideal body weight for length or height. A 15 mo old boy who is 79 cm is at the 50th percentile. The ideal weight is 12 kg. If he weighs 8 kg (<5th percentile), he is 67% of ideal body weight, an indication of severe wasting. Table 13-2 provides interpretation of percent ideal body weight from obese to severe wasting.

Extremes of height or weight can also be expressed in terms of the age for which they would represent the standard or median. For instance, a 30 mo old girl who is 79 cm (<5%) is at the 50th percentile for a 16 mo old. Thus the height age is 16 mo. Weight age can also be expressed this way.

Linear growth deficiency (stunting) is more likely to be due to congenital, constitutional, familial, or endocrine causes than to nutritional deficiency (see also Chapter 43). In endocrine disor- 5

Table 13-1 GROWTH AND CALORIC REQUIREMENTS

AGE	APPROXIMATE DAILY WEIGHT GAIN (g)	APPROXIMATE MONTHLY WEIGHT GAIN	GROWTH IN LENGTH (cm/mo)	GROWTH IN HEAD CIRCUMFERENCE (cm/mo)	RECOMMENDED DAILY ALLOWANCE (Kcal/kg/day)
0-3 mo	30	2 lb	3.5	2.00	115
3-6 mo	20	1.25 lb	2.0	1.00	110
6-9 mo	15	1 lb	1.5	0.50	100
9-12 mo	12	13 oz	1.2	0.50	100
1-3 yr	8	8 oz	1.0	0.25	100
4-6 yr	6	6 oz	3 cm/yr	1 cm/yr	90-100

Adapted from National Research Council, Food and Nutrition Board: *Recommended daily allowances*, Washington, DC, 1989, National Academy of Sciences; Frank D, Silva M, Needlman R: Failure to thrive: myth and method, *Contemp Pediatr* 10:114, 1993.

ders, length or height declines first or at the same time as weight; weight for height is normal or elevated. In nutritional insufficiency, weight declines before length, and weight for height is low (unless there has been chronic stunting). Figure 13-3 depicts typical growth curves for 4 classes of decreased linear growth. In congenital pathologic short stature, an infant is born small and growth gradually tapers off throughout infancy. Causes include chromosomal abnormalities (Turner syndrome, trisomy 21; see Chapter 76), perinatal infection (TORCH), extreme prematurity, and teratogens (phenytoin, alcohol) (see Chapter 90). In constitutional growth delay, weight and height decrease near the end of infancy, parallel the norm through middle childhood, and accelerate toward the end of adolescence. Adult size is normal. In familial short stature, both the infant and the parents are small; growth runs parallel to and just below the normal curves.

Obesity affects large numbers of children. Growth charts can confirm an impression of obesity if the weight for height exceeds 120% of the standard (median) weight for height. According to the CDC, a BMI over the 95th percentile indicates obesity and a BMI between the 85th and 95th percentiles indicates overweight. Although widely accepted as the best clinical measure of under- and overweight, BMI may not provide an accurate index of adiposity, because it does not differentiate lean tissue and bone from fat. Measurement of the triceps, subscapular, and suprailiac skinfold thickness can be used to estimate adiposity; considerable experience is needed for accuracy. The *American Academy of Pediatrics Nutrition Handbook*, 6th edition, questions the use of fat folds to estimate total body fat, noting that the method has not been validated in young children and that basic assumptions of the method, that subcutaneous fat is a marker of total fat and that measured sites represent average skin fat thickness, are not true. Other methods of measuring fat, such as hydrodensitometry, bioelectrical impedance, and total body water measurement are used in research, but not in clinical evaluation.

Table 13-2 INTERPRETATION OF PERCENT OF IDEAL BODY WEIGHT

>120%	Obese
110-120%	Overweight
90-110%	Normal variation
80-90%	Mild wasting
70-80%	Moderate wasting
<70%	Severe wasting

OTHER INDICES OF GROWTH

Body Proportions

Body proportions follow a predictable sequence of changes with development. The head and trunk are relatively large at birth, with progressive lengthening of the limbs throughout development, particularly during puberty. The **lower body segment** is defined as the length from the symphysis pubis to the floor, and the **upper body segment** is the height minus the lower body segment. The ratio of upper body segment divided by lower body segment (U/L ratio) equals approximately 1.7 at birth, 1.3 at 3 yr of age, and 1.0 after 7 yr of age. Higher U/L ratios are characteristic of short-limb dwarfism or bone disorders, such as rickets.

Skeletal Maturation

Reference standards for bone maturation facilitate estimation of bone age (see Table 8-3). Bone age correlates well with stage of pubertal development and can be helpful in predicting adult height in early- or late-maturing adolescents. In familial short stature, the bone age is normal (comparable to chronological age). In constitutional delay, endocrinologic short stature, and undernutrition, the bone age is low and comparable to the height age. Skeletal maturation is linked more closely to sexual maturity rating than to chronological age. It is more rapid and less variable in girls than in boys.

Dental Development

Dental development includes mineralization, eruption, and exfoliation (Table 13-3). Initial mineralization begins as early as the 2nd trimester (mean age for central incisors, 14 wk) and continues through 3 yr of age for the primary (deciduous) teeth and 25 yr of age for the permanent teeth. Mineralization begins at the crown and progresses toward the root. Eruption begins with

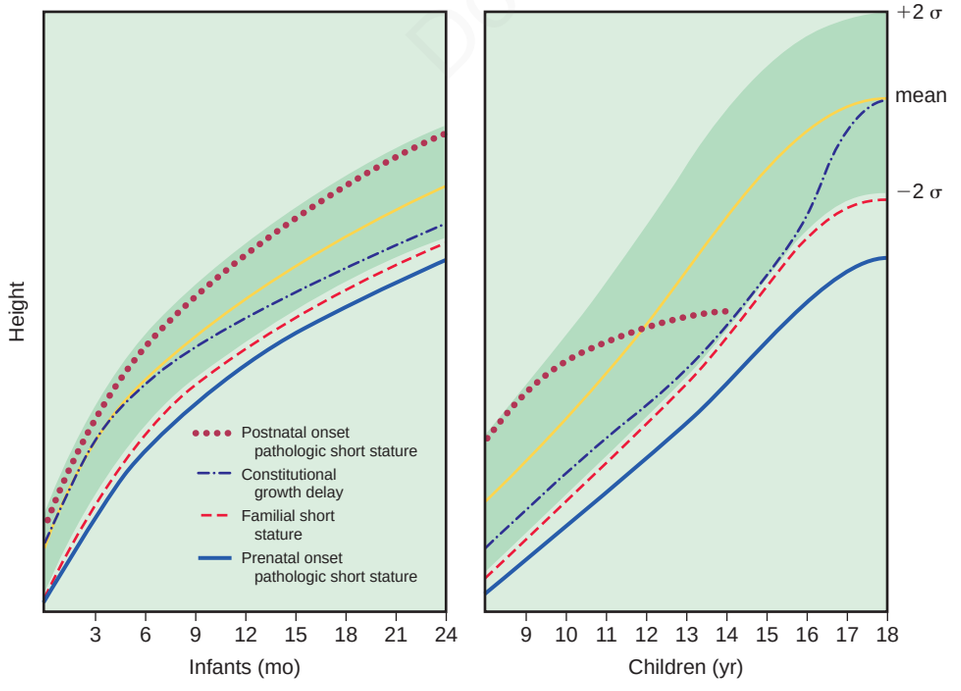

Figure 13-3 Height-for-age curves of the four general causes of proportional short stature: postnatal onset pathologic short stature, constitutional growth delay, familial short stature, and prenatal onset short stature. (From Mahoney CP: Evaluating the child with short stature, *Pediatr Clin North Am* 34:825, 1987.)

Table 13-3 CHRONOLOGY OF HUMAN DENTITION OF PRIMARY OR DECIDUOUS AND SECONDARY OR PERMANENT TEETH

	CALCIFICATION		AGE AT ERUPTION		AGE AT SHEDDING	
	Begins At	Complete At	Maxillary	Mandibular	Maxillary	Mandibular
PRIMARY TEETH						
Central incisors	5th fetal mo	18-24 mo	6-8 mo	5-7 mo	7-8 yr	6-7 yr
Lateral incisors	5th fetal mo	18-24 mo	8-11 mo	7-10 mo	8-9 yr	7-8 yr
Cuspids (canines)	6th fetal mo	30-36 mo	16-20 mo	16-20 mo	11-12 yr	9-11 yr
First molars	5th fetal mo	24-30 mo	10-16 mo	10-16 mo	10-12 yr	10-12 yr
Second molars	6th fetal mo	36 mo	20-30 mo	20-30 mo	10-12 yr	11-13 yr
SECONDARY TEETH						
Central incisors	3-4 mo	9-10 yr	7-8 yr	6-7 yr		
Lateral incisors	Max, 10-12 mo	10-11 yr	8-9 yr	7-8 yr		
	Mand, 3-4 mo					
Cuspids (canines)	4-5 mo	12-15 yr	11-12 yr	9-11 yr		
First premolars (bicuspids)	18-21 mo	12-13 yr	10-11 yr	10-12 yr		
Second premolars (bicuspids)	24-30 mo	12-14 yr	10-12 yr	11-13 yr		
First molars	Birth	9-10 yr	6-7 yr	6-7 yr		
Second molars	30-36 mo	14-16 yr	12-13 yr	12-13 yr		
Third molars	Max, 7-9 yr	18-25 yr	17-22 yr	17-22 yr		
	Mand, 8-10 yr					

Mand; mandibular; Max, maxillary.
Adapted from chart prepared by P.K. Losch, Harvard School of Dental Medicine, who provided the data for this table.

the central incisors and progresses laterally. Exfoliation begins at about 6 yr of age and continues through 12 yr of age. Eruption of the permanent teeth may follow exfoliation immediately or may lag by 4-5 mo. The timing of dental development is poorly correlated with other processes of growth and maturation. **Delayed eruption** is usually considered when there are no teeth by approximately 13 mo of age (mean + 3 standard deviations). Common causes include hypothyroid, hypoparathyroid, familial, and (the most common) idiopathic. Individual teeth may fail to erupt because of mechanical blockage (crowding, gum fibrosis). Causes of **early exfoliation** include histiocytosis X, cyclic neutropenia, leukemia, trauma, and idiopathic factors. Nutritional and metabolic disturbances, prolonged illness, and certain medications (tetracycline) commonly result in discoloration or malformations of the dental enamel. A discrete line of pitting on the enamel suggests a time-limited insult.

Structural Growth

Virtually every organ and physiologic process undergoes a predictable sequence of structural or functional changes, or both, during development. Reference values for developmental changes in a wide variety of systems (pituitary and renal function, electroencephalogram, and electrocardiogram) have been published.

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Chapter 14
Developmental Screening and Surveillance

Frances P. Glascoe and Kevin Marks

Developmental-behavioral problems are the most common conditions of childhood and adolescence. When combined with school failure and high school drop-out rates, prevalence reaches 1 in 4 to 1 in 5 children. In inner-city low-income settings, drop-out rates often reach as high as 50%. If intervention is instituted prior to school entrance, many problems can be prevented, and all can be ameliorated. The Individuals with Disabilities Education Act (IDEA) coupled with the Head Start Act ensure a free national system to locate and treat young children deemed at risk for developmental-behavioral problems or who have established delays. Early intervention depends on early detection performed by primary care providers.

Many young children at risk for school failure lack measurable delays but have markers in the form of multiple psychosocial risk factors that are strong predictors of future problems. Measurable delays are common in children with a history of abuse or neglect. High-risk psychosocial risk factors such as these, typically present in foster children, warrant an automatic referral (no screen required) to an IDEA program. Other psychosocial risks include parents with less than a high school education, parental mental health problems (depression or anxiety), housing and food instability, ethnic or linguistic minority, ≥3 children in the home, or an authoritarian parenting style, (e.g., highly directive, rarely engaging verbally in children's unique interests, punitive). Such risks, with or without apparent delays, typically result in children being held back in grade, dropping out of high school, teen pregnancy, unemployment, drug abuse, or criminality. Early intervention may reverse this cycle. Access to programs such as Head Start/Early Head Start for most children with psychosocial risk factors are based on federal poverty guidelines. Families often need parenting support groups, mental health referrals, housing, and social work services. Older children with risk factors, benefit from drop-out prevention assistance, including after-school tutoring, Boys and Girls Club, summer academic programs, and mentoring.

Of children with measurable delays or disabilities, the most common (and least well-identified) condition is speech-language impairment (17.5% at 30-36 mo) (see Chapter 32). Prevalence varies by age, but this is followed in frequency by attention-deficit/hyperactivity disorder (4-12%) (see Chapter 30), learning disabilities (6.5%), and cognitive disabilities/mental retardation (1.2% overall) (see Chapter 33). Less common conditions include autism spectrum disorder (0.67% overall), pervasive developmental disorder-NOS (0.27%) (see Chapter 28), cerebral palsy (0.23%) (see Chapter 591.1), hearing impairment (0.12%), and other forms of health or physical impairments (e.g., Down syndrome, fragile X syndrome, traumatic brain injury). Early detection of emerging deficits among very young children typically requires clinicians to screen with tools proven to be accurate. 1

Very young children with delays, (i.e., birth to 3 yr of age) do not require a specific diagnosis to receive IDEA services. They are eligible under *developmental delay*, defined as a 25% departure from typical performance in ≥2 developmental domains (e.g., receptive language, expressive language, fine motor, gross motor, social-emotional, cognitive/pre-academic, and behavior). Primary care providers need not make a diagnosis in very young children but instead should focus on detection and referral to IDEA programs. Nevertheless, clinicians can simultaneously refer to subspecialty services, particularly when autism spectrum disorder is suspected. Children over the age of 3 yr are served and tested by the public schools psychologists, and speech-language pathologists will define disabilities more discretely.

EARLY DETECTION IN PRIMARY CARE

Only about 25% of children with developmental delays are detected prior to school entrance when children have missed opportunities for early intervention. Although clinicians are effective at detecting severe disabilities associated with congenital, metabolic, or genetic abnormalities, clinicians are far less adept at discerning the more common conditions that typically lack overt symptoms (dysmorphic features, metabolic crisis).

Reasons for underdetection in primary care include (1) dependence on nonstandard administration of standardized screens (including selected items from longer measures) and informal milestones checklists; both approaches lack proof of validity and criteria for making accurate decisions; (2) failure to continually check on developmental progress; (3) clinical judgment (because it tends to depend heavily on dysmorphology and organicity, which are not present in the majority of children with disabilities); (4) requirement of repeated screening test failure before making a referral (due to lack of awareness that quality screening measures are highly reliable and that a repeated screen is likely to yield identical results); (5) false optimism about outcome (children rarely outgrow developmental problems in the absence of intervention); (6) discomfort at delivering difficult news; (7) lack of familiarity with tools effective for busy primary care settings; and (8) problematic reimbursement for screening services (generally due to insurance non-reimbursement policies or ineffective use of procedure codes).

To improve better detection in primary care, the American Academy of Pediatrics recommends developmental screening and surveillance at well visits. **Developmental screening** refers to the administration of brief, standardized, and validated instruments that have been researched for their *sensitivity* in detecting children with probable problems and *specificity* in determining when children probably do not have problems. Standards for screening test accuracy are 70-80% sensitivity and specificity. Although these figures are low compared to standards for most medical screens, developmental problems develop over time. Repeated screening is expected to compensate for underdetection of what is essentially a "moving target." Over-referrals are less concerning because research shows that most children with false-positive screens, while ineligible for special education services, are nevertheless in need of remedial programs (e.g., Head Start, after-school tutoring, summer school, and quality preschool or day care,) due to psychosocial risk factors, including poverty and limited maternal education and below-average performance in the better predictors of school success (i.e., language, intelligence, and academic/pre-academic skills).

Table 14-1 shows a range of tools useful for early detection of developmental and behavioral problems. In addition, screening of for autism spectrum disorders should begin in the first and continued in the subsequent years of life (see Chapter 28). Well visits are brief and have enormous agendas: physical exams, immunizations, anticipatory guidance, safety and injury prevention counseling, and developmental promotion. Developmental screens that rely on information from parents are ideal because they can be completed in advance of appointments, online, or in waiting or exam rooms. 2

In addition to repeated developmental screening, physicians are also encouraged to practice developmental surveillance at each well visit. **Developmental surveillance** provides a context for screening results and involves scrutinizing family functioning and risk factors, observing longitudinally child behavior and developmental skills, eliciting and attending to parents' concerns, and deploying knowledge of children's medical history (Table 14-2). Information obtained through surveillance should never be used to override a positive screening test result, but it can be used to elevate suspicions about negative screening results. Surveillance is essential for determining service needs, and for selecting optimal methods to help parents promote positive development through written materials, hands-on parent training, and/or social work services.

RESOURCES FOR SCREENING, NONMEDICAL REFERRAL, AND DEVELOPMENTAL PROMOTION

American Academy of Pediatrics' Section on Developmental and Behavioral Pediatrics provides information on screening, rationale, implementation, etc. *www.dbpeds.org* 3

National Early Childhood Technical Assistance Center provides links to early intervention and public school services in each state, region, and community. *www.nectac.org*

American Academy of Pediatrics website with information on coding, reimbursement, advocacy assistance with denied claims and guidance on establishing a medical home for children with special needs. *www.medicalhomeinfo.org/tools/coding.html*

Table 14-1 TOOLS FOR DEVELOPMENTAL-BEHAVIORAL SCREENING AND SURVEILLANCE

The following chart is a list of measures meeting standards for screening test accuracy, meaning that they correctly identify, at all ages, at least 70-80% of children with disabilities while also correctly identifying at least 70-80% children without disabilities. All listed measures were standardized on national samples, proven to be reliable, and validated against a range of diagnostic measures and diagnosed conditions. Not included are measures such as the Denver-II that fail to meet psychometric standards (limited standardization, absent validation, problematic sensitivity and specificity).

The first column provides publication information and the cost of purchasing a specimen set. The "Description" column provides information on alternative ways, if available, to administer measures (e.g., waiting rooms). The "Accuracy" column shows the percentage of patients with and without problems identified correctly. The "Time Frame/Costs" column shows the costs of materials per visit, along with the costs of professional time (using an average salary of $50 per hour) needed to administer each measure, but does not include time needed for generating referral letters. For parent-report tools, administration time reflects not only scoring of test results, but also the relationship between each test's reading level and the percentage of parents with less than a high school education (who may or may not be able to complete measures in waiting rooms due to literacy problems and thus will need interview administrations).

BROAD-BAND DEVELOPMENTAL-BEHAVIORAL SCREENS	AGE RANGE	DESCRIPTION	SCORING	ACCURACY	TIME FRAME/ COSTS
Parents' Evaluation of Developmental Status (PEDS) (2008) Ellsworth & Vandermeer Press, Ltd., 1013 Austin Court, Nolensville, TN 37135 Phone: 615-776-4121; fax: 615-776-4119 *http://www.pedstest.com* ($30.00) PEDS is online together with the M-CHAT. A no-cost trial is available at: *http://www.pedstest.com*	Birth to 8 yr	Parent-report, provides longitudinal surveillance and screening via 10 questions eliciting parents' concerns with decision-guidance for providers. Written at the 4th-5th grade level. Determines when to refer, provide a second screen, provide patient education, or monitor development, behavior/emotional, and academic progress. In English, Spanish, Vietnamese, and many other languages.	Identifies children as low, moderate, or high risk for various kinds of disabilities and delays	Sensitivity ranging from 74-79% and specificity ranging from 70-80% across all age levels	About 2 minutes (if interview needed) Print materials ~$0.31 Admin. ~$0.88 Total = ~$1.19
Ages and Stages Questionnaire (ASQ-3, 3rd ed., 2009) Paul H. Brookes Publishing, Inc., PO Box 10624, Baltimore, MD 21285 Phone: 800-638-3775 *http://www.pbrookes.com* ($249) Online ASQ-3 is currently under development; refer to: *http://www.agesandstages.com*	2-60 mo (5 yr)	Parent-report, elicits children's developmental skills in 5 domains with 30 items and 6-7 overall questions using an age-appropriate form for each well visit. Reading level varies across items from 3rd-12th grade. Proven feasible for office use with an option to complete at home (ideally before the visit). Online and mail-out approaches are used for child-find programs. In English, Spanish, French, Korean and other languages.	Single (refer/ no-refer) cutoff scores per age-interval	Sensitivity (overall 86%) range = 82.5-89.2%. Specificity (overall 85%) range = 77.9-92.1% across all age intervals Standardized on a diverse, large sample of 12,695 children	10-20 minutes (likely depends on whether the ASQ-3 is completed in a clinic or at home) Materials ~$0.40 Admin. ~$4.20 Total = ~$4.60
PEDS-Developmental Milestones (PEDS-DM) (2007) Ellsworth & Vandermeer Press, Ltd., 1013 Austin Court, Nolensville, TN 37135 Phone: 615-776-4121; fax: 615-776-4119 *http://www.pedstest.com* ($275.00) To be online soon at: *http://www.pedstest.com*	0-8 yr	Provides longitudinal surveillance and screening via 6-8 items at each age level (spanning the well visit schedule). Each item taps a different domain (fine/ gross motor, self-help, academics, expressive/receptive language, social-emotional). Forms are laminated and marked with a grease pencil. Administered by parent-report or directly to children. Written at the high 1st grade level. A longitudinal score form tracks performance and optionally incorporates scoring/interpretation for PEDS or stand alone. Includes supplemental measures helpful for surveillance: M-CHAT, Family Psychosocial Screen, PPSC-17, the SWILS, the Vanderbilt, and the Brigance Parent-Child Interactions Scale. An Assessment Level version is available for NICU follow-up and early intervention programs. In English and Spanish.	Cutoffs tied to performance above and below the 16th percentile for each item and its domain. On the Assessment Level, age equivalent scores are produced and enable users to compute percentage of delays.	Sensitivity (75-87%); specificity (71-88% to performance in each domain. Sensitivity (70-94%); specificity (77-93%) across all ages intervals	About 3-5 minutes Materials ~$0.02 Admin. ~$1.00 Total = ~$1.02
AUTISM SPECIFIC SCREENING					
Note: The American Academy of Pediatrics recommends ASD screening at 18 mo and again at 24-30 mo. Nevertheless, the following measure should not be used as the sole screen for all children, because it will not accurately detect the more common disabilities of childhood, i.e., language impairment, intellectual disabilities, and learning disabilities. Narrow-band tools should always be administered along with a broad-band tool, such as those listed previously.					
Modified Checklist for Autism in Toddlers (M-CHAT) (1999) The M-CHAT is included in the PEDS:DM and online with PEDS at: *http://www.pedstest.com.* Download in multiple languages at: *http://www2.gsu.edu/~psydlr/Diana_L._Robins,_Ph.D..html* and included with the PEDS:DM	16-30 mo	Parent-report, 23 questions, modified for American use, 4th-6th grade reading level. Available in English, Spanish, and numerous other languages. The full text article appeared in the April 2001 issue of the *Journal of Autism and Developmental Disorders.*	Cutoff scores based on 2 of 6 critical items, or any 3 from the checklist.	Initial study shows sensitivity at 90%; specificity at 99%. However, subsequent studies showed high false-positive rates.	About 5 minutes Print Materials ~$0.10 Admin. ~$0.88 Total = ~$0.98
M-CHAT Follow-up Interview (2008) Available at: *http://www2.gsu.edu/~psydlr/Diana_L._Robins,_Ph.D..html*		Designed to reduce false-positive M-CHAT results and prevent unnecessary, expensive comprehensive diagnostic evaluations for autism	Single (refer/ no-refer) cutoff scores	A concerning M-CHAT (6-10% of children at 18 and 24 mo) should lead to an in-office, standardized M-CHAT Follow-up Interview	???

Table 14-1 TOOLS FOR DEVELOPMENTAL-BEHAVIORAL SCREENING AND SURVEILLANCE—cont'd

BROAD-BAND DEVELOPMENTAL-BEHAVIORAL SCREENS	AGE RANGE	DESCRIPTION	SCORING	ACCURACY	TIME FRAME/ COSTS
SCREENS FOR CHILDREN 6-8 YR AND OLDER					
The following two measures provide a basic evidence-based surveillance and screening battery for well visits with older children, i.e., mental health/attention span and academic skills.					
Pediatric Symptom Checklist (PSC): Screens school-aged children for mental health and attentional problems. Research studies and downloads at: *http://www2.massgeneral.org/allpsych/psc/psc_home.htm* or *http://www.brightfutures.org/mentalhealth/pdf/professionals/ped_sympton_chklst.pdf* The Pictorial PSC (more effective with Spanish-speaking families can be downloaded at *http://www.dbpeds.org* and is also included in the PEDS:DM Pediatric Symptom Checklist-Youth Report (Y-PSC)	4-16+ yr	Parent-report, 35 short statements of problem behaviors including both externalizing (conduct) and internalizing (depression, anxiety, adjustment, etc.). Ratings of never, sometimes, or often are assigned a value of 0, 1, or 2, respectively. Referral cutoff score is 24 or higher for children 4-5 yr old and 28 for children 6-10 yr old. Factor scores identify attentional, internalizing, and externalizing problems. Factor scoring freely downloaded at: *http://www.pedstest.com/links/resources.html* Child-report, 35 short statements, for children/teens 11 yr and above, cutoff score is 30 or higher	Single (refer/no-refer) cutoff scores, dependent on age	All but one study showed high sensitivity (80-95%) but somewhat scattered specificity (68-100%).	About 7 min (if interview needed) Materials ~$0.10 Admin. ~$2 38 Total = ~$2.48
Safety Word Inventory and Literacy Screener (SWILS) (2002) The SWILS can be freely downloaded at: *http://www.pedstest.com* and is also included in the PEDS:DM	6-14 yr	Children are asked to read aloud up to 29 common safety words (e.g., High Voltage, Wait, Poison) aloud. The number of correctly read words is compared to a cutoff score. Results predict performance in math, written language, and a range of reading skills. Test content may serve as a springboard to injury prevention counseling. In English only.	Single (refer/no-refer) cutoff scores, dependent on age	78-84% sensitivity and specificity across all ages	About 7 minutes (if interview needed) Materials ~$0.30 Admin. ~$2 38 Total = ~$2.68
FAMILY PSYCHOSOCIAL SCREENING					
Family Psychosocial Screen (FPS) (1996) Freely downloaded at: *http://www.pedstest.com* (also included in the PEDS:DM); also adapted to Bright Future's Pediatric Intake Form, freely downloaded at: *http://www.brightfutures.org/mentalhealth/pdf/professionals/ped_intake_form.pdf*	Complements the previous screens with quality surveillance to assess developmental risk	A 2-page clinic intake form that identifies psychosocial risk factors associated with developmental problems including: (1) a 4-item measure of parental history of physical abuse as a child; (2) a 6-item measure of parental substance abuse, and (3) a 3-item measure of maternal depression. Bright Future's Pediatric Intake Form also has 6 "social support" items and other pertinent child & family intake questions	Refer/no-refer scores for each risk category. Also has guides to referring and resource lists.	All studies showed sensitivity and specificity to larger inventories >90%	About 15 minutes (if interview needed) Materials ~$0.20 Admin. ~$4.20 Total = ~$4.40

Updated in 2009 from Glascoe FP: *Collaborating with parents*, Nashville, TN, 1998, Ellsworth & Vandermeer Press. Permission is granted for reproduction of this table.

Table 14-2 COMBINING SCREENING AND SURVEILLANCE: A PRACTICE ALGORITHM

1. ENSURE A MEDICAL HOME.
Timely, equitable access to care logically correlates to well child care compliance rates and therefore, developmental delay identification rates. Children with developmental and behavioral problems or special health care needs use health care services at >2× the rate of other patients. Visits are often complex due to the need to make referrals, locate information from prior visits and services, make follow-up appointments, and coordinate with other providers. The AAP's medical home model (*www.medicalhomeinfo.org*) is an essential guide to organizing practices to ensure continuity and coordination of care and to best meet the needs of children with disabilities and their families.

2. REVIEW MEDICAL CHART FOR HEALTH RISK FACTORS.
Consider potentially harmful exposures including radiation or medications, infectious illnesses, fever, addictive substances, trauma, and results of neonatal screens, including phenylketonuria, congenital hypothyroidism, and numerous other metabolic conditions. The perinatal history includes birthweight, gestational age, Apgar scores, and any medical complications (see Chapter 88.1). Postnatal medical factors that are sometimes overlooked include failure to thrive, abnormal growth curves for head circumference, neurological (e.g., seizure) disorders, endocrine disorders, amblyopia or other significant forms of visual impairment, chronic respiratory or allergic illness, conductive or sensorineural hearing impairment, congenital heart disease, iron deficiency anemia, head trauma, and sleep disorders (particularly obstructive sleep apnea [see Chapter 17]).

3. DETERMINE PRESENCE OF PSYCHOSOCIAL RISK FACTORS.
This includes parents with less than a high school education, parental mental health or substance abuse problems, 4 or more children in the home, single parent, poverty, frequent household moves, limited social support, parental history of abuse as a child, ethnic minority, etc. Four or more risk factors tend to plunge developmental status into the below average range and suggest the need for enrichment or remedial programs regardless of screening results. An initial visit standardized intake measure, such as the Family Psychosocial Screen (see Table 14-1), and thereafter a standardized postpartum mood disorder screen, such as the Edinburgh Postnatal Depression Scale or Patient Health Questionnaire-2/-9 (typically administered at the 2 wk and 2 mo) is often helpful for capturing psychosocial risk factors. When a concerning psychosocial screen occurs, the next step is to provide an appropriate community referral (e.g., mental health provider, domestic violence shelter, parenting or postpartum depression support group) and to contact (via a phone call or a courtesy copy note) the parent's primary care provider. If parental suicidal/homicidal ideation or psychosis is identified, consider that a medical emergency. Not only does psychosocial screening allow for higher quality surveillance, it's an early opportunity to ameliorate or prevent a future delay.

Continued

Table 14-2 COMBINING SCREENING AND SURVEILLANCE: A PRACTICE ALGORITHM—cont'd

4. ELICIT AND ADDRESS PARENTS' CONCERNS.
This may be accomplished informally, although careful attention to wording is essential. The AAP's Bright Futures guidelines contain helpful trigger questions. An 11 alternative is to use a measure such as PEDS (see Table 14-1), which has empirically tested wording and offers a way to weight the types of concerns parents raise, assign levels of risk, and identify optimal responses. PEDS also functions as a broad-band screening and surveillance tool.

5. PROVIDE PHYSICAL EXAMINATION.
Points of particular importance include growth parameters and head shape and circumference, facial and other body dysmorphology, eye findings (e.g., cataracts in various inborn errors of metabolism), vascular markings, and signs of neurocutaneous disorders (café-au-lait spots in neurofibromatosis, hypopigmented macules in tuberous sclerosis). Vision and hearing screening should occur per the AAP's guidelines. Examine closely for findings consistent with abuse/neglect (e.g., geometrically 12 shaped bruises). A neurological exam (see Chapter 584), along with careful observation of the child's behavior and the parent-child interaction, is a key part to any developmental evaluation. Does the parent interact appropriately with the child or does something "not feel right" during your exam? Does the child behave age-appropriately around the parent? Is there a concern about the child being over or under attached to the parent?

6. ADMINISTER AND SCORE THE DEVELOPMENTAL-BEHAVIORAL SCREENING TEST.
Use of parent-report measures, pre-visit or in the waiting/exam room reduces the amount of time needed for screening. Screening measures, particularly the ASQ and PEDS:DM also offer a way to track development over time via monitoring of milestones.

7. RESPOND TO POSITIVE SCREENING TEST RESULTS.
Additional screens of social-emotional or social-communication functioning (e.g., ASQ-SE, M-CHAT) will further identify the areas of delay and types of services needed. In conjunction with surveillance, careful interpretation of a broad-band tool's unique pattern performance profile helps clinicians to discriminate which children require a follow-up office visit for additional screening.

8. WHEN INDICATED, RESPOND TO CONCERNING SCREENS WITH ADDITIONAL MEDICAL TESTS.
Iron deficiency and lead poisoning are common contributors to developmental delays and are easily detected through screening. Electroencephalograms and neuroimaging are not routinely indicated, but might be used if there is clinical suspicion of a seizure disorder, hydrocephalus, microcephaly, encephalopathy, neurofibromatosis, tuberous sclerosis, brain tumor, or other neurological problem (not including autism). Uncommonly, surveillance may indicate a need for additional metabolic screens, such as serum electrolytes and glucose, venous blood gas, serum ammonia, urine glycosaminoglycans, endocrine screens (e.g., TSH, free T4), genetic testing (chromosomal analysis, DNA for fragile X, etc.), or screens for an infectious disease (e.g., HIV antibody testing [see Chapter 273], TORCH infection testing [see Chapter 13 14 103]).

9. EXPLAIN SCREENING RESULTS TO PARENTS.
The primary medical provider should present the screening results to parents in person, emphasizing available community services and how to optimize a child's (and family's) outcome. It is advisable to use euphemistic terms for diagnosis, because the specific condition will not be known (e.g., "developmental delay," "behind other children," "having difficulties with….") Offers to re-explain findings to other family members are helpful. Asking the parents if they know any families with children who have developmental differences may be helpful in understanding any strong reaction to the information being presented.

10. MAKE REFERRALS FOR SUBSPECIALTY MEDICAL SERVICES.
If the record review or physical exam suggests the need, referral for further evaluation should be offered. (e.g., developmental-behavioral or neurodevelopmental pediatricians, psychiatrists, audiologists, otolaryngologists, occupational or physical therapists, neurologists, genetic or metabolic subspecialists, endocrinologists).

11. MAKE REFERRALS FOR NONMEDICAL INTERVENTIONS.
This should include IDEA programs (*www.nectac.org*). Services are free to parents and generally provide high quality therapies, evaluations, remediation programs or high quality preschool for those with psychosocial risk factors (or when further evaluation reveals the screening results were false-positive). Referral forms or letters, which target the areas of concern, help IDEA programs to better assess and track children. To expedite assessments and eligibility placements, parental signatures should be obtained to release information back and forth between the medical provider and the IDEA program. Some children will be automatically eligible for services based on a condition highly likely to result in a developmental delay (e.g., Down syndrome, birth weight <1500 g). Referral forms or letters should include suggestions for the types of evaluations needed (e.g., speech-language therapy, occupational and physical therapy, social-emotional assessment, intelligence testing, academics) and documentation of hearing and vision status, because IDEA programs require this information before providing evaluations.

12. PROVIDE DEVELOPMENTAL-BEHAVIORAL PROMOTION.
Helping parents encourage language and preacademic/academic development can be accomplished via written patient education materials, by encouraging parents to visit websites with quality information, or by parent training classes, group well visits, or social work services. A well-organized system for filing and retrieving parent-15 focused materials is essential (see Table 15.3). Follow up with families, in 6-8 weeks to assess the effectiveness of promotion activities, especially in-office advice about behavior and social skills. If less than successful, encourage parents to engage in more intensive services (e.g., parenting classes, family therapy).

13. REVIEW REPORTS AND OTHER FEEDBACK FROM REFERRAL SOURCES.
As with the importance of following up on the effectiveness of in-office developmental-behavioral promotion, surveillance does not end after a referral. Clinicians should carefully review (and when indicated, take action upon) reports from the IDEA programs and other subspecialists. IDEA programs should ideally give feedback to clinicians about whether the child followed up on the referral. Was the child lost to follow-up, screened out, placed on a monitoring list, or made eligible for services? Evaluation reports, eligibility statements and Individualized Family Service Plans should be reviewed. Tracking eligibility status with problem lists is helpful to clinicians at subsequent well visits. When reports show significant concerns, follow-up office visits might need to be arranged. Circle back to step 1.

4 American Academy of Pediatrics, policy statement on developmental screening and surveillance. *www.aap.org/*

Centers for Disease Control and Prevention, Using Developmental Screening to Improve Children's Health: offers information on the value of screening with links to research and services, and wall charts on milestones. *www.cdc.gov/ncbddd/child/improve.htm*

Guidelines and information on providing comprehensive health supervision services, case-based learning examples, etc. *www.brightfutures.aap.org/index.html*

Slide shows and other materials for teaching screening measures, a trial of online developmental-behavioral and autism screens, parent education handouts, and an early detection discussion list. *www.pedstest.com*

Implementation guidance and research, with an excellent video of pediatricians and a hospital administrator at Harvard University showing opinions about screening before and after implementing a quality tool. *www.developmentalscreening.org*

Help locating Head Start and Early Head Start programs. *www.ehsnrc.org*

Find quality preschool and day care programs. *www.childcareaware.org* and *www.naeyc.org/*

Information on parent training programs and the YWCA. *www.patnc.org* and *www.ywca.org*

Help locating mental health services. *www.mentalhealth.org*

Find services and information about autistic spectrum disorders. *www.firstsigns.org*.

Download parenting information. *www.kidshealth.org*

Locate social services addressing domestic violence, housing and food instability, child abuse and neglect, adoption, state, and local services, etc. *www.acf.hhs.gov*

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Chapter 15
Child Care: How Pediatricians Can Support Children and Families

Laura Stout Sosinsky and Walter S. Gilliam

With increasing movement of women into the workplace across the globe, child care is a primary developmental context for millions of young children. Child-care providers play a major role in the day-to-day safety, health, and developmental well-being of young children. Given the large proportion of young children in child-care settings, child-care providers are an important potential ally to parents and pediatricians. The provision of child care is complex, with enormous variation across the globe. Child care is affected by many factors including maternal leave policies. The U.S. federal leave program allows for 12 weeks of unpaid job-protected leave during pregnancy or after childbirth, but companies with <50 employees, part-time employees, and those working in informal labor markets are exempt. By contrast, according to the national leave programs in Norway and Sweden, mothers may receive up to 42 and 52 weeks, respectively, of paid benefits after the birth of an infant. Countries vary in terms of the proportion of children being cared for by the extended family. Pediatricians need to understand how child care is structured and utilized and in their country or region appreciate the challenges parents face in finding and accessing high-quality child care and the challenges child-care providers face in maintaining a physically and developmentally healthy environment.

PROVISION AND REGULATION OF CHILD CARE IN AMERICA

Child Care Usage

In the USA, about 11.3 million young children are regularly in care by someone other than their parents, largely due to the vast increase in employment of mothers of young children in recent decades. Fifty-eight percent of children 4 yr old and younger with employed parents are in regular child care. The largest increase in child care use is among infants and toddlers, with 53% of infants and 57% of toddlers in child care. Additionally, children are in care for long hours, with 42% of children age 4 yr or younger attending child care for 35 hr or more each week.

Child-Care Settings

These settings vary widely and fall into 4 broad categories, from the least to the most formal: relative care, in-home nonrelative care (e.g., nannies, au pairs), family daycare, and center-based care. Parents more often utilize home-based care for infants and toddlers, in part due to greater preference, flexibility, and availability, and sometimes due to lower cost. Almost 30% of infants and toddlers in care are in family daycare homes. Family daycare providers typically provide care in their home for up to 6 young children, often including children of mixed ages, siblings, or the provider's own children. Use of center-based child care, provided in nonresidential facilities for typically 13 or more children, is greater among preschoolers (children 3-5 yr old). Early education settings for preschoolers (e.g., Head Start, prekindergarten) also may play an important role in child care. Although early education programs may have a greater focus on educational activities and often only provide limited hours of care per days, the health and safety issues involved with early education programs are similar to those presented by other group child-care settings. Child-care centers and early education programs are administered by a wide array of businesses and organizations, including for-profit independent companies and chains, religious organizations, public and private schools, community organizations, cooperatives, and public agencies.

Sick Children

When children are ill, they may be excluded from out-of-home arrangements, and settings under state licensure are required to exclude children with certain conditions. Guidelines for health and safety in out-of-home care from the American Academy of Pediatrics, the American Public Health Association, and the National Resource Center for Health and Safety in Child Care offer recommendations regarding the conditions under which sick children should and should not be excluded from group programs (Table 15-1). These include fever, vomiting, and diarrhea, as well as certain parasitic conditions. State laws typically mirror these guidelines but may be stricter in some states. Most families need to make arrangements to keep sick children at home (staying home from work). Alternative care arrangements outside the home for sick children are relatively rare but may include either (1) care in the child's own center, if it offers special provisions designed for the care of ill children (sometimes called the infirmary model or sick daycare); or (2) care in a center that serves only children with illness or temporary conditions. Although it is important that such arrangements emphasize preventing further spread of disease, one study found no occurrence of additional transmission of communicable disease in children attending a sick center. The impact of group care of ill children

Table 15-1 CONDITIONS THAT DO AND DO NOT REQUIRE EXCLUSION FROM GROUP CHILD CARE SETTINGS

CONDITIONS THAT REQUIRE EXCLUSION	COMMENTS
Illness preventing the child from participating comfortably in activities as determined by the child-care provider	Providers should specify in their policies, approved by the facilities' health care consultant, what severity level of illness the facility can manage and how much and what types of illness will be addressed. Severity level 1 consists of children whose health condition is accompanied by high interest and complete involvement in activity associated with an absence of symptoms of illness (such as children recovering from pinkeye, rash, or chickenpox), but who need further recuperation time. Severity level 2 encompasses children whose health condition is accompanied by a medium activity level because of symptoms (such as children with low-grade fever, children at the beginning of an illness, and children in the early recovery period of an illness). Severity level 3 is composed of children whose health condition is accompanied by a low activity level because of symptoms that preclude much involvement.
Illness resulting in a greater need for care than the child-care staff can provide without compromising the health and safety of the other children as determined by the child-care provider	
Fever	Accompanied by behavior changes or other signs or symptoms of illness until medical professional evaluation finds the child able to be included at the facility
Symptoms and signs of possibly severe illness including lethargy, uncontrolled coughing, inexplicable irritability or persistent crying, difficult breathing, wheezing, or other unusual signs for the child	Until evaluation by a medical professional finds the child able to be included at the facility
Diarrhea	Children whose stools remain loose but who, otherwise, seem well and whose stool cultures are negative need not be excluded. Children with diarrheal illness of infectious origin generally may be allowed to return to child care once the diarrhea resolves, except children with positive cultures for *Salmonella typhi* (3 negative stool cultures required for inclusion), *Shigella*, or *E. coli 0157:H7* (2 negative stool cultures required for inclusion).
Blood in stool	Not explained by dietary change, medication, or hard stools
Vomiting illness	2 or more episodes of vomiting in the previous 24 hr until vomiting resolves or until a health care provider determines that the cause of the vomiting is not contagious and the child is not in danger of dehydration
Abdominal pain	Persistent (continues more than 2 hr) or intermittent associated with fever or other signs or symptoms
Mouth sores with drooling	Unless a health care professional or health department official determines that the child is noninfectious
Rash with fever or behavior changes	Until a physician determines that these symptoms do not indicate a communicable disease
Purulent conjunctivitis	Defined as pink or red conjunctiva with white or yellow eye discharge, until after treatment has been initiated
Pediculosis (head lice)	Exclusion at the end of the day is appropriate
Scabies	Until after treatment has been completed
Tuberculosis	Until a health care provider or health official states that the child is on appropriate therapy and can attend child care
Impetigo	Until 24 hr after treatment has been initiated
Strep throat	Or other streptococcal infection until 24 hours after initial antibiotic treatment and cessation of fever
Varicella-zoster (chickenpox)	Until all sores have dried and crusted (usually 6 days)
Pertussis	Until 5 days of appropriate antibiotic treatment (currently erythromycin, which is given for 14 consecutive days) has been completed
Mumps	Until 9 days after onset of parotid gland swelling
Hepatitis A virus	Until 1 wk after onset of illness, jaundice, or as directed by the health department when passive immunoprophylaxis (currently, immune serum globulin) has been administered to appropriate children and staff members
Measles	Until 4 days after onset of rash
Rubella	Until 6 days after onset of rash
Unspecified respiratory tract illness	
Shingles (herpes zoster)	
Herpes simplex	
CONDITIONS THAT DO NOT REQUIRE EXCLUSION	**COMMENTS**
Presence of bacteria or viruses in urine or feces in the absence of illness symptoms, like diarrhea	Exceptions include children infected with highly contagious organisms capable of causing serious illness
Nonpurulent conjunctivitis	Pink conjunctiva with a clear, watery eye discharge and without fever, eye pain, or eyelid redness
Rash without fever and without behavioral changes	
CMV infection	
Hepatitis B virus carrier state	Provided that children who carry HBV chronically have no behavioral or medical risk factors, such as unusually aggressive behavior (biting, frequent scratching), generalized dermatitis, or bleeding problems
HIV infection	Provided that the health, neurologic development, behavior, and immune status of an HIV-infected child are appropriate as determined on a case-by-case basis by qualified health professionals, including the child's health care provider, who are able to evaluate whether the child will receive optimal care in the specific facility being considered and whether that child poses a potential threat to others
Parvovirus B19 infection	In a person with a normal immune system

Adapted from American Academy of Pediatrics, American Public Health Association, National Resource Center for Health and Safety in Child Care: *Caring for our children: national health and safety performance standards: guidelines for out-of-home child care,* ed 2, Elk Grove Village, IL, 2002, American Academy of Pediatrics, American Public Health Association, and National Resource Center for Health and Safety in Child Care, pp 124–129. http://nrc.uchsc.edu/CFOC/index.html.

on their subsequent health and on the health of their families and community is unknown.

Child Care Licensing, Regulation, and Accreditation

Most child-care centers and preschools and many family daycare providers are subject to state licensing and regulation. Licensing and regulatory requirements for the most part mandate basic health and safety standards, such as sanitary practices, child and provider vaccinations, access to a health care professional, and facilities and equipment safety, as well as basic structural and caregiver characteristics, such as the ratio of children to staff, group sizes, and minimum caregiver education and training requirements.

The types of facilities that are subject to licensure vary by state. Most child-care centers in all 50 states are subject to state health and safety licensure, with Idaho being the last state to require licensure beginning in January 2010. Most states license some types of family child-care homes, although some states only license specific types of family child-care homes, and 3 states do not license these providers at all (Idaho, Louisiana, and New Jersey). Seven states (Arizona, Idaho, Louisiana, New Jersey, Ohio, South Dakota, and Virginia) do not license small family child-care homes, and 11 states (Arkansas, Idaho, Kentucky, Louisiana, Maryland, Maine, North Carolina, New Jersey, Vermont, Washington, and Wisconsin) and the District of Columbia do not license large/group family child-care homes. Louisiana has a registration process for family child-care homes with no more than 6 children, but registration is only required when the provider cares for children subsidized by the federal Child Care and Development Fund (which assists low-income families receiving temporary public assistance, or those needing child care in order to work or receiving training to transition off of public assistance). New Jersey has a voluntary registration process for family child-care homes that is operated by child-care resource and referral agencies in the state.

Many providers are exempt from licensing requirements (often programs operated by a religious organization or a public school), many others are out of compliance, and an unknown proportion of family daycare homes are unregulated and unknown to the public licensure system. Health and safety conditions may be unsatisfactory in unlicensed settings. Furthermore, in most states, licensing and regulatory standards have been found to be inadequate to promote optimal child development, and in many states standards are so low as to endanger child health and safety. Therefore, even licensed providers may be providing care at quality levels far below professional recommendations. For example, the National Association for the Education of Young Children (NAEYC; *www.naeyc.org)* and the National Association for Family Child Care (NAFCC; *www.nafcc.org*) recommend infant-to-staff ratios of no more than 3 to 1. But in 2007, requirements were 3 or 3.5 to 1 in only 3 states, whereas the legally allowable ratio was 5 to 1 in 9 states and 6 to 1 in another 5 states.

A small portion of providers become accredited by NAEYC, NAFCC, or other organizations by voluntarily meeting high-quality, developmentally appropriate, professionally recommended standards. The accreditation process goes far beyond health and safety practices and structural and caregiver characteristics to examine the quality of child-caregiver interactions, which are crucial for child development, as described in the next section. Research indicates that child-care programs that complete voluntary accreditation through NAEYC improve in quality and provide an environment that better facilitates children's overall development. Less than 8% of providers are accredited; this is due in part to a lack of knowledge, resources, and incentives for providers to improve quality, but it may also be due in part to expenses providers incur in the process of becoming accredited.

State child care licensing agencies are playing a larger role in various initiatives designed to improve the quality of child care working through the infrastructure of the early care and education system. Several states' licensing agencies are part of quality initiatives, such as tiered quality strategies (e.g., tiered reimbursement systems for participating providers who achieve levels of quality beyond basic licensing requirements), public funding to facilitate accreditation, professional development systems, and program assessments and technical assistance.

CHILD CARE'S ROLE IN CHILD HEALTH AND DEVELOPMENT

Characteristics of Child Care and Associations with Child Developmental Outcomes

High-quality child care is characterized by warm, responsive, and stimulating interactions between children and caregivers. In high-quality interactions, caregivers express positive feelings toward their children; are emotionally involved, engaged, and aware of the child's needs and sensitive and responsive to their initiations; speak directly with children in a manner that is elaborative and stimulating while being age-appropriate; and ask questions and encourage children's ideas and verbalizations. Structural quality features of the setting, including ratio of children to adults, group size, and caregiver education and training, act indirectly on child outcomes by facilitating high-quality child-caregiver interactions. It would be difficult for even the most sensitive and stimulating provider to engage in high-quality interactions with each child, if she was the sole caregiver of 10 toddlers.

The quality, quantity, and type of child care experienced by young children contribute to child development. Child care use by itself does not affect maternal-child attachment. Only when combined with low maternal sensitivity and responsiveness does poor-quality child care, larger quantities of child care, or multiple child care arrangements predict greater likelihood of insecure attachment.

Adjusting for family factors (parental income, education, race/ethnicity, family structure, parental sensitivity) the quality of child care is a consistent and modest predictor of child outcomes across most domains of development, whereas the quantity of child care is a consistent and modest predictor of social behavior. The type of child care setting, however, is an inconsistent, modest predictor of cognitive and social outcomes. Specifically in regards to quality, children who experience higher-quality child care perform better than other children on cognitive, language, and academic skill tests and, at some points in early childhood, show more prosocial skills and fewer behavior problems and negative peer interactions. Parenting quality, however, matters far more. Compared to the effects for child care, which are relatively consistent and modest in magnitude, the effects of parenting quality on the same outcomes are very consistent and strong, being about twice as strong as the effects of child care quality.

The effects of quantity and type of child care on child development are less strong and less consistent. Quantity of child care is related only to social outcomes. Children who spend more time in any kind of child care are rated or observed at some points in the preschool period to display more problem behaviors, more teacher-child conflict, and more negative behaviors in interactions with friends. The magnitudes of these effects of child care hours on social outcomes are modest. Type of care shows mixed associations with child outcomes. Although findings vary across age, children who experience more center care have stronger cognitive, language, and memory skills and display more positive behaviors in interactions with a friend, but also show fewer prosocial skills and more behavior problems. These effects of center-based care on child outcomes are less consistent and more modest in magnitude compared to other reported effects.

Despite the importance of high-quality child care for child development, several large studies have found that most U.S. child care is of "poor to mediocre" quality. In one study, only 14% of centers (8% of center-based infant care) were found to provide developmentally appropriate care, while 12% scored at

minimal levels that compromised health and safety (40% for infant care). In another study, 58% of family daycare homes provided adequate or custodial care, and only 8% provided good care. Children with the greatest amount of family risk may be the most likely to receive child care that is substandard in quality. Many children from lower-risk families also receive lower-quality care, and despite their advantages at home, these children may not be protected from the negative effects of poor-quality care.

Affordable, accessible, high-quality child care is hard to find. Middle-class families spend about 6% of their annual income on child care expenses, while poor families spend about 33% (on par with housing expenses). Infant and toddler care is particularly expensive with fewer available slots. In addition to the stress of meeting such a high expense, many parents worry that their child will feel unhappy in group settings, will suffer from separation from the parents, or will be subjected to neglect or abuse. This worry is especially likely among low-income parents with more risk factors, fewer resources, and fewer high-quality options available. Parents are the purchasers but not the recipients of care, and are not in the best position to judge its quality. Many parents are first-time purchasers of child care with little experience and very immediate needs, selecting care in a market that does little to provide them with useful information about child care arrangements. In many states, efforts are underway to improve quality and provide parents with quality information, but most states do not have a quality rating and information system, and programs in states that do are still emerging, and testing of effectiveness is still underway. To inform their care decisions, parents may turn to their child's pediatrician as the only professional with expertise in child development with whom they have regular and convenient contact.

Child Care and Child Health

A disproportionate number of sudden infant death syndrome (SIDS) deaths occur in child-care centers or family-based child-care homes (approximately 20%). Infants who are back-sleepers at home, but are put to sleep on their fronts in child-care settings, have a higher risk of SIDS. Providers and parents should be made aware of the importance of placing infants on their backs to sleep.

Children enrolled in child care are also of an age that places them at increased risk for acquiring infectious diseases. Participation in group settings elevates exposure. Children enrolled in such settings have a higher incidence of illness (e.g., upper respiratory tract infections, otitis media, diarrhea, hepatitis A infections, skin conditions, and asthma) than those cared for at home, especially in the preschool years. However, a review of correlational and experimental research found that these illnesses had no long-term adverse consequences. Child-care providers that follow child care licensure guidelines for handwashing, diapering, food handling, and manage child illness appropriately can reduce communicable illnesses.

There is debate about whether child care exposure serves as a risk or protective factor for asthma. One cross-sectional study found that preschoolers in child care had increased risk of the common cold and otitis media, and children who began child care before the age of 2 yr had increased risk of developing recurrent otitis media and asthma. However, a longitudinal study found that children who were exposed to older children at home or to other children at child care during the first 6 mo of life were less likely to have frequent wheezing from age 6-13 yr, suggesting that child care exposure may protect against the development of asthma and frequent wheezing later in childhood. A 10-yr follow up of a birth cohort found no association between child care attendance and respiratory infections, asthma, allergic rhinitis, or skin prick test reactivity. Another study found that in the first year of elementary school, children who had attended child care had fewer absences from school, half as many episodes of asthma, and less acute respiratory illness than their peers who had never attended child care. These results are perhaps related to protection against respiratory illness as a result of early exposure or a shift in the age-related peak of illness, though selection of illness-prone children into home care may play a role. Other factors may also be relevant to this issue, such as children in child care potentially being less exposed to passive smoking than children at home.

Child Care and Children with Special Needs

The needs of children with mental, physical, or emotional disabilities who, because of their chronic illness, require special care and instruction may require particular attention when it comes to their participation in most child-care settings. Guiding principles of services for children with disabilities advocate supporting children in natural environments, including child care. Furthermore, the Americans with Disabilities Act (ADA) and Section 504 of the Rehabilitation Act of 1973 prohibit discrimination against children and adults with disabilities by requiring equal access to offered programs and services.

Although many child-care providers and settings are unprepared to identify or administer services for children with special needs, child care could be utilized for delivery of support services to these children and/or for linking families to services, such as early intervention and doctor referrals. Further, pediatricians can draw upon child-care providers to help provide important evaluative data regarding a child's well-being, since these providers have extensive daily contact with the child and may have broad, professional understanding of normative child development. A child-care provider may be the first to identify a child's potential language delay. Child-care providers are also necessary and valuable partners in the development and administration of early intervention service plans.

Children with special needs may be eligible for services under the Individuals with Disabilities Education Act (IDEA). The purpose of this law is to provide "free appropriate public education," regardless of disability or chronic illness to all eligible children birth to 21 yr in a natural and/or least restrictive environment. Eligible children include those with mental, physical, or emotional disabilities who, because of their disability or chronic illness, require special instruction in order to learn. As a part of these services, a formal plan of intervention is to be developed by the service providers, families, and the children's health care providers. Federal funds are available to implement a collaborative early intervention system of services for eligible infants and toddlers between the ages of birth and 3 yr and their families. These services include screening, assessment, service coordination, and collaborative development of an **individualized family service plan (IFSP).** The IFSP describes early intervention services for the infant or toddler and family including family support and the child's health, therapeutic, and educational needs. An understanding of the child's routines and real-life opportunities and activities, such as eating, playing, interacting with others, and working on developmental skills, is crucial to enhancing a child's ability to achieve the functional goals of the IFSP. Therefore, it is critical that child-care providers be involved in IFSP development or revision, with parental consent. Child-care providers should also become familiar with the child's IFSP and understand the providers' role and the resources available to support the family and child-care provider.

Additionally, IDEA provides support for eligible preschool age children to receive services through the local school district. This includes development of a written **individualized education program (IEP)**, with implementation being the responsibility of the local education agency in either a public or private preschool setting. As with IFSPs, child-care providers should become familiar with the preschooler's special needs as identified in the IEP and may become involved, with parental consent, in IEP development and review meetings. In cases where children may have or be at risk of developmental delays, a diagnosis is important for

Table 15-2 CHILD CARE INFORMATION RESOURCES

ORGANIZATION	SPONSOR	WEBSITE AND CONTACT INFORMATION
Child Care Aware	National Association of Child Care Resource and Referral Agencies (NACCRRA)	*http://www.childcareaware.org* 800-424-2246
Child Care and Development Fund	Child Care Bureau, Office of Family Assistance, U.S. Administration for Children and Families	*http://www.acf.hhs.gov/programs/ccb/index.html*
Healthy Child Care America	American Academy of Pediatrics (AAP)	*http://www.healthychildcare.org*
National Association for Family Child Care (NAFCC)		*http://www.nafcc.org*
National Association for Sick Child Daycare (NASCD)		*http://www.nascd.com*
National Association for the Education of Young Children (NAEYC)		*http://www.naeyc.org*
National Child Care Information Center (NCCIC)	U.S. Department of Health and Human Services, Administration for Children & Families Child Care Bureau	*http://www.nccic.org*
National Resource Center for Health and Safety in Child Care (NRC)		*http://nrc.uchsc.edu* 800-598-KIDS (5437) For the 2002 report from the AAP, APHA, & NRC, *Caring for Our Children: National Health and Safety Performance Standards: Guidelines for Out-of-Home Child Care,* 2nd ed, go to: *http://nrc.uchsc.edu/CFOC/index.html*

obtaining and coordinating services and further evaluation. To this end, pediatricians can partner with child-care providers to screen and monitor children's behavior and development.

ROLE OF PEDIATRIC PROVIDERS IN CHILD CARE

Pediatricians can promote successful child care experiences for their young patients in several ways, including helping parents understand child-care issues, helping children with disabilities and their families have successful child-care experiences, and consulting to child-care/early intervention and education providers.

Advising Parents on Child Care Selection

Insufficient organized professional guidance in choosing child care is available. Pediatricians can help parents understand the importance for their child's development of selecting high-quality care by describing how it looks and providing referrals and tips on how to find and select high-quality child care (Table 15-2). In addition, pediatricians can help parents determine how to adjust child care arrangements to best meet their child's specific needs (e.g., allergies, eating and sleeping habits). For most parents, finding child care that they can afford, access, manage, and accept as a good environment for their child is a very difficult process and one many parents find distressing. Many parents are also worried about how their child will fare in child care, (e.g., Will their child feel distressed by group settings, suffer from separation from the parents, or even be subjected to neglect or abuse?). These worries are especially likely among low-income parents with fewer family and community resources to draw upon. A few parents may think of child care only as babysitting, and may not consider the consequences for their child's cognitive, linguistic, and social development, focusing solely on whether the child is safe and warm. These parents may be less likely to select a high-quality child care arrangement, which is especially problematic if the family is facing socioeconomic challenges that already place them at risk of receiving lower-quality care for their children. For these parents, it is vital to stress the importance of quality and its implications for their child's cognitive, language, and behavioral development and school readiness.

Advising Parents on Child Care Health Issues

Parents of infants should be advised to ensure that child-care providers put infants on their back to sleep to prevent SIDS. Further, when children are ill, parents should be advised to follow guidelines for inclusion and exclusion (see Table 15-1). Parents may disagree with child-care staff about whether a child meets or does not meet the exclusion criteria. However, professional guidelines state that "*if the reason for exclusion relates to the child's ability to participate or the caregiver's ability to provide care for the other children, the child-care provider is entitled to make this decision and cannot be forced by a parent to accept responsibility for the care of an ill child. If the reason for exclusion relates to a decision about whether the child has a communicable disease that poses a risk to the other children in the group, different health care professionals in the community might give conflicting opinions. In these cases, the health department has the legal authority to make a determination.*" Pediatricians should emphasize the importance of following vaccination schedules; most states require compliance for children to participate in licensed group child-care settings.

Helping Children with Special Needs

Pediatricians should work with parents and communicate with other service providers and early intervention staff to identify problems, remove access barriers, and coordinate service delivery for children with special needs. They should also encourage involvement of parents and child-care providers in IFSP or IEP plan development.

Consulting and Partnering with Child-Care Providers

Most state regulations mandate that licensed programs have a formal relationship with a health care provider. Pediatricians can provide consultation to child-care providers about measures to protect and maintain the health and safety of children and staff. This may include consultation regarding promoting practices to prevent SIDS; preventing and reducing the spread of communicable disease; reducing allergen, toxin, and parasite exposure; ensuring vaccinations for children and staff; removing environmental hazards; and preventing injuries.

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Chapter 16
Loss, Separation, and Bereavement

Janet R. Serwint

All children will experience involuntary separations from, illness, and/or death of loved ones at some time in their lives. Parents and children may turn to their pediatrician and other health care professionals for help following various types of personal losses. Relatively brief separations of children from their parents, such as vacations, usually produce minor transient effects, but more enduring and frequent separation may cause sequelae. The potential impact of each event must be considered in light of the age and stage of development of the child, the particular relationship with the absent person, and the nature of the situation. As a trustworthy, familiar resource, pediatricians are uniquely positioned to offer information, support, and guidance, and to facilitate coping.

SEPARATION AND LOSS

Separations may be due to temporary causes, such as vacations, parental job restrictions, natural disasters, or parental or sibling illness requiring hospitalization. More long-term separations occur due to divorce, placement in foster care, or adoption, while permanent separation may occur due to death. The initial reaction of young children to separation of any duration may involve crying, either of a tantrum-like, protesting type or of a quieter, sadder type. Children's behavior may appear subdued, withdrawn, fussy, or moody, or they may demonstrate resistance to authority. Specific problems may include poor appetite, behavior issues such as acting against caregiver requests, reluctance to go to bed, sleep problems, or regressive behavior, such as requesting a bottle or bed-wetting. School-aged children may experience impaired cognitive functioning and poor performance in school. Some children may repeatedly ask for the absent parent and question when he or she will return. The child may go to the window or door or out into the neighborhood to look for the absent parent; a few may even leave home or their place of temporary placement to search for their parents. Other children may not refer to the parental absence at all.

A child's response to reunion may surprise or alarm an unprepared parent. A parent who joyfully returns to the family may be met by wary or cautious children. After a brief interchange of affection, children may seem indifferent to the parent's return. This response may indicate anger at being left and wariness that the event will happen again, or the child may feel as if he or she caused the parent's departure due to magical thinking. If the mother who frequently says "Stop it, or you'll give me a headache" is hospitalized, the child may feel at fault and guilty. As a result of these feelings, children may seem to be more closely attached to the other present parent than to the absent one, or even to the grandparent or baby sitter who cared for them during their parent's absence. Some children, particularly younger ones, may become more clinging and dependent than they were before the separation, while continuing any regressive behavior that occurred during the separation. Such behavior may engage the returned parent more closely and help to re-establish the bond that the child felt was broken. Such reactions are usually transient and within 1-2 wk, children will have recovered their usual behavior and equilibrium. Recurrent separations may tend to make children more wary and guarded about re-establishing the relationship with the repeatedly absent parent, and these traits may affect other personal relationships. Parents should be advised not try to ameliorate a child's behavior by threatening to leave.

DIVORCE

More sustained experiences of loss, such as divorce or placement in foster care, can give rise to the same kinds of reactions noted earlier, but they are more intense and possibly more lasting. Currently in the USA, about 40% of marriages end in divorce. Divorce has been found to be associated with negative parent functioning such as parental depression and feelings of incompetence, negative child behavior such as noncompliance and whining, and negative parent-child interaction such as inconsistent discipline, decreased communication, and decreased affection. Greater childhood distress is associated with greater parental distress. Continued parental conflict and loss of contact with the noncustodial parent, usually the father, is common. Two of the most important factors that contribute to morbidity of the children in a divorce include parental psychopathology and disrupted parenting before the separation. The year following the divorce is the period when problems are most apparent; these problems tend to dissipate over the next 2 yr. Depression may be present 5 yr later, and educational or occupational decline may occur even 10 yr later. It is difficult to sort out all of the confounding factors. Children may suffer when exposed to parental conflict that continues after divorce, and in some cases may escalate. The degree of inter-parental conflict may be the most important factor associated with child morbidity. A continued relationship with the noncustodial parent, as long as there is minimal inter-parental conflict, was a factor associated with more positive outcomes.

School-aged children may respond with evident depression, may seem indifferent, or may be markedly angry. Other children appear to deny or avoid the issue, behaviorally or verbally. Most children cling to the hope that the actual placement or separation is not real and is only temporary. The child may experience guilt by feeling that the loss, separation, or placement represents rejection and perhaps punishment for misbehavior. Children may protect a parent and assume guilt, believing that their own "badness" caused the parent to depart. Outwardly blaming parents may be perceived by a child as fairly risky; parents who discover that a child harbors resentment might punish him or her further for these thoughts or feelings. Children who feel that their misbehavior caused their parents to separate or become divorced have the fantasy that their own trivial or recurrent behavioral patterns caused their parents to become angry with each other. Some children have behavioral or psychosomatic symptoms and unwittingly adopt a "sick" role as a strategy for reuniting their parents.

In response to divorce of parents and the subsequent separation and loss, older children and adolescents commonly show intense anger. Five years after the breakup, approximately one third of children report intense unhappiness and dissatisfaction

with their live and their reconfigured families, another one third show clear evidence of a satisfactory adjustment, whereas the remaining third demonstrate a mixed picture, with good achievement in some areas and faltering achievement in others. After 10 yr, approximately 45% do well, but 40% may have academic, social, and/or emotional problems. As adults, some are reluctant to form intimate relationships, fearful of repeating their parents' experience. Parental divorce has a moderate long-term negative impact on the adult mental health status of children who had experienced it, even after controlling for changes in economic status and problems before divorce. Good adjustment of children after a divorce is related to ongoing involvement with 2 psychologically healthy parents who minimize conflict, and to the siblings and other relatives who provide a positive support system. Divorcing parents should be encouraged to avoid adversarial processes and to use a trained mediator to resolve disputes if needed. Joint custody arrangements may reduce ongoing parental conflict, but children in joint custody may feel overburdened by the demands of maintaining a strong presence in 2 homes.

The primary care provider may provide an important role for divorcing and divorced parents and their children. When asked about the effects of divorce, parents should be informed that different children may have different reactions, but that the parents' behavior and the way they interact with each other will have a major and long term effect on the child's adjustment. The continued presence of both parents in the child's life, with minimal inter-parental conflict, is most beneficial to the child.

MOVE/FAMILY RELOCATION

A significant proportion of the population of the USA changes residence each year. The effects of this movement on children and families are frequently overlooked. For children, the move is essentially involuntary and out of their control. When such changes in family structure as divorce or death precipitate moves, children face the stresses created by both the precipitating events and the move itself. Parental sadness surrounding the move may transmit unhappiness to the children. Children who move lose their old friends, the comfort of a familiar bedroom and house, and their ties to school and community. They not only must sever old relationships but also are faced with developing new ones in new neighborhoods and new schools. Children may enter neighborhoods with different customs and values, and because academic standards and curricula vary among communities, children who have performed well in one school may find themselves struggling in a new one. Frequent moves during the school years are likely to have adverse consequences on social and academic performance.

Migrant children and children who emigrate from other countries present with special circumstances. These children not only need to adjust to a new house, school, and community but also need to adjust to a new culture and, in many cases, a new language. Because children have faster language acquisition than adults, they may function as translators for the adults in their families. This powerful position may lead to role reversal and potential conflict within the family. In the evaluation of migrant children and families, it is important to ask about the circumstances of the migration, including legal status, violence or threat of violence, conflict of loyalties, and moral, ethical, and religious differences.

Parents should prepare children well in advance of any move and allow them to express any unhappy feelings or misgivings. Parents should acknowledge their own mixed feelings and agree that they will miss their old home while looking forward to a new one. Visits to the new home in advance are often useful preludes to the actual move. Transient periods of regressive behavior may be noted in preschool children after moving, and these should be understood and accepted. Parents should assist the entry of their children into the new community, and whenever possible, exchanges of letters and visits with old friends should be encouraged.

SEPARATION DUE TO HOSPITALIZATION

Potential challenges for hospitalized children include coping with separation, adapting to the new hospital environment, adjusting to multiple caregivers, seeing very sick children, and sometimes experiencing the disorientation of intensive care, anesthesia, and surgery. To help mitigate potential problems, a preadmission visit to the hospital is important to allow the child to meet the people who will be offering care and ask questions about what will happen. Parents of children younger than 5-6 yr of age should room with the child if feasible. Older children may also benefit from parents staying with them while in the hospital, depending on the severity of their illness. Creative and active recreational or socialization programs with child life workers, chances to act out feared procedures in play with dolls or mannequins, and liberal visiting hours including visits from siblings are all helpful. Sensitive, sympathetic, and accepting attitudes toward children and parents by the hospital staff are very important. Health care providers need to remember that parents have the best interest of their children at heart and know their children the best. Whenever possible, school assignments and tutoring for the hospitalized children should be available in order to engage the child intellectually and prevent them from falling behind in their scholastic achievements.

The psychologic aspects of illness should be evaluated from the outset, and physicians should act as a model for parents and children by showing interest in a child's feelings, allowing them a venue for expression, and demonstrating that it is possible and appropriate to communicate discomfort in verbal, symbolic language. Continuity of medical personnel may be reassuring to the child and family.

PARENTAL/SIBLING DEATH

Approximately 5-8% of U.S. children will experience parental death; rates are much higher in other parts of the world more directly affected by war, AIDS, and natural disasters (see Chapter 36.2). Anticipated deaths due to chronic illness may place a 1 significant strain on a family, with frequent bouts of illness, hospitalization, disruption of normal home life, absence of the ill parent, and perhaps more responsibilities placed on the child. Additional strains include changes in daily routines, financial pressures, and the need to cope with aggressive treatment options.

Children can and should continue to be involved with the sick parent or sibling, but they need to be prepared for what they will see in the home or hospital setting. The stresses that a child will face include visualizing the physical deterioration of the family member, helplessness, and emotional liability. Forewarning the child that the family member may demonstrate physical changes, such as appearing thinner or losing hair will help the child to adjust. These warnings, combined with simple yet specific explanations of the need for equipment such as a nasogastric tube for nutrition, an oxygen mask, or a ventilator, will help lessen the child's fear. The primary care provider can be of great help in addressing these issues. Children should be honestly informed of what is happening, in language they can understand, allowing them choices, but with parental involvement in decision-making. They should be encouraged, but not forced to see their ill family member. Parents who are caring for a dying spouse or child may be too emotionally depleted to be able to tend to their healthy child's needs or to continue regular routines. Children of a dying parent may suffer the loss of security and belief in the world as a safe place, and the surviving parent may be inclined to impose his or her own need for support and comfort onto the child. However, the well parent and caring relatives must keep in mind

that children need to be allowed to remain children, with appropriate support and attention. Sudden, unexpected deaths lead to more anxiety and fear, because there was no time for preparation and uncertainty as to explanations.

GRIEF AND BEREAVEMENT

Grief is a personal, emotional state of bereavement or an anticipated response to loss, such as a death. Common reactions include sadness, anger, guilt, fear, and at times, relief. The normality of these reactions needs to be emphasized. Most bereaved families remain socially connected and expect that life will return to some new, albeit different, sense of normalcy. The pain and suffering imposed by grief should never be automatically deemed "normal" and thus neglected or ignored. In uncomplicated grief reactions, the steadfast concern of the pediatrician can help promote the family's sense of well-being. In more distressing reactions (such as those seen in traumatic grief of sudden deaths), the pediatrician may be a major, first-line force in helping children and families address their loss. Pediatricians' involvement has become even more important since death of children has become less common. Fewer families have family members or friends who understand this experience. Hence, they turn to health care professionals more commonly for advice and support.

Participation in the care of a child with a life-threatening or terminal illness is a profound experience. Parents experience much anxiety and worry during the final stages of their child's life. In one study at a children's hospital, 45% of children dying from cancer died in the pediatric intensive care unit, and parents report that 89% of their children suffered "a lot" or "a great deal" during the last month of life. Physicians consistently underreport children's symptoms in comparison to parents' reports. Better ways are needed to provide for dying children, and to maintain honest and open communication, provide appropriate pain management, and meet the families' wishes as to the preferred location of the child's death, in some cases in their own home. Inclusion of multiple disciplines, such as hospice, clergy, nursing, pain service, child life, and social work, often helps to fully support families during this difficult experience.

The practice of withholding information from children and parents regarding a child's diagnosis and prognosis has generally been abandoned as physicians have learned that protecting parents and patients from the seriousness of their child's condition does not alleviate concerns and anxieties. Even very young children may have a real understanding of their illness. Children who have serious diseases and are undergoing aggressive treatments and medication regimens, but are told by their parents that they are okay, are not reassured by their parents. These children understand that something serious is happening to them, and they are often forced to suffer in silence and isolation because the message they have been given by their parents is to not discuss it and to maintain a cheerful demeanor. Children have the right to know their diagnosis and should be informed early in their treatment. The content and depth of the discussion needs to be tailored to the child's personality and developmental level of understanding. Parents have choices as to how to orchestrate the disclosure. Parents may want to be the ones to inform the child themselves, may choose for the pediatric health care provider to do so, or may do it in partnership with the pediatrician.

A death, especially the death of a family member, is the most difficult loss for a child. Many changes in normal patterns of functioning may occur, including loss of love and support from the deceased family member, a change in income, the possible need to relocate, less emotional support from surviving family members, altering of routines, and a possible change in status from sibling to only child. Relationships between family members may become strained, and children may blame themselves or other family members for the death of a parent or sibling. Bereaved children may exhibit many of the emotions discussed earlier due to loss, in addition to behaviors of withdrawal into their own world, sleep disturbances, nightmares, and symptoms such as headache, abdominal pains, or possibly symptoms similar to those of the family member who has died. Children 3-5 yr of age who have experienced a family bereavement may show regressive behaviors such as bed-wetting and thumb sucking. School age children may exhibit nonspecific symptoms such as headache, abdominal pain, chest pain, fatigue, and lack of energy. Children and adolescents may also demonstrate enhanced anxiety should these symptoms resemble those of the family member who died. The presence of secure and stable adults who can meet the child's needs and who permit discussion about the loss is most important in helping a child to grieve. The pediatrician should help the family understand this necessary presence and encourage the protective functioning of the family unit. More frequent visits to the health care professional may be necessary to address these symptoms and provide reassurance when appropriate.

Death, separation, and loss as a result of natural catastrophes and man-made disasters have become increasingly common events in children's lives. Exposure to such disasters occurs either directly or indirectly, where the event is experienced through the media. Examples of indirect exposure include televised scenes of hurricanes, tsunamis, and the terrorist attacks in the USA on 9/11/01, with the subsequent news stories about anthrax and heightened states of alert. Children who experience personal loss in disasters tend to watch more television coverage than children who do not. However, children without a personal loss watch as a way of participating in the event and may thus experience repetitive exposure to traumatic scenes and stories. The loss and devastation for a child who personally lives through a disaster is significant; the effect of the simultaneous occurrence of disaster and personal loss complicates the bereavement process as grief reactions become interwoven with post-traumatic stress symptoms. After a death that occurs as a result of aggressive or traumatic circumstances, access to expert help may be required. Under conditions of threat and fear, children seek proximity to safe, stable, protective figures.

It is important for parents to grieve with their children. Some parents feel they want to protect their children from their grief, so they put on an outwardly brave front or don't talk about the deceased family member. Instead of the desired protective effect, however, the child receives the message that demonstrating grief or talking about death is wrong, leading him or her to feel isolated, to grieve privately, or to delay grieving. The child may also conclude that the parents didn't really care about the deceased since they have forgotten him or her so easily or demonstrate no emotion. The parents' efforts to avoid talking about the death may cause them to isolate themselves from their children at a time when they are most needed. Children need to know that their parents love them and will continue to protect them. Children need opportunities to talk about their relative's death and associated memories. A surviving sibling may feel guilty simply because he or she has survived, especially if the death was due to an accident that involved both children. Siblings' grief, especially when compounded by feelings of guilt, may be manifested by regressive behavior or anger. Parents should be informed of this possibility and encouraged to discuss the possibility with their children.

DEVELOPMENTAL PERSPECTIVE

Children's responses to death reflect the family's current culture, their past heritage, experiences, and the sociopolitical environment. Personal experience with terminal illness and dying may also facilitate children's comprehension of death and familiarity with mourning. Developmental differences in children's efforts to make sense of and master the concept and reality of death do exist and profoundly influence their grief reactions.

Children **younger than 3 yr** of age have little or no understanding of the concept of death. Despair, separation anxiety, and detachment may occur at the withdrawal of nurturing caretakers. Young children may respond in reaction to observing distress in others, such as a parent or sibling who is crying, withdrawn, or angry. Young children also express signs and symptoms of grief in their emotional states, such as irritability or lethargy, and in severe cases, mutism. If the reaction is severe, failure to thrive may occur.

Preschool children are in the preoperational cognitive stage, in which communication takes place through play and fantasy. They do not show well-established cause-and-effect reasoning. They feel that death is reversible, analogous to someone going away. In attempts to master the finality and permanence of death, preschoolers frequently ask unrelenting, repeated questions about when the person who died will be returning. This makes it difficult for parents, who may become frustrated because they don't understand why the child keeps asking and do not like the constant reminders of the person's death. The primary care provider has a very important role in helping families understand the child's struggle to comprehend death. Preschool children typically express magical explanations of death events, sometimes resulting in guilt and self-blame ("He died because I wouldn't play with him." "She died because I was mad at her."). Some children have these thoughts, but do not express them verbally due to embarrassment or guilt. Parents and primary care providers need to be aware of magical thinking and must reassure preschool children that their thoughts had nothing to do with the outcome. Children this age are often frightened by prolonged, powerful expressions of grief by others. Children conceptualize events in the context of their own experiential reality, and therefore consider death in terms of sleep, separation, and injury. Young children express grief intermittently and show marked affective shifts over brief periods. Regression, accompanied by longing, sadness, and anger, may accompany grief.

Younger school-aged children think concretely, recognize that death is irreversible but feel it will not happen to them or affect them, and begin to understand biologic processes of the human body ("You'll die if your body stops working"). Information gathered from the media, peers, and parents forms lasting impressions. Consequently, they may ask candid questions about death that adults will have difficulty addressing ("He must have been blown to pieces, huh?").

Children 9 yr of age and older do understand that death is irreversible and that it may involve them or their families. These children tend to experience more anxiety, overt symptoms of depression, and somatic complaints than do younger children. School-aged children are often left with anger focused on the loved one, those who could not save the deceased, or those presumed responsible for the death. Contact with the pediatrician may provide great reassurance, especially for the child with somatic symptoms, and particularly when the death followed a medical illness. School and learning problems may also occur, and these reactions are often linked to difficulty concentrating or preoccupation with the death. Close collaboration with the child's school may provide important diagnostic information and offer opportunities to mobilize intervention or support.

At 12-14 yr of age, children begin to use symbolic thinking, reason abstractly, and analyze hypothetical, or "what if," scenarios systematically. Death and the end of life become concepts, rather than events. Teenagers are often ambivalent about dependence and independence and may withdraw emotionally from surviving family members, only to mourn in isolation. Adolescents begin to understand complex physiologic systems in relationship to death. Since they are often egocentric, they may be more concerned about the impact of the death on themselves than about the deceased or other family members. Fascination with dramatic, sensational, or romantic death sometimes occurs and may find expression in copycat behavior, such as cluster suicides, as well as competitive behavior to forge emotional links to the deceased person ("He was my best friend."). Somatic expression of grief may revolve around highly complex syndromes (eating disorders or conversion reactions) as well as symptoms limited to the more immediate perceptions, as with younger children (stomachaches). Quality of life takes on meaning, and the teenager develops a focus on the future. Depression, resentment, mood swings, rage, and risk-taking behaviors can emerge as the adolescent seeks answers to questions of values, safety, evil, and fairness. Alternately, the adolescent may seek philosophical or spiritual explanations ("being at peace") to ease their sense of loss. The death of a peer may be especially traumatic.

Families often struggle with how to inform their children of the death of a family member. The answer depends on the child's developmental level. It is best to avoid misleading euphemisms and metaphor. A child who is told that the relative who died "went to sleep" may become frightened of falling asleep, resulting in sleep problems or nightmares. Children can be told that the person is "no longer living" or "no longer moving or feeling." Using examples of pets that have died sometimes can help children gain a more realistic idea of the meaning of death. Parents who have religious beliefs may comfort their children with explanations, such as "Your sister's soul is in heaven" or "Grandfather is now with God," provided those beliefs are honestly held. If these are not religious beliefs that the parents share, children will sense the insincerity and experience anxiety rather than the hoped-for reassurance. Children's books about death can provide an important source of information, and when read together, these books may help the parent to find the right words, while addressing the child's needs.

ROLE OF THE PEDIATRICIAN IN GRIEF

The pediatrician has an important role in assisting grieving families, because death has become an uncommon experience in our society. Whereas in earlier times, parents could turn to other family members or friends who had had a similar experience, bereaved parents are now more likely to turn to their physician, hospital staff, or medical home staff for support. The pediatric health care provider who has had a longitudinal relationship with the family will be an important source of support in the disclosure of bad news and critical decision-making, during both the dying process and the bereavement period.

The involvement of the health care provider may include being present at the time the diagnosis is disclosed, at the hospital or home at the time of death, being available to the family by phone during the bereavement period, sending a sympathy card, attending the funeral, and/or scheduling a follow-up visit. Attendance at the funeral sends a strong message that the family and their child are important, respected by the health care provider, and can also help the pediatric health care provider to grieve and reach personal closure about the death. A family meeting 1-3 mo later may be helpful since parents may not be able to formulate their questions at the time of death. This meeting allows the family time to ask questions, share concerns, and review autopsy findings (if one was performed), and allows the health care provider to determine how the parents and family are adjusting to the death.

Instead of leaving the family feeling abandoned by a health care system that they have counted on, this visit allows them to have continued support. This is even more important when the health care provider will be continuing to provide care for surviving siblings. The visit can be used to determine how the mourning process is progressing, detect evidence of marital discord, and evaluate how well surviving siblings are coping. This is also an opportunity to evaluate whether referrals to support groups or mental health providers may be of benefit. Continuing to recognize the child who has died is important. Families appreciate the

receipt of a card on their child's birthday or the anniversary of their child's death.

The health care provider needs to be an educator about disease, death, and grief. The pediatrician can offer a safe environment for the family to talk about painful emotions, express fears, and share memories. By giving families permission to talk and modeling how to address children's concerns, the pediatrician demystifies death. Parents often request practical help. The health care provider can offer families resources, such as literature (both fiction and nonfiction), referrals to therapeutic services, and tools to help them learn about illness, loss, and grief. In this way, the physician reinforces the sense that other people understand what they are going through and helps to normalize their distressing emotions. The pediatrician can also facilitate and demystify the grief process by sharing basic tenets of grief therapy. There is no single right or wrong way to grieve. Everyone grieves differently; mothers may grieve differently than fathers, and children mourn differently than adults. Helping family members to respect these differences and reach out to support each other is critical. Grief is not something to "get over," but a lifelong process of adapting, readjusting, and reconnecting.

Parents may need help in knowing what constitutes normal grieving. Hearing, seeing, or feeling their child's presence may be a normal response. Vivid memories or dreams may occur. The pediatrician can help parents to learn that, although their pain and sadness may seem intolerable, other parents have survived similar experiences, and their pain will lessen over time. The support of the pediatrician, medical home staff, support groups, or individual counselors may be needed during this time.

Pediatricians are often asked whether children should attend the funeral of a parent or sibling. These rituals allow the family to begin their mourning process. Children older than 4 yr of age should be given a choice. If the child chooses to attend, he or she should have a designated, trusted adult, who is not part of the immediate family, to stay with the child, offer comfort, and be willing to leave with the child if the experience proves to be overwhelming. If the child chooses not to attend, he or she should be offered additional opportunities to share in a ritual, go to the cemetery to view the grave, tell stories about the deceased, or obtain a keepsake object from the deceased family member as a remembrance.

In the era of regionalized tertiary care medicine, the primary care provider and medical home staff may not be informed when one of their patients dies in the hospital. Yet, this communication is critically important. Families assume their pediatrician has been notified, and often feel hurt when they don't receive some symbol of condolence. Because of their longitudinal relationship with the family, primary care providers may offer much needed support. There are practical issues, such as the need to cancel previously made appointments and the need to alert office and nursing staff so that they are prepared should the family return for a follow-up visit or for ongoing health maintenance care with the surviving siblings. Even minor illnesses in the surviving siblings may frighten children. Parents may contribute to this anxiety since their inability to protect the child who has died may leave them with a sense of guilt or helplessness. They may seek medical attention sooner or may be hypervigilant in the care of the siblings because of guilt over the other child's death, concern about their judgment, or the need for continued reassurance. A visit to the pediatrician can do a lot to allay their fears.

Clinicians must remain vigilant for risk factors in each family member and in the family unit as a whole. Primary care providers, who care for families over time, know bereft patients' premorbid functioning and can identify those at current or future risk for physical and psychiatric morbidity. Providers must focus on symptoms that interfere with a patient's normal activities and compromise a child's attainment of developmental tasks. Symptom duration, intensity, and severity, in context with the family's culture, can help identify complicated grief reactions in need of therapeutic attention. Descriptive words, such as "unrelenting," "intense," "intrusive," or "prolonged," should raise concern. Total absence of signs of mourning, specifically, an inability to discuss the loss or express sadness, also suggests potential problems.

No specific sign, symptom, or cluster of behaviors identifies the child or family in need of help. Further assessment is indicated if the following occur: (1) persistent somatic or psychosomatic complaints of undetermined origin (headache, stomachache, eating and sleeping disorders, conversion symptoms, symptoms related to the deceased's condition, hypochondriasis); (2) unusual circumstances of death or loss (sudden, violent, or traumatic death; inexplicable, unbelievable, or particularly senseless death; prolonged, complicated illness; unexpected separation); (3) school or work difficulties (declining grades or school performance, social withdrawal, aggression); (4) changes in home or family functioning (multiple family stresses, lack of social support, unavailable or ineffective functioning of caretakers, multiple disruptions in routines, lack of safety); (5) concerning psychologic factors (persistent guilt or blame, desire to die or talk of suicide, severe separation distress, disturbing hallucinations, self-abuse, risk-taking behaviors, symptoms of trauma such as hyperarousal or severe flashbacks, grief from previous or multiple deaths). Children who are intellectually impaired may require additional support.

TREATMENT

Suggesting interventions outside the natural support network of family and friends can often prove useful to grieving families. Bereavement counseling should be readily offered if needed or requested by the family. Interventions that enhance or promote attachments and security, as well as give the family a means of expressing and understanding death, help to reduce the likelihood of future or prolonged disturbance, especially in children. Collaboration between pediatric and mental health professionals can help determine the timing and appropriateness of services.

Interventions for children and families who are struggling to cope with a loss in the community include gestures such as sending a card or offering food to the relatives of the deceased and teaching children the etiquette of behaviors and rituals around bereavement and mutual support. Performing community service or joining charitable organizations, such as fund-raising in memory of the deceased, may be useful. In the wake of a disaster, parents and older siblings can give blood or volunteer in search and recovery efforts. When a loss does not involve an actual death (e.g., parental divorce or geographic relocation), empowering the child to join or start a "divorced kids' club" in school or planning a "new kids in town" party may help. Participating in a constructive activity helps move the family away from a sense of helplessness and hopelessness and helps them to find meaning in their loss.

Psychotherapeutic services may benefit the entire family or individual members. Many support or self-help groups focus on specific types of losses (sudden infant death syndrome, suicide, widow/widowers, or AIDS) and provide an opportunity to talk with other people who have experienced similar losses. Family, couple, sibling or individual counseling may be useful, depending on the nature of the residual coping issues. Combinations of approaches may work well for children or parents with evolving needs. A child may participate in family therapy to deal with the loss of a sibling and use individual treatment to address issues of personal ambivalence and guilt related to the death.

The question of pharmacologic intervention for grief reactions often arises. Explaining that medication does not cure grief and often does not reduce the intensity of some symptoms (separation distress) can help. Although medication can blunt reac-

tions, the psychologic work of grieving still must occur. The pediatrician must consider the patient's premorbid psychiatric vulnerability, current level of functioning, other available supports, and the use of additional therapeutic interventions. Medication, as a first line of defense, rarely proves useful in normal or uncomplicated grief reactions. In certain situations (severe sleep disruption, incapacitating anxiety, or intense hyperarousal), use of an anxiolytic or antidepressant medication for symptom relief and to provide the patient with the emotional energy to mourn may help. Medication used in conjunction with some form of psychotherapy, and in consultation with a psychopharmacologist, has optimal results.

Children who are refugees and may have experienced war, violence, or personal torture deserve special mention. These children, while often resilient, may experience post-traumatic stress disorder if exposures were severe or repeated. Sequelae such as depression, anxiety, and grief need to be addressed, and mental health therapy is indicated. Cognitive behavioral treatment, use of journaling and narratives to bear witness to the experiences, and use of translators may be essential.

SPIRITUAL ISSUES

Responding to patients' and families' spiritual beliefs can help in comforting them during family tragedies. Offering to call members of pastoral care teams or their own spiritual leader can be a real support to them and aid in decision-making. Families have found it important to have their beliefs and their need for hope acknowledged in end-of-life care. The majority of patients report welcoming discussions on spirituality, which may help individual patients cope with illness, disease, dying, and death. In addressing spirituality, physicians need to follow certain guidelines, including maintaining respect for the patient's beliefs, following the patient's lead in exploring how spirituality affects his or her decision-making, acknowledging the limits of their own expertise and role in spirituality, and maintaining their own integrity by not saying or doing anything that violates their own spiritual or religious views. Health care providers should not impose their own religious or antireligious beliefs on patients, but rather should listen respectfully to their patients. By responding to spiritual needs, physicians may better aid their patients and families in end-of-life care and bereavement and take on the role of healers.

SELF-CARE OF THE HEALTH CARE PROVIDER

Just as the death of a child is a very stressful experience for the family, it is also a very powerful one for health care providers. Since the death of a child is contrary to everything for which a pediatrician strives, the death of a patient can cause a grief reaction in physicians that is comparable to the death of a loved one, resulting in emotions of sadness, anger, guilt, and occasionally, relief. A medical culture in which health care providers acknowledge their own grief and mourning and select ways to address it is important. Possibilities include attending the memorial service or funeral, participating in a debriefing with colleagues within the hospital or medical home, and creating opportunities to both mourn the patient's death and celebrate the patient's life. Getting regular exercise, maintaining good nutrition, getting adequate sleep, meditating, spending time with family and friends, taking time for journaling and self-reflection, participating in hobbies, and taking vacations are all examples of self-care. Health care providers have demanding but rewarding jobs. They need to maintain their inner strength and resilience in order to be effective in their profession. The way that a health care professional integrates the death of a child can change this experience from a very tragic and stressful one, leading to burnout, to a rewarding and memorable experience, in which he or she functions as a true healer to a family.

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Chapter 17
Sleep Medicine

Judith A. Owens

INTRODUCTION

Sleep regulation involves the simultaneous operation of two basic highly coupled processes that govern sleep and wakefulness (the "two process" sleep system). The **homeostatic process** ("Process S"), primarily regulates the length and depth of sleep, and may be related to the accumulation of adenosine and other sleep-promoting chemicals ("somnogens"), such as cytokines, during prolonged periods of wakefulness. This sleep pressure appears to build more quickly in infants and young children, thus limiting the duration of sustained wakefulness during the day and necessitating periods of daytime sleep (i.e., naps). The endogenous **circadian rhythm** ("Process C"), influences the internal organization of sleep and timing and duration of daily sleep-wake cycles, and govern predictable patterns of alertness throughout the 24 hr day. The "master circadian clock" that controls sleep-wake patterns is located in the suprachiasmatic nucleus (SCN) in the

ventral hypothalamus; other "circadian clocks" govern the timing of multiple other physiologic systems in the body (e.g., cardiovascular reactivity, hormone levels, renal and pulmonary functions). Because the human circadian clock is actually slightly longer than 24 hr, intrinsic circadian rhythms must are synchronized or "entrained" to the 24-hr day cycle by environmental cues called **zeitgebers**. The most powerful of these zeitgebers is the light–dark cycle; light signals are transmitted to the SCN via the circadian photoreceptor system within the retina (functionally and anatomically separate from the visual system), which switch the body's production of the hormone melatonin off (light) or on (dark) by the pineal gland. Circadian rhythms are also synchronized by other external time cues, such as timing of meals and alarm clocks.

The relative level of sleepiness (sleep propensity) or alertness existing at any given time during a 24-hr period is partially determined by the duration and quality of previous sleep, as well as time awake since the last sleep period (the homeostatic or "sleep drive"). Interacting with this "sleep homeostat" is the 24 hr cyclic pattern or rhythm characterized by clock-dependent periods of maximum sleepiness ("circadian troughs") and maximum alertness ("circadian nadirs"). There are 2 periods of maximum sleepiness, 1 in the late afternoon (3:00-5:00 PM) and one towards the end of the night (3:00-5:00 AM), and 2 periods of maximum alertness, 1 in mid-morning and 1 in the evening, just prior to sleep onset (the so-called second wind).

Another basic principle of sleep physiology relates to the consequences of the failure to meet basic sleep needs, termed insufficient/inadequate sleep or **sleep loss**. Adequate sleep is a biologic imperative that appears necessary for sustaining life as well as for optimal functioning. Slow-wave sleep (SWS) appears to be the most "restorative" form of sleep and rapid eye movement (REM) sleep appears not only to be involved in vital cognitive functions, such as the consolidation of memory, but to be an integral component of the growth and development of the central nervous system (CNS). Adequate amounts of both of these sleep stages are necessary for optimal learning. Partial sleep loss (sleep restriction) on a chronic basis accumulates in what is termed a **sleep debt** and produces deficits equivalent to those seen under conditions of total sleep deprivation. If the sleep debt becomes large enough and is not voluntarily paid back (by obtaining adequate recovery sleep), the body may respond by overriding voluntary control of wakefulness, resulting in periods of decreased alertness, dozing off, and napping, that is excessive daytime sleepiness. The sleep-deprived individual may also experience very brief (several seconds) repeated daytime microsleeps of which he or she may be completely unaware, but which nonetheless may result in significant lapses in attention and vigilance. There is also a relationship between the amount of sleep restriction and performance, with decreased performance correlating with decreased sleep.

Both insufficient quantity and poor quality of sleep in children and adolescents usually result in excessive daytime sleepiness and decreased daytime alertness levels. Sleepiness may be recognizable as drowsiness, yawning, and other classic "sleepy behaviors," but can also be manifested as mood disturbance, including complaints of moodiness, irritability, emotional lability, depression, and anger; fatigue and daytime lethargy, including increased somatic complaints (headaches, muscle aches); cognitive impairment, including problems with memory, attention, concentration, decision-making, and problem solving; daytime behavior problems, including overactivity, impulsivity, and noncompliance; and academic problems, including chronic tardiness related to insufficient sleep and school failure resulting from chronic daytime sleepiness.

To evaluate sleep problems, it is important to have an understanding of what constitutes "normal" sleep in children and adolescents. Sleep disturbances, as well as many characteristics of sleep itself, have some distinctly different features in children from sleep and sleep disorders in adults. In addition, changes in sleep architecture and the evolution of sleep patterns and behaviors reflect the physiologic/chronobiologic, developmental, and social/environmental changes that are occurring across childhood. These trends may be summarized as the gradual assumption of more adult sleep patterns as children mature:

- A decline in the average 24 hr sleep duration from infancy through adolescence, which involves a decrease in both diurnal and nocturnal sleep amounts. There is a dramatic decline in daytime sleep (scheduled napping) by 5 yr, with a less marked and more gradual continued decrease in nocturnal sleep amounts into late adolescence.
- A dramatic decrease in the proportion of REM sleep from birth (50% of sleep) through early childhood into adulthood (25-30%), and a similar initial predominance of SWS that peaks in early childhood, drops off abruptly after puberty (40-60% decline), and then further decreases over the life span. This SWS preponderance in early life has clinical significance; the high prevalence of partial arousal parasomnias (sleepwalking and sleep terrors) in preschool and early school-aged children is related to the relative increased proportion of SWS in this age group.
- Due to the lengthening of the nocturnal ultradian sleep cycle, a concomitant decrease in the number of end-of-cycle arousals across the nocturnal sleep period occurs.
- A gradual shift to a later bedtime and sleep onset time that begins in middle childhood and accelerates in early to mid adolescence.
- Irregularity of sleep/wake patterns characterized by increasingly larger discrepancies between school night and non–school night bedtimes and wake times, and increased weekend oversleep that typically begins in middle childhood and peaks in adolescence.

Normal developmental changes in children's sleep are found in Table 17-1.

COMMON SLEEP DISORDERS

Most sleep problems in children may be broadly conceptualized as resulting from either inadequate duration of sleep for age and sleep needs (insufficient sleep quantity) or disruption and fragmentation of sleep (poor sleep quality) as a result of frequent, repetitive, and brief arousals during sleep. Less common causes of sleep disturbance in childhood involve inappropriate timing of the sleep period (as occurs in circadian rhythm disturbances), or primary disorders of excessive daytime sleepiness (central hypersomnias such as narcolepsy). Insufficient sleep is usually the result of difficulty initiating (delayed sleep onset) and/or maintaining sleep (prolonged night wakings), but, especially in older children and adolescents, may also represent a conscious lifestyle decision to sacrifice sleep in favor of competing priorities, such as homework and social activities. The underlying causes of sleep onset delay/prolonged night wakings or sleep fragmentation may in turn be related to primarily behavioral factors (bedtime resistance resulting in shortened sleep duration) and/or medical causes (obstructive sleep apnea causing frequent, brief arousals).

It should be noted that certain pediatric populations are relatively more vulnerable to acute or chronic sleep problems. These include children with medical problems, including chronic illnesses, such as cystic fibrosis, asthma, and rheumatoid arthritis, and acute illnesses, such as otitis media; children taking medications or ingesting substances with stimulant (e.g., psychostimulants, caffeine), sleep-disrupting (e.g., corticosteroids), or daytime sedating (some anticonvulsants, α-agonists) properties; hospitalized children; and children with a variety of psychiatric disorders, including attention-deficit/hyperactivity disorder (ADHD), depression, bipolar disorder, and anxiety disorders. Children with neurodevelopmental disorders may be more prone to noc-

Table 17-1 NORMAL DEVELOPMENTAL CHANGES IN CHILDREN'S SLEEP

AGE CATEGORY	SLEEP DURATION AND SLEEP PATTERNS	ADDITIONAL SLEEP ISSUES	SLEEP DISORDERS
Newborn (0-2 mo)	Total sleep: 10-19 hr per 24 r (average = 13-14.5 hr), may be higher in premature babies Bottle-fed babies generally sleep for longer periods (2-5 hr bouts) than breast-fed babies (1-3 hr) Sleep periods are separated by 1-2 hr awake. No established nocturnal/diurnal pattern in the 1st few wk; sleep is evenly distributed throughout the day and night, averaging 8.5 hr at night and 5.75 hr during the day	The American Academy of Pediatrics issued a formal recommendation in 2005 advocating against bed sharing in the first year of life, instead encouraging proximate but separate sleeping surfaces for mother and infant. Safe sleep practices for infants: Place the baby on his or her back to sleep at night and during nap times. Place the baby on a firm mattress with a well-fitting sheet in a safety-approved crib. Do not use pillows or comforters Cribs should not have corner posts over 1/16 in high or decorative cut-outs. Make sure the baby's face and head stay uncovered and clear of blankets and other coverings during sleep.	Most sleep issues that are perceived as problematic at this stage represent a discrepancy between parental expectations and developmentally appropriate sleep behaviors. Newborns who are noted by parents to be extremely fussy and persistently difficult to console are more likely to have underlying medical issues, such as colic, gastroesophageal reflux, and formula intolerance.
Infant (2-12 mo)	Total sleep: average is 12-13 hr (note that there is great individual variability in sleep times during infancy) Nighttime: average is 9-10 hr Naps: average is 3-4 hr	Sleep regulation or self-soothing involves the infant's ability to negotiate the sleep-wake transition, both at sleep onset and following normal awakenings throughout the night. The capacity to self-soothe begins to develop in the 1st 12 wk of life, and is a reflection of both neurodevelopmental maturation and learning. Sleep consolidation, or "sleeping through the night," is usually defined by parents as a continuous sleep episode without the need for parental intervention (e.g., feeding, soothing) from the child's bedtime through the early morning. Infants develop the ability to consolidate sleep between 6 wk to 3 mo	Behavioral insomnia of childhood; sleep onset association type Sleep-related rhythmic movements (head banging, body rocking)
Toddler (1-3 yr)	Total sleep: average is 11-13 hr Nighttime: average is 9.5-10.5 hr Naps: average is 2-3 hr; decrease from 2 naps to 1 at average age of 18 mo	Cognitive, motor, social, language developmental issues impact on sleep Nighttime fears develop; transitional objects, bedtime routines important	Behavioral insomnia of childhood, sleep onset association type Behavioral insomnia of childhood, limit setting type
Preschool (3-5 yr)	Nighttime: average is 9-10 hr Naps decrease from 1 nap to no nap Overall, 26% of 4 yr olds and just 15% of 5 yr olds nap	Persistent co-sleeping tends to be highly associated with sleep problems in this age group	Behavioral insomnia of childhood, limit setting type
		Sleep problems may become chronic	Sleepwalking Sleep terrors
			Nighttime fears/nightmares
			Obstructive sleep apnea
Middle childhood (6-12 hr)	9-11 hr	School and behavior problems may be related to sleep problems	Nightmares
		Media and electronics, such as television, computer, video games, and the internet compete increasingly for sleep time Irregularity of sleep–wake schedules reflects increasing discrepancy between school and nonschool night bedtimes and waketimes	Obstructive sleep apnea Insufficient sleep
Adolescence (>12 yr)	Average sleep duration 7-7.5 hr; only 20% of adolescents overall get the recommended 9-9.25 hr of sleep Later bedtimes; increased discrepancy sleep patterns weekdays/weekends	Puberty-mediated phase delay (later sleep onset and wake times), relative to sleep-wake cycles in middle childhood Earlier required wake times Environmental competing priorities for sleep	Insufficient sleep Delayed sleep phase disorder Narcolepsy Restless legs syndrome/periodic limb movement disorder

turnal seizures, as well as other sleep disruptions, and children with blindness, mental retardation, some chromosomal syndromes (Smith-Magenis, fragile X), and autism spectrum disorders are at increased risk for severe sleep onset difficulty and night wakings, as well as circadian rhythm disturbances.

Insomnia of Childhood

Insomnia may be broadly defined as repeated difficulty initiating and/or maintaining sleep that occurs despite age-appropriate time and opportunity for sleep. These sleep complaints must also result in some degree of impairment in daytime functioning for the child and/or family, which may range from fatigue, irritability, lack of energy, and mild cognitive impairment to effects on mood, school performance, and quality of life. Insomnia complaints may be of a short-term and transient nature (usually related to an acute event), or may be characterized as long-term and chronic. Insomnia is a set of *symptoms* with a large number of possible etiologies (e.g., pain, medication, medical and psychiatric conditions, learned behaviors) and not as a *diagnosis* per se. Insomnia, like many behavioral issues in children, is often primarily defined by parental concerns rather than by objective criteria, and therefore should be viewed in the context of family (i.e., maternal depression, stress), child (i.e., temperament, developmental level), and environmental (i.e., cultural practices, sleeping space) considerations.

One of the most common sleep disorders found in infants and toddlers is **behavioral insomnia of childhood, sleep onset association type.** In this disorder, the child learns to fall asleep only under certain conditions or associations which typically require parental presence, such as being rocked or fed, and does not develop the ability to self-soothe. During the night, when the child experiences the type of brief arousal that normally occurs at the end of a sleep cycle (every 60-90 minutes in infants) or awakens for other reasons, he or she is not able to get back to sleep without those same conditions being present. The infant then "signals" the parent by crying (or coming into the parents'

Table 17-2 BASIC PRINCIPLES OF SLEEP HYGIENE FOR CHILDREN

1. **Have a set bedtime and bedtime routine** for your child.
2. **Bedtime and wake-up time should be about the same time on school nights and non-school nights.** There should not be more than about an hour difference from one day to another.
3. **Make the hour before bed shared quiet time.** Avoid high-energy activities, such as rough play, and stimulating activities, such as watching television or playing computer games, just before bed.
4. **Don't send your child to bed hungry.** A *light* snack (such as milk and cookies) before bed is a good idea. Heavy meals within an hour or two of bedtime, however, may interfere with sleep.
5. **Avoid products containing caffeine for at least several hours before bedtime.** These include caffeinated sodas, coffee, tea, and chocolate.
6. **Make sure your child spends time outside every day** whenever possible and is involved in regular exercise.
7. **Keep your child's bedroom quiet and dark.** A low-level night light is acceptable for children who find completely dark rooms frightening.
8. **Keep your child's bedroom at a comfortable temperature** during the night (<75°F).
9. **Don't use your child's bedroom for time-out or punishment.**
10. **Keep the television set out of your child's bedroom.** Children can easily develop the bad habit of "needing" the television to fall asleep. It's also much more difficult to control your child's viewing if the set is in the bedroom.

bedroom, if the child is no longer in a crib) until the necessary associations are provided. The problem is one of prolonged night waking resulting in insufficient sleep (for both child and parent).

Management of night wakings should include establishment of a set sleep schedule and bedtime routine, and implementation of a behavioral program. The treatment approach typically involves a program of rapid withdrawal (extinction) or more gradual withdrawal (graduated extinction) of parental assistance at sleep onset and during the night. Extinction ("cry it out") involves putting the child to bed at a designated bedtime, "drowsy but awake," and then systematically ignoring the child until a set time the next morning. Although it has considerable empirical support, extinction is often not an acceptable choice for families. Graduated extinction involves weaning the child from dependence on parental presence with periodic "checks" by the parents at successively longer intervals during the sleep-wake transition; the exact amount of time is determined by the parents' tolerance for crying and the child's temperament. The goal is to allow the infant or child to develop skills in self-soothing during the night, as well as at bedtime. In older infants, the introduction of more appropriate sleep associations that will be readily available to the child during the night (transitional objects, such as a blanket or toy), in addition to positive reinforcement (i.e., stickers for remaining in bed), is often beneficial; If the child has become habituated to awaken for nighttime feedings ("learned hunger"), then these feedings should be slowly eliminated. Parents must be consistent in applying behavioral programs to avoid inadvertent, intermittent reinforcement of night wakings; they should also be forewarned that crying behavior often temporarily escalates at the beginning of treatment ("post-extinction burst").

Bedtime problems, including stalling and refusing to go to bed, are more common in preschool-aged and older children. Sleep disturbances of this type generally fall within the diagnostic category known as **behavioral insomnia of childhood, limit setting type**, and are often the result of parental difficulties in setting limits and managing behavior, including the inability or unwillingness to set consistent bedtime rules and enforce a regular bedtime, and may be exacerbated by the child's oppositional behavior. In some cases the child's resistance at bedtime is due to an underlying problem in falling asleep that is caused by other factors (medical conditions, such as asthma or medication use; a sleep disorder, such as restless legs syndrome; or anxiety) or a mismatch between the child's intrinsic circadian rhythm ("night owl") and parental expectations.

Successful treatment of limit setting sleep disorder generally involves a combination of parent education regarding appropriate limit setting, decreased parental attention for bedtime-delaying behavior, establishment of bedtime routines, and positive reinforcement (sticker charts) for appropriate behavior at bedtime; other behavioral management strategies that have empirical support include bedtime fading (temporarily setting the bedtime closer to the actual sleep onset time and then gradually advancing the bedtime to an earlier target bedtime). Older children may benefit from being taught relaxation techniques to help themselves fall asleep more readily. Following the principles of sleep hygiene for children is essential (Table 17-2).

When the insomnia is not primarily a result of parent behavior or secondary to another sleep disturbance, or to a psychiatric or medical problem, it is referred to as **psychophysiologic or primary insomnia**, also sometimes called "learned insomnia." Primary insomnia usually occurs largely in adolescents and is characterized by a combination of learned sleep-preventing associations and heightened physiologic arousal resulting in a complaint of sleeplessness and decreased daytime functioning. A hallmark of primary insomnia is excessive worry about sleep and an exaggerated concern of the potential daytime consequences. The physiologic arousal can be in the form of cognitive hypervigilance, such as "racing" thoughts; in many individuals with insomnia an increased baseline level of arousal is further intensified by this secondary anxiety about sleeplessness. Treatment usually involves educating the adolescent about the principles of sleep hygiene (Table 17-3), institution of a consistent sleep-wake schedule, avoidance of daytime napping, instructions to use the bed for sleep only and to get out of bed if unable to fall asleep (stimulus control), restricting time in bed to the actual time asleep (sleep restriction), addressing maladaptive cognitions about sleep, and teaching relaxation techniques to reduce anxiety. Hypnotic medications are rarely needed.

Obstructive Sleep Apnea

Sleep-disordered breathing (SDB) in children encompasses a broad spectrum of respiratory disorders that occur exclusively in or are exacerbated by sleep, and includes primary snoring and upper airway resistance syndrome, as well as apnea of prematurity and central apnea. **Obstructive sleep apnea (OSA)**, the most important clinical entity within the SDB spectrum, is a respiratory disorder that is characterized by repeated episodes of prolonged upper airway obstruction during sleep despite continued or increased respiratory effort, resulting in complete (apnea) or partial (hypopnea; ≥50% reduction in airflow) cessation of airflow at the nose and/or mouth, as well as in disrupted sleep. Both intermittent hypoxia and the multiple arousals resulting from these obstructive events likely contribute to significant metabolic, cardiovascular, and neurocognitive/neurobehavioral morbidity.

Primary snoring is defined as snoring without associated ventilatory abnormalities (e.g., apneas or hypopneas, hypoxemia, hypercapnia) or respiratory-related arousals, and is a manifestation of the vibrations of the oropharyngeal soft tissue walls that occur when an individual attempts to breathe against increased

Table 17-3 BASIC PRINCIPLES OF SLEEP HYGIENE FOR ADOLESCENTS

1. **Wake up and go to bed at about the same time** every night. Bedtime and wake-up time should not differ from school to non-school nights by more than approximately an hour.
2. **Avoid sleeping in on weekends** to "catch up" on sleep. This makes it more likely that you will have problems falling asleep.
3. If you take **naps**, they should be **short** (no more than an hour) and **scheduled in the early to midafternoon**. However, if you have a problem with falling asleep at night, **napping** during the day may make it worse and should be avoided.
4. **Spend time outside** every day. Exposure to sunlight helps to keep your body's internal clock on track.
5. **Exercise regularly.** Exercise may help you fall asleep and sleep more deeply.
6. **Use your bed for sleeping only.** Don't study, read, listen to music, watch television, etc., on your bed.
7. Make the 30-60 minutes before a **quiet or wind-down time**. Relaxing, calm, enjoyable activities, such as reading a book or listening to calm music, help your body and mind slow down enough to let you get to sleep. Don't study, watch exciting/scary movies, exercise, or get involved in "energizing" activities just before bed.
8. Eat regular meals and **don't go to bed hungry**. A light snack before bed is a good idea; eating a full meal in the hour before bed is not.
9. **Avoid** eating or drinking products containing **caffeine** from dinner time on. These include caffeinated sodas, coffee, tea, and chocolate.
10. **Do not use alcohol.** Alcohol disrupts sleep and may cause you to awaken throughout the night.
11. **Smoking disturbs sleep.** Don't smoke at least one hour before bed (and preferably, not at all!).
12. Don't use **sleeping pills, melatonin**, or other **over-the-counter sleep aids** to help you sleep unless specifically recommended by your doctor. These can be dangerous, and the sleep problems often return when you stop taking the medicine.

upper airway resistance during sleep. Children with primary snoring may still have subtle breathing abnormalities during sleep, including evidence of increased respiratory effort, which in turn may be associated with adverse neurodevelopmental outcomes.

ETIOLOGY In general terms, OSA results from an anatomically or functionally narrowed upper airway; this typically involves some combination of decreased upper airway patency (upper airway obstruction and/or decreased upper airway diameter), increased upper airway collapsibility (reduced pharyngeal muscle tone), and decreased drive to breathe in the face of reduced upper airway patency (reduced central ventilatory drive) (Table 17-4). Upper airway obstruction varies in degree and level (i.e., nose, nasopharynx/oropharynx, hypopharynx) and is most commonly due to adenotonsillar hypertrophy, although tonsillar size does not necessarily correlate with degree of obstruction, especially in older children. Other causes of airway obstruction include allergies associated with chronic rhinitis/nasal obstruction; craniofacial abnormalities, including hypoplasia/displacement of the maxilla and mandible; gastroesophageal reflux with resulting pharyngeal reactive edema; nasal septal deviation; and velopharyngeal flap cleft palate repair. Reduced upper airway tome may result from neuromuscular diseases, including hypotonic cerebral palsy and muscular dystrophies, or hypothyroidism. Reduced central ventilatory drive may be present in some children with Arnold-Chiari malformation and meningomyelocele. In other situations, the etiology is mixed; individuals with Down syndrome, by virtue of their facial anatomy, hypotonia, macroglossia, and central adiposity, as well as the increased incidence of hypothyroidism, are at particularly high risk for OSA, with some estimates of as great as 70% prevalence.

Although many children with OSA are of normal weight, an increasingly large percentage are overweight or obese, and many of these children are school-aged and younger. There is a significant correlation between weight and SDB (habitual snoring, OSA, central apneas). While adenotonsillar hypertrophy also plays an important etiologic role in overweight/obese children with OSA, mechanical factors related to an increase in the amount of adipose tissue in the throat (pharyngeal fat pads), neck (increased neck circumference), and chest wall and abdomen can create increased upper airway resistance, worsen gas exchange, and increased work of breathing, particularly in the supine position and during REM sleep. There may be a component of blunted central ventilatory drive in response to hypoxia/hypercapnia and hypoventilation as well, particularly in children with morbid or syndrome-based (Prader-Willi) obesity. Overweight and obese children and adolescents are at a particularly high risk for metabolic and cardiovascular complications of SDB, such as insulin resistance and systemic hypertension; morbidly obese children may also be at increased risk for postoperative complications following adenotonsillectomy.

Table 17-4 ANATOMIC FACTORS THAT PREDISPOSE TO OBSTRUCTIVE SLEEP APNEA AND HYPOVENTILATION IN CHILDREN

NOSE
Anterior nasal stenosis
Choanal stenosis/atresia
Deviated nasal septum
Seasonal or perennial rhinitis
Nasal polyps, foreign body, hematoma, mass lesion
NASOPHARYNGEAL AND OROPHARYNGEAL
Adenotonsillar hypertrophy
Macroglossia
Cystic hygroma
Velopharyngeal flap repair
Cleft palate repair
Pharyngeal mass lesion
CRANIOFACIAL
Micrognathia/retrognathia
Midface hypoplasia (e.g., trisomy 21, Crouzon, Apert syndrome)
Mandibular hypoplasia (Pierre Robin sequence, Treacher Collins, Cornelia de Lange)
Craniofacial trauma
Skeletal and storage diseases
Achondroplasia
Glycogen storage disease (e.g., Hunter, Hurler syndrome)

EPIDEMIOLOGY Overall prevalence of parent-reported snoring in the pediatric population is about 8%; "always" snoring is reported in 1.5-6%, and "often" snoring in 3-15%. When defined by parent-reported symptoms, the prevalence of OSA is 4-11%. The prevalence of pediatric OSA as documented by overnight sleep studies utilizing ventilatory monitoring procedures (e.g., in-lab PSG, home studies) is 1-4% overall, with a reported range of 0.1-13%. Prevalence is also affected by the demographic characteristics, such as age (increased prevalence between 2 and 8 yr), gender (more common in boys, especially after puberty), race/ethnicity (increased prevalence in African-American and Asian children), and family history of OSA.

PATHOGENESIS The upregulation of inflammatory pathways, as indicated by an increase in peripheral markers of inflammation such as C-reactive protein (CRP), appear to be linked to metabolic dysfunction (e.g., insulin resistance, dyslipidemia) in both

obese and non-obese children with OSA. Both systemic inflammation and arousal-mediated increases in sympathetic autonomic nervous system activity with altered vasomotor tone may be key contributors to increased cardiovascular risk in both adults and children with OSA. Mechanical stress on the upper airway induced by chronic snoring may also result in both local mucosal inflammation of adenotonsillar tissues and subsequent upregulation of inflammatory molecules, most notably leukotrienes. Another potential mechanism that may mediate cardiovascular sequelae in both adults and children with OSA is altered endothelial function.

Although yet to be fully elucidated, one of the primary mechanisms by which OSA is believed to exert negative influences on cognitive function appears to involve repeated episodic arousals from sleep leading to sleep fragmentation and resulting sleepiness. An equally important role may be intermittent hypoxia that leads directly to systemic inflammatory vascular changes in the brain. Levels of inflammatory markers such as CRP and cytokine IL-6 are elevated in children with OSA and are also associated with cognitive dysfunction.

CLINICAL MANIFESTATIONS The clinical manifestations of OSA may be divided into sleep-related and daytime symptoms. The most common nocturnal manifestations of OSA in children and adolescents are loud, frequent, and disruptive snoring, breathing pauses, choking or gasping arousals, restless sleep, and nocturnal diaphoresis. Many children who snore do not have OSA, but very few children with OSA do not snore. Most children, like adults, tend to have more frequent and more severe obstructive events in REM sleep and when sleeping in the supine position. Children with OSA may adopt unusual sleeping positions, keeping their necks hyperextended in order to maintain airway patency. Frequent arousals associated with obstruction may result in nocturnal awakenings, but are more likely to cause fragmented sleep.

Daytime symptoms of OSA include mouth breathing and dry mouth, chronic nasal congestion/rhinorrhea, hyponasal speech, morning headaches, difficulty swallowing, and poor appetite. Children with OSA may have secondary enuresis, most likely as a result of the disruption of the normal nocturnal pattern of antidiuretic hormone secretion. Partial arousal parasomnias (sleepwalking and sleep terrors) may occur more frequently in children with OSA, related to the frequent associated arousals and an increased percentage of delta sleep, or SWS.

One of the most important but frequently overlooked sequelae of OSA in children is the effect on mood, behavior, learning, and academic functioning. The neurobehavioral consequences of OSA in children include daytime sleepiness with drowsiness, difficulty in morning waking, and unplanned napping or dozing off during activities, although evidence of frank hypersomnolence tends to be less common in children compared to adults with OSA. Mood changes include increased irritability, mood instability and emotional dysregulation, low frustration tolerance, and depression/anxiety. Behavioral issues include both "internalizing" (i.e., increased somatic complaints and social withdrawal) and "externalizing" behaviors, including aggression, impulsivity, hyperactivity, oppositional behavior, and conduct problems. There is a substantial overlap between the clinical impairments associated with OSA and the diagnostic criteria for ADHD, including inattention, poor concentration, and distractibility (see Chapter 30). There also appears to be a selective impact of OSA specifically on "executive functions," which include cognitive flexibility, task initiation, self-monitoring, planning, organization, and self-regulation of affect and arousal; executive function deficits are also a hallmark of ADHD.

Studies that have looked at changes in behavior and neuropsychologic functioning in children following treatment (usually adenotonsillectomy) for OSA have largely documented significant improvement in outcomes, in both the short and long term, of OSA syndrome post-treatment, including daytime sleepiness, mood, behavior, academics, and quality of life. Many studies have failed to find a dose-dependent relationship between OSA in children and specific neurobehavioral/neurocognitive deficits, suggesting that other factors may influence neurocognitive outcomes, including individual genetic susceptibility, environmental influences such as passive smoking exposure, and co-morbid conditions, such as obesity, shortened sleep duration, and the presence of other sleep disorders.

Table 17-5 AMERICAN ACADEMY OF PEDIATRICS CLINICAL PRACTICE GUIDELINES FOR OBSTRUCTIVE SLEEP APNEA SYNDROME (APRIL 2002)

All children should be screened for snoring.
Complex high-risk patients should be referred to a specialist.
Patients with cardiorespiratory failure cannot await elective evaluation.
Diagnostic evaluation is useful in discriminating between primary snoring and obstructive sleep apnea syndrome, the gold standard being polysomnography.
Adenotonsillectomy is the first line of treatment for most children, and continuous positive airway pressure (CPAP) is an option for those who are not candidates for surgery or do not respond to surgery.
High-risk patients should be monitored as inpatients postoperatively.
Patients should be re-evaluated postoperatively to determine whether additional treatment is required.

DIAGNOSIS The American Academy of Pediatrics clinical practice guidelines provide excellent information for the evaluation and management of uncomplicated childhood OSA (Table 17-5). There are no physical examination findings that are truly pathognomonic for OSA, and most healthy children with OSA appear normal; certain physical examination findings may suggest OSA. Growth parameters may be abnormal (obesity or, less commonly, failure to thrive), and there may be evidence of chronic nasal obstruction (hyponasal speech, mouth breathing, septal deviation, "adenoidal facies"), as well as signs of atopic disease (i.e., "allergic shiners"). Oropharyngeal examination may reveal enlarged tonsils, excess soft tissue in the posterior pharynx, and a narrowed posterior pharyngeal space. Any abnormalities of the facial structure, such as retrognathia and/or micrognathia, midfacial hypoplasia, best appreciated by inspection of the lateral facial profile, increase the likelihood of OSA and should be noted. In very severe cases, there may be evidence of pulmonary hypertension, right-sided heart failure, and cor pulmonale; systemic hypertension, unlike in adults, is relatively uncommon.

Because no combination of clinical history and physical findings can accurately predict which children with snoring have OSA, the gold standard for diagnosing OSA remains an overnight **polysomnogram** (PSG).

An overnight PSG is a technician-supervised, monitored study that documents physiologic variables during sleep; sleep staging, arousal measurement, cardiovascular parameters, and body movements (EEG, EOG, chin and leg EMG, ECG, body position sensors, and video recording), and a combination of breathing monitors (oronasal thermal sensor and nasal air pressure transducer for airflow, chest/abdominal monitors (e.g., inductance plethysmography for respiratory effort, pulse oximeter for O_2 saturation, end-tidal or transcutaneous CO_2 for hypercarbia, snore microphone). The polysomnographic parameter most commonly used in evaluating for sleep disordered breathing is the apnea/hypopnea index (AHI), which indicates the number of apneic and hypopneic events per hr of sleep. It should be noted that currently there are no universally accepted polysomnographic normal reference values and parameters for diagnosing OSA in children, and it is still unclear which parameters best predict morbidity. Normal preschool and early school-aged children may have a total AHI of less than 1.5, and this is the most widely used cutoff value for OSA in children 12 yr and below; in adolescents, the adult cutoff of an AHI ≥5 is generally used.

In cases in which the AHI is between 1 and 5 obstructive events per hour, clinical judgment regarding risk factors for SDB, evidence of daytime sequelae, and the technical quality of the overnight sleep study should determine further management.

TREATMENT There are presently no universally accepted guidelines regarding the indications for treatment of pediatric SDB (i.e., including primary snoring and OSA). Current recommendations largely emphasize weighing what is known about the potential cardiovascular, metabolic, and neurocognitive sequelae of SDB in children in combination with the individual health care professional's clinical judgment. The decision of whether and how to treat OSA specifically in children is contingent on a number of parameters, including severity (nocturnal symptoms, daytime sequelae, sleep study results), duration of disease, and individual patient variables such as age, co-morbid conditions, and underlying etiologic factors. In the case of moderate to severe disease (AHI >10), the decision to treat is usually straightforward, and most pediatric sleep experts recommend that any child with an apnea index >5 should be treated.

In the majority of cases of pediatric OSA, adenotonsillectomy is the first-line treatment in any child with significant adenotonsillar hypertrophy, even in the presence of additional risk factors such as obesity. Adenotonsillectomy in uncomplicated cases generally (70-90% of children) results in complete resolution of symptoms; regrowth of adenoidal tissue after surgical removal occurs in some cases. Groups considered high-risk include young children (<3 yr old), as well as those with severe OSA documented on polysomnography, significant clinical sequelae of OSA (e.g., failure to thrive), or associated medical conditions, such as craniofacial syndromes, morbid obesity, and hypotonia. All patients should be re-evaluated postoperatively to determine whether additional evaluation and/or treatment are required. If there are significant residual risk factors (e.g., obesity) or continued symptoms of OSA, a follow-up sleep study at least 6 wk post-adenotonsillectomy may be indicated.

Additional treatment measures that may be appropriate include weight loss, positional therapy (attaching a firm object, such as a tennis ball, to the back of a sleep garment to prevent the child from sleeping in the supine position), and aggressive treatment of additional risk factors when present, such as asthma, seasonal allergies, and gastroesophageal reflux; there is some evidence that intranasal corticosteroids and leukotriene inhibitors may be helpful in mild OSA. Other surgical procedures, such as uvulopharyngopalatoplasty, and maxillofacial surgery (mandibular distraction osteogenesis and maxillomandibular advancement), are seldom performed in children but may be indicated in selected cases. Oral appliances, such as mandibular advancing devices and tongue retainers, are typically considered for adolescents in whom facial bone growth is largely complete.

Continuous or bilevel positive airway pressure (nasal CPAP or BiPAP) is the most common treatment for OSA in adults and can be used successfully in children and adolescents. CPAP delivers humidified, warmed air through an interface (mask, nasal pillows) that, under pressure, effectively "splints" the upper airway open. Optimal pressure settings (that abolish or significantly reduce respiratory events without increasing arousals or central apneas) are determined in the sleep lab during a full night CPAP titration. Efficacy studies at the current pressure and retitrations should be conducted periodically with long-term use (every 6 mo in young children and at least yearly or with significant weight changes in older children and adolescents). CPAP may be recommended if removing the adenoids and tonsils is not indicated, if there is residual disease following adenotonsillectomy, or if there are major risk factors that are not amenable to treatment with surgery (obesity, hypotonia).

Parasomnias

Parasomnias are defined as episodic nocturnal behaviors that often involve cognitive disorientation and autonomic and skeletal muscle disturbance. Parasomnias may be further characterized as occurring primarily during NREM sleep (partial arousal parasomnias or in association with REM sleep, including nightmares, hypnogogic hallucinations, and sleep paralysis; other common parasomnias include sleep-talking. Sleep-related movement disorders, including restless legs syndrome/periodic limb movement disorder (RLS/PLMD) and rhythmic movement disorder (head banging, body rocking), are reviewed in a separate section below.

ETIOLOGY Partial arousal parasomnias, which include **sleepwalking, sleep terrors**, and **confusional arousals** are more common in preschool and school-aged children because of the relatively higher percentage of SWS in younger children. Any factor that is associated with an increase in the relative percentage of SWS (certain medications, previous sleep deprivation) may increase the frequency of events in a predisposed child. There appears to be a genetic predisposition for both sleepwalking and night terrors. In contrast, nightmares, which are much more common than the partial arousal parasomnias but are often confused with them, are concentrated in the last third of the night, when REM sleep is most prominent. Partial arousal parasomnias may also be difficult to distinguish from nocturnal seizures. Table 17-6 summarizes similarities and differences among these nocturnal arousal events.

EPIDEMIOLOGY Many children (15-40%) **sleepwalk** on at least one occasion; the prevalence of children who regularly sleepwalk is approximately 17%, and 3-4% have frequent episodes. Sleepwalking may persist into adulthood, with the prevalence in adults of about 4%. The prevalence is approximately 10 times greater in children with a family history of sleepwalking. Approximately 1-6% of children experience **sleep terrors**, primarily during the preschool and elementary school years, and the age of onset is usually between 4 and 12 yr. Because of the common genetic predisposition, the prevalence of sleep terrors in children who sleepwalk is about 10%. Although sleep terrors can occur at any age from infancy through adulthood, most individuals outgrow sleep terrors by adolescence. Confusional arousals commonly co-occur with sleepwalking and sleep terrors; prevalence rates

Table 17-6 DIFFERENTIATION OF EPISODIC NOCTURNAL PHENOMENA

CHARACTERISTICS	PARTIAL AROUSAL PARASOMNIAS	NIGHTMARES	NOCTURNAL SEIZURES
Sleep stage	SWS	REM	Non-REM > Wake > REM
Timing during night	First third	Last third	Variable; often at sleep-wake transition
Level autonomic arousal	Low/high/medium	Mild to high	Variable
Arousal threshold	High	Low	Low
Recall of event	None or fragmentary	Vivid	Not usual
Daytime sleepiness	None	+/–	Often
Incontinence, tongue biting, drooling, stereotypy, postictal behavior	No	No	Yes
Multiple episodes per night	Rare	Occasional	More common
Increased by sleep deprivation	Yes	Sometimes	+/–
PSG	Indicated if atypical features	Not indicated	Indicated if atypical features; requires extended EEG montage
Family history	Common	Rare	Variable

EEG, ••; PSG, polysomnography; REM, rapid eye movement; SWS, slow-wave sleep.

have been estimated to be upwards of 15% in children ages 3-13 yr.

CLINICAL MANIFESTATIONS The partial arousal parasomnias have several features in common. Because they typically occur at the transition out of "deep" or SWS, partial arousal parasomnias have clinical features of both the awake (ambulation, vocalizations) and the sleeping (high arousal threshold, unresponsiveness to the environment) states; there is usually amnesia for the events. The typical timing of partial arousal parasomnias during the first few hours of sleep is related to the predominance of SWS in the first third of the night; the duration is typically a few minutes (sleep terrors) to an hour (confusional arousals). Sleep terrors are sudden in onset and characteristically involve a high degree of autonomic arousal (i.e., tachycardia, dilated pupils), while confusional arousals typically arise more gradually from sleep, may involve thrashing around but usually not displacement from bed, and are often accompanied by slow mentation on arousal from sleep ("sleep inertia"). Sleepwalking may be associated with safety concerns (e.g., falling out of windows, wandering outside). Avoidance of, or increased agitation with, comforting by parents or attempts at awakening are also common features of all partial arousal parasomnias.

TREATMENT Management of partial arousal parasomnias involves some combination of parental education and reassurance, good sleep hygiene, and avoidance of exacerbating factors such as sleep deprivation and caffeine. Particularly in the case of sleepwalking, it is important to institute safety precautions such as use of gates in doorways and at the top of staircases, locking of outside doors and windows, and installation of parent notification systems such as bedroom door alarms. Scheduled awakenings, a behavioral intervention that involve having the parent wake the child approximately 15 to 30 min before the time of night that the first parasomnia episode is most likely to be successful in situations in which partial arousal episodes occur on a nightly basis. Pharmacotherapy is rarely necessary, but may be indicated in cases of frequent or severe episodes, high risk of injury, violent behavior, or serious disruption to the family; the primary pharmacologic agents used are potent SWS suppressants, primarily benzodiazepines and tricyclic antidepressants.

Sleep-Related Movement Disorders: Restless Legs Syndrome/ Periodic Limb Movement Disorder and Rhythmic Movements

Restless legs syndrome (RLS) is a neurologic, primarily sensory disorder, characterized by uncomfortable sensations in the lower extremities that are accompanied by an almost irresistible urge to move the legs. The sensations are usually at least partially relieved by movement, including walking, stretching, and rubbing, but only as long as the motion continues. RLS is a clinical diagnosis that is based on the presence of these key symptoms. **Periodic limb movement disorder** (PLMD) is characterized by periodic, repetitive, brief (0.5-10 sec), and highly stereotyped limb jerks typically occurring at 20 to 40 sec intervals. These movements occur primarily during sleep, most commonly occur in the legs, and frequently consist of rhythmic extension of the big toe and dorsiflexion at the ankle. The diagnosis of **periodic limb movements** (PLMs) requires overnight polysomnography to document the characteristic limb movements with anterior tibialis EMG leads.

ETIOLOGY "Early-onset" RLS (i.e., onset of symptoms before 35-40 yr of age), often termed "primary" RLS, appears to have a particularly strong genetic component. Low serum iron levels in both adults and children may be an important etiologic factor for the presence and severity of both RLS symptoms and PLMs. As a marker of decreased iron stores, serum ferritin levels in both children and adults with RLS are frequently low. The underlying mechanism that has been postulated is related to the role of iron as a cofactor of tyrosine hydroxylase in a rate-limiting step of the synthesis of dopamine; in turn, dopaminergic dysfunction has been implicated as playing a key role particularly in the genesis of the sensory component of RLS, as well as in PLMD. Certain medical conditions, including diabetes mellitus, end-stage renal disease, cancer, rheumatoid arthritis, hypothyroidism, and pregnancy, may also be associated with RLS/PLMD, as are specific medications (i.e., antihistamines such as diphenhydramine, antidepressants, and H-2 blockers such as cimetidine) and substances (e.g., caffeine). 3

EPIDEMIOLOGY Previous studies have found prevalence rates of RLS in the pediatric population ranging from 1-6%; the percent of 8-17 yr olds meeting criteria for "definite" RLS is approximately 2%. Prevalence rates of PLMs greater than 5 per hour in clinical populations of children referred for sleep studies range from 5-27%; in survey studies of PLM symptoms, rates are 8-12%. Several studies in referral populations have found that PLMs occur in as much as one fourth of children diagnosed with ADHD.

CLINICAL MANIFESTATIONS In addition to the sensory component and the urge to move the legs, most RLS episodes begin or are exacerbated by rest or inactivity, such as lying in bed to fall asleep or riding in a car for prolonged periods. A unique feature of RLS is that the timing of symptoms also appears to have a circadian component, in that they often peak in the evening hours. Some children may complain of "growing pains," although this is considered a nonspecific feature. Because RLS symptoms are usually worse in the evening, bedtime struggles and difficulty falling asleep are 2 of the most common presenting complaints. In contrast to patients with RLS, individuals with PLMs are usually unaware of these movements; these movements may result in arousals during sleep and consequent significant sleep disruption. Parents of children with RLS/PLMD may complain that their child is a restless sleeper, moves around or even falls out of bed during the night.

TREATMENT The decision of whether and how to treat RLS depends on the level of severity (intensity, frequency, and periodicity) of sensory symptoms, the degree of interference with sleep, and the impact of daytime sequelae in a particular child or adolescent. With PLMs, for an index (PLMs per hr) less than 5, usually no treatment is recommended; for an index over 5, the decision to specifically treat PLMs should be based on the presence or absence of nocturnal symptoms (restless or nonrestorative sleep) and daytime clinical sequelae. A reasonable initial approach would be to promote good sleep hygiene (including restricting caffeine) and instituting iron supplements in children if serum ferritin levels are low (<50); the recommended dose is typically in the range of 6 mg/kg/day for a duration of 3-6 mo. Medications that increase dopamine levels in the CNS, such as ropinirole and pramipexole, have been found to be effective in relieving RLS/PLMD symptoms in adults; data in children are extremely limited. 4

Sleep-related rhythmic movements, including head banging, body rocking, and head rolling, are characterized by repetitive, stereotyped, and rhythmic movements or behaviors that involve large muscle groups. These behaviors typically occur with the transition at sleep at bedtime, but also at nap times and following nighttime arousals. Children typically engage in these behaviors as a means of soothing themselves to (or back to) sleep; they are much more common in the 1st yr of life and usually disappear by 4 yr of age. In most instances, rhythmic movement behaviors are benign, because sleep is not significantly disrupted as a result of these movements and associated significant injury is rare. These behaviors typically occur in normally developing children, and in the vast majority of cases their presence does not indicate that there is some underlying neurological or psychological problem. Usually, the most important aspect in management of sleep-related rhythmic movements is reassurance to the family that this behavior is normal, common, benign, and self-limited.

Narcolepsy

Hypersomnia is a clinical term that is used to describe a group of disorders characterized by recurrent episodes of **excessive**

daytime sleepiness (EDS), reduced baseline alertness, and/or prolonged nighttime sleep periods that interfere with normal daily functioning. It is important to recognize that there are many potential causes of EDS, which may be broadly grouped as "extrinsic" (e.g., secondary to insufficient and/or fragmented sleep) or "intrinsic" (e.g., resulting from an increased need for sleep). **Narcolepsy** is a chronic lifelong CNS disorder, typically presenting in adolescence and early adulthood, that is characterized by profound daytime sleepiness and resultant significant functional impairment. Other symptoms frequently associated with narcolepsy, cataplexy, hypnagogic/hypnopompic hallucinations, and sleep paralysis, may be conceptualized as representing the "intrusion" of REM sleep features into the waking state.

ETIOLOGY There is a specific deficit in the hypothalamic orexin/hypocretin neurotransmitter system in the genesis of narcolepsy with cataplexy. The underlying pathogenesis of narcolepsy involves selective loss of cells that secrete hypocretin/orexin in the lateral hypothalamus; it has been postulated that autoimmune mechanisms, possibly triggered by viral infections, in combination with a genetic predisposition and environmental factors, may be involved. Human leukocyte antigen testing also shows a strong association with narcolepsy; however, the vast majority of individuals with this antigen do not have narcolepsy. Although the majority of cases of narcolepsy are considered idiopathic, "secondary" narcolepsy with cataplexy may also result from CNS insults.

EPIDEMIOLOGY The prevalence of narcolepsy is reported to be between 3 and 16 per 10,000, with the prevalence of narcolepsy with cataplexy approximately 0.2 -0.5/10,000. The risk of developing narcolepsy with cataplexy in a first-degree relative of a narcoleptic patient is estimated at 1-2%; this represents an increase of 10- to 40-fold compared to the general population.

CLINICAL MANIFESTATIONS AND DIAGNOSIS The typical onset of symptoms of narcolepsy is in adolescence and early adulthood, although symptoms may initially present in school-aged and even younger children. The early manifestations of narcolepsy are often ignored, misinterpreted, or misdiagnosed as other medical, neurologic, and psychiatric conditions, and the appropriate diagnosis is frequently delayed for a number of years.

The most prominent clinical manifestation of narcolepsy is profound daytime sleepiness, characterized by both an increased baseline level of daytime drowsiness and by the repeated occurrence of sudden and unpredictable sleep episodes. These "**sleep attacks**" are often described as "irresistible" in that the child or adolescent is unable to stay awake despite considerable effort, and they occur even in the context of normally stimulating activities (e.g., during meals, in the middle of a conversation). Very brief (several seconds) sleep attacks may also occur in which the individual may "stare off," appear unresponsive, or continue to engage in an ongoing activity (automatic behavior). **Cateplexy** is considered pathognomonic for narcolepsy. Cataplexy is rarely the first symptom of narcolepsy, but it often develops within the 1st year of the onset of EDS. It is described as an abrupt, bilateral, partial or complete loss of muscle tone, classically triggered by an intense positive emotion (e.g., laughter, surprise). The cataplectic attacks are typically brief (seconds to minutes), and fully reversible, with complete recovery of normal tone when the episode ends. **Hypnagogic/hypnopompic hallucinations** involve vivid visual, auditory, and sometimes tactile sensory experiences occurring during transitions between sleep and wakefulness, primarily at sleep onset (hypnagogic) and sleep offset (hypnopompic). **Sleep paralysis** is the inability to move or speak for a few seconds or minutes at sleep onset or offset, and often accompanies the hallucinations. Other symptoms associated with narcolepsy include disrupted nocturnal sleep, inattention, and behavioral and mood issues.

Overnight polysomnography followed by a multiple sleep latency test (MSLT) are strongly recommended components of the evaluation of a patient with profound unexplained daytime sleepiness or suspected narcolepsy. The purpose of the overnight PSG is to evaluate for primary sleep disorders, such as OSA that may cause EDS. The MSLT involves a series of 5 opportunities to nap (20 min long), during which narcoleptics demonstrate a pathologically shortened sleep onset latency as well as periods of REM sleep occurring immediately after sleep onset.

TREATMENT An individualized narcolepsy treatment plan usually involves education, good sleep hygiene, behavioral changes, and medication. Scheduled naps may be helpful. Medications such as psychostimulants and modafinil are often prescribed to control the EDS. The goal should be to allow the fullest possible return of normal functioning in school, at home, and in social situations. Medications such as tricyclic antidepressants and serotonin reuptake inhibitors may also be used to control the REM-associated phenomena, such as cataplexy, hypnagogic hallucinations, and sleep paralysis.

Delayed Sleep Phase Disorder

Delayed sleep phase disorder (DSPD), a circadian rhythm disorder, involves a significant, persistent, and intractable phase shift in sleep-wake schedule (later sleep onset and wake time) that conflicts with the individual's normal school, work, and/or lifestyle demands. DSPD may occur at any age, but is most common in adolescents and young adults.

ETIOLOGY Individuals with DSPD often start out as night owls; that is, they have an underlying predisposition or circadian preference for staying up late at night and sleeping late in the morning, especially on weekends, holidays, and summer vacations. The underlying pathophysiology of DSPD is still unknown, although some authors have theorized that it involves an intrinsic abnormality in the circadian oscillators that govern the timing of the sleep period.

EPIDEMIOLOGY Studies indicate that DSPD affects approximately 7-16% of adolescents.

CLINICAL MANIFESTATIONS The most common clinical presentation is sleep initiation insomnia when the individual attempts to fall asleep at a "socially acceptable" desired bedtime, accompanied by extreme difficulty getting up in the morning even for desired activities, and daytime sleepiness. Sleep maintenance is generally not problematic, and no sleep onset insomnia is experienced if bedtime coincides with the preferred sleep onset time (e.g., on weekends, school vacations). School tardiness and frequent absenteeism are often present.

TREATMENT The goal in the treatment of DSPD is basically 2-fold: first, shifting the sleep-wake schedule to an earlier time, and second, maintaining the new schedule. Gradual advancement of bedtime in the evening and rise time in the morning typically involves shifting bedtime/wake time earlier by 15-30 min increments; more significant phase delays (difference between current sleep onset and desired bedtime) may require "chronotherapy," which involves delaying bedtime and wake time by 2-3 hr daily to every other day. Exposure to light in the morning (either natural light or a "light box") and avoidance of evening light exposure are often beneficial. Exogenous oral melatonin supplementation may also be used; larger doses (i.e., 5 mg) are typically given at bedtime, but some studies have suggested that physiologic doses of oral melatonin (0.3-0.5 mg) administered in the afternoon or early evening (i.e., 5-7 hr before the habitual sleep onset time) seem to be most effective in advancing the sleep phase.

HEALTH SUPERVISION

It is especially important for pediatricians to both screen for and recognize sleep disorders in children and adolescents during health encounters. The well child visit is an opportunity to educate parents about normal sleep in children and to teach strategies to prevent sleep problems from developing (primary prevention) or from becoming chronic, if problems already exist (secondary prevention). Developmentally appropriate screening

Table 17-7 BEARS SLEEP SCREENING ALGORITHM

The BEARS instrument is divided into 5 major sleep domains, providing a comprehensive screen for the major sleep disorders affecting children 2-18 years old. Each sleep domain has a set of age-appropriate "trigger questions" for use in the clinical interview.

B = Bedtime problems

E = Excessive daytime sleepiness

A = Awakenings during the night

R = Regularity and duration of sleep

S = Snoring

EXAMPLES OF DEVELOPMENTALLY APPROPRIATE TRIGGER QUESTIONS

	TODDLER/PRESCHOOL CHILD (2-5 YR)	SCHOOL-AGED CHILD (6-12 YR)	ADOLESCENT (13-18 YR)
1. **B**edtime problems	Does your child have any problems going to bed? Falling asleep?	Does your child have any problems at bedtime? (P) Do you any problems going to bed? (C)	Do you have any problems falling asleep at bedtime? (C)
2. **E**xcessive daytime sleepiness	Does your child seem overtired or sleepy a lot during the day? Does she still take naps?	Does your child have difficulty waking in the morning, seem sleepy during the day, or take naps? (P) Do you feel tired a lot? (C)	Do you feel sleepy a lot during the day? In school? While driving? (C)
3. **A**wakenings during the night	Does your child wake up a lot at night?	Does your child seem to wake up a lot at night? Any sleepwalking or nightmares? (P) Do you wake up a lot at night? Do you have trouble getting back to sleep? (C)	Do you wake up a lot at night? Do you have trouble getting back to sleep? (C)
4. **R**egularity and duration of sleep	Does your child have a regular bedtime and wake time? What are they?	What time does your child go to bed and get up on school days? Weekends? Do you think he is getting enough sleep? (P)	What time do you usually go to bed on school nights? Weekends? How much sleep do you usually get? (C)
5. **S**noring	Does your child snore a lot or have difficulty breathing at night?	Does your child have loud or nightly snoring or any breathing difficulties at night? (P)	Does your teenager snore loudly or nightly? (P)

C, child; P, parent.

for sleep disturbances should take place in the context of every well child visit and should include a range of potential sleep problems; one simple sleep screening algorithm, the "BEARS," is outlined in Table 17-7. Because parents may not always be aware of sleep problems, especially in older children and adolescents, it is also important to question the child directly about sleep concerns. The recognition and evaluation of sleep problems in children requires both an understanding of the association between sleep disturbances and daytime consequences, such as irritability, inattention, and poor impulse control, and familiarity with the developmentally appropriate differential diagnoses of common presenting sleep complaints (difficulty initiating and maintaining sleep, episodic nocturnal events). An assessment of sleep patterns and possible sleep problems should be part of the initial evaluation of every child presenting with behavioral and/or academic problems, especially ADHD.

Effective preventive measures include educating parents of newborns about normal sleep amounts and patterns. The ability to regulate sleep, or control internal states of arousal to fall asleep at bedtime and to fall back asleep during the night, begins to develop in the first 12 wk of life. Thus, it is important to recommend that parents put their 2-4 mo old infants to bed "drowsy but awake" to avoid dependence on parental presence at sleep onset and to foster the infants' ability to self-soothe. Other important sleep issues include discussing the importance of regular bedtimes, bedtime routines, and transitional objects for toddlers, and providing parents and children with basic information about good "sleep hygiene" and adequate sleep amounts.

The cultural and family context within which sleep problems in children occur should be considered. Co-sleeping of infants and parents is a common and accepted practice in many ethnic groups, including African-Americans, Hispanics, and Southeast Asians. The goal of independent self-soothing in young infants may not be shared by these families. On the other hand, the institution of co-sleeping by parents as an attempt to address a child's underlying sleep problem, rather than as a lifestyle choice, is likely to yield only a temporary respite from the problem and may set the stage for more significant sleep issues.

EVALUATION OF PEDIATRIC SLEEP PROBLEMS

The clinical evaluation of a child presenting with a sleep problem involves obtaining a careful medical history to assess for potential medical causes of sleep disturbances, such as allergies, concomitant medications, and acute or chronic pain conditions. A developmental history is important because of the aforementioned frequent association of sleep problems with developmental delays and autism spectrum disorders. Assessment of the child's current level of functioning (school, home) is a key part of evaluating possible mood, behavioral, and neurocognitive sequelae of sleep problems. Current sleep patterns, including the usual sleep duration and sleep-wake schedule, are often best assessed with a sleep diary, in which parents record daily sleep behaviors for an extended period. A review of sleep habits, such as bedtime routines, daily caffeine intake, and the sleeping environment (e.g., temperature, noise level) may reveal environmental factors that contribute to the sleep problems. Nocturnal symptoms that may be indicative of a medically based sleep disorder, such as OSA (loud snoring, choking or gasping, sweating) or PLMs (restless sleep, repetitive kicking movements), should be elicited. An overnight sleep study is seldom warranted in the evaluation of a child with sleep problems unless there are symptoms suggestive of OSA or periodic leg movements, unusual features of episodic nocturnal events, or daytime sleepiness that is unexplained.

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