

# PEDIATRIC ANESTHESIOLOGY EXAMINATION

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Content Outline  
April 2022

The Content Outline for the Pediatric Anesthesiology Examination reflects the subject matter for the Pediatric Anesthesiology subspecialty. It is divided into five sections including Basic Science, Organ Based Basic and Clinical Sciences, Clinical Subspecialties, Clinical Science of Anesthesia, and Special Problems or Issues. The examination covers material from all of these sections. The outline reflects disease states, management considerations, and issues relatively unique to the pediatric patient. The subspecialty board certified pediatric anesthesiologist is expected to have knowledge within each of these categories and topics.



## **I. BASIC SCIENCE**

### **A. Anatomy**

1. General Development
  - a. Airway
  - b. Body habitus
  - c. Water, volume, and blood composition
2. Anatomy for Procedures
  - a. Airway management
  - b. Central neuraxial blockade
  - c. Peripheral nerve blockade
  - d. Vascular cannulation

### **B. Physics and Anesthesia Equipment**

1. Respiration
  - a. Breathing circuits
  - b. Ventilation devices and techniques
2. Methods for Monitoring
  - a. Brain, spinal cord, and neuromuscular function
  - b. Cardiac rhythm and vascular pressures
  - c. Oxygenation, gas concentration, and ventilation
  - d. Temperature
3. Ultrasound: Physics and Clinical applications

### **C. Anesthetic Pharmacology: Physiologic States, Pathophysiologic States and Adverse Effects, Development Pharmacology**

1. Pharmacokinetics and Pharmacodynamics
  - a. Blood-brain barrier
  - b. Drug absorption
  - c. Drug distribution
  - d. Neuromuscular system
  - e. Biotransformation and excretion
  - f. Pharmacogenetics
2. Non-opioid Analgesics
3. Opioid Analgesics
4. Sedative and Anxiolytic Agents
5. Anti-emetics
6. Inhalation Anesthetics
7. Local Anesthetics
8. Neuromuscular Blocking and Reversal Agents
9. Sympathetic and Parasympathetic Agents
10. Agents Affecting Coagulation

## **II. ORGAN-BASED BASIC AND CLINICAL SCIENCES**

### **A. Respiratory System**

1. Anatomy and Physiology
  - a. Prenatal and postnatal development
  - b. Respiratory mechanics, ventilation, and lung volumes
  - c. Oxygen transport
  - d. Surfactant, surface activity, and lung mechanics
  - e. Lung physiology

1. surfactant and surface tension
  2. metabolism
  3. ventilation / perfusion matching
2. Clinical Sciences
    - a. Obstructive disease
      1. upper airway
      2. tracheobronchial
      3. parenchymal
    - b. Restrictive disease
      1. pleural
      2. neurologic
      3. musculoskeletal
    - c. Anesthesia for thoracic procedures
      1. one lung ventilation
      2. video-assisted thoracoscopy
      3. mediastinal masses
      4. chest wall surgery / reconstruction
      5. lung Transplantation

## **B. Cardiovascular System**

1. Anatomy and Physiology
  - a. Prenatal and postnatal development
  - b. Fetal, transitional, and adult circulation
  - c. Benign heart murmur
2. Clinical Science
  - a. General considerations
    1. cardiovascular effects on anesthetic uptake and delivery
    2. anesthetic effects on the cardiovascular system
    3. vasoactive medications
  - b. Disease states
    1. acyanotic lesions
    2. cyanotic lesions
    3. palliative procedures
    4. pulmonary hypertension
    5. infectious diseases
    6. cardiomyopathies
    7. pericardial disease
    8. intracardiac masses
    9. arrhythmic lesions
    10. heart transplantation
  - c. Anesthesia for cardiac procedures
    1. complete anatomic and physiological repairs
    2. single ventricle procedures
    3. palliation surgery
    4. management and consequences of cardiopulmonary bypass
    5. deep hypothermic circulatory arrest
    6. anesthesia for pacemaker / implantable cardiac defibrillator insertion and replacement

7. anesthesia for diagnostic, interventional and electrophysical procedures
- d. Anesthesia for the adult with congenital heart disease
- e. Cardiopulmonary resuscitation
- f. Anesthesia for non-cardiac procedures in child with congenital heart disease

### **C. Central and Peripheral Nervous Systems**

1. Anatomy and Physiology
  - a. Prenatal and postnatal development
    1. brain, fontanelles, cranial sutures, and spinal cord
    2. myelination, autonomic nervous systems, and pain pathways
    3. neurodegenerative changes after anesthesia
  - b. Neurophysiology
2. Clinical Science
  - a. General considerations
    1. intracranial pressure and blood flow
    2. pharmacology of diuretics, steroids, and anticonvulsant medications,
  - b. Disease states
    1. autism, developmental delay, and attention-deficit hyperactivity disorder
    2. hydrocephalus
    3. tumors
    4. seizure disorders
    5. cerebrovascular disorders
    6. open and closed head injuries
    7. spinal cord disorders
    8. neurodegenerative disorders
    9. spasticity
    10. Chiari malformations
  - c. Anesthesia for neurosurgical procedures
    1. seizure surgery
    2. intracranial tumors and vascular lesions
    3. craniofacial reconstruction / cranioplasty
    4. meningomyelocele / spinal surgery
    5. neurologic imaging

### **D. Gastrointestinal System**

1. Anatomy and Physiology
  - a. Prenatal and postnatal development
2. Clinical Science
  - a. Esophageal, stomach and intestine disorders
    1. abdominal wall defects
    2. intestinal rotation defects
    3. atresias, stenoses and webs
    4. inflammatory states
    5. duplications and cysts
    6. hernias
    7. necrotizing enterocolitis
  - b. Liver, biliary tract and spleen disorders
  - c. Anorectal disorders

- d. Morbid obesity / bariatric surgery
- e. Gastrointestinal endoscopy
- f. Esophageal / gastrointestinal foreign bodies
- g. Liver, intestinal, and multivisceral transplantation

#### **E. Renal/Urinary**

- 1. Anatomy and Physiology
  - a. Prenatal and postnatal development
  - b. Homeostasis functions
- 2. Clinical Science
  - a. Renal failure
  - b. Phimosis and hypospadias
  - c. Ureteropelvic junction obstruction
  - d. Vesicoureteral reflux
  - e. Bladder exstrophy
  - f. Renal transplantation

#### **F. Endocrine/Metabolic**

- 1. Anatomy and Physiology
  - a. Prenatal and postnatal development
  - b. Puberty and variants
- 2. Clinical Science
  - a. Adrenal disorders
  - b. Diabetes mellitus
  - c. Diabetes insipidus
  - d. Disorders of sodium regulation
  - e. Pheochromocytoma
  - f. Thyroid disorders
  - g. 22q.11 deletion syndrome (DiGeorge)

#### **G. Hematology/Oncology**

- 1. Anatomy and Physiology
  - a. Prenatal and postnatal development
- 2. Clinical Science
  - a. Hematology
    - 1. anemias
    - 2. coagulation disorders
  - b. Oncology
    - 1. leukemia
    - 2. neuroblastoma
    - 3. retinoblastoma
    - 4. sarcomas / osteosarcomas
    - 5. Wilms tumor
  - c. Chemotherapeutic agents and side effects
  - d. Radiotherapy
  - e. Bone marrow and stem cell transplants
    - 1. graft versus host disease
  - f. Immunologic disorders (congenital and acquired)

#### **H. Genetics**

1. Anatomy and Physiology
2. Clinical Sciences
  - a. Chromosomal abnormalities
  - b. Craniofacial syndromes
  - c. Effects of environmental agents
  - d. Endocrine disorders
  - e. Immunologic disorders
  - f. Inborn errors of metabolism
  - g. Malignant hyperthermia
  - h. Mitochondrial myopathies
  - i. Myopathic disorders
  - j. Myotonias
  - k. Muscular dystrophies
  - l. Neurologic disorders
  - m. Overgrowth syndromes
  - n. Osteochondrodysplastic syndromes
  - o. Skin and connective tissue disorders

### **III. CLINICAL SUBSPECIALTIES**

#### **A. Fetal**

1. General Considerations
  - a. Fetal oxygenation
  - b. Fetal pain and stress
  - c. Fetal monitoring
2. Clinical Science
  - a. Fetal surgery
  - b. Ex utero intrapartum treatment (EXIT) procedure

#### **B. Neonatal**

1. General Considerations
  - a. Apgar scoring
  - b. Post conceptional age and organ system maturity
  - c. Effects of anesthesia and surgery on cognitive development
  - d. Stress response
  - e. Transport medicine
  - f. Neonatal resuscitation
2. Clinical Science
  - a. Surgical disease states
    1. amniotic bands
    2. congenital cystic adenomatoid malformation
    3. congenital diaphragmatic hernia
    4. duodenal atresia
    5. hernia
    6. hypertrophic pyloric stenosis
    7. myelomeningocele
    8. necrotizing enterocolitis
    9. neonatal lobar emphysema
    10. omphalocele and gastroschisis
    11. sacrococcygeal teratoma
    12. tracheo-esophageal fistula
    13. vein of Galen malformation

- b. Medical disease states
  - 1. apnea and bradycardia
  - 2. anemia
  - 3. bronchopulmonary dysplasia
  - 4. failure to thrive
  - 5. intraventricular hemorrhage
  - 6. kernicterus
  - 7. persistent pulmonary hypertension
  - 8. persistent fetal circulation
  - 9. retinopathy of prematurity
  - 10. neonatal abstinence syndrome

**C. Painful Disease States**

- 1. Pathophysiology
  - a. Procedural, postoperative, and posttraumatic pain
  - b. Pain in the neonate
  - c. Chronic pain states
- 2. Treatment
  - a. Regional analgesia
  - b. Pharmacologic and non-pharmacologic techniques of pain management
  - c. Complementary and alternative pain management

**D. Otolaryngology**

- 1. Airway Procedures
  - a. Bronchoscopic procedures
  - b. Tonsillectomy, adenoidectomy, and abscess drainage
  - c. Tracheotomy
  - d. Choanal atresia repair
  - e. Laryngotracheal reconstruction
  - f. Laser procedures
- 2. Otologic Procedures
  - a. Myringotomy and tubes
  - b. Cochlear implant, tympanoplasty, and mastoidectomy

**E. Plastic and Oral-Maxillary Facial Surgery**

- 1. Coexisting Diseases
  - a. Craniofacial syndromes
  - b. Congenital heart disease
  - c. Increased intracranial pressure
  - d. Obstructive sleep apnea
- 2. Clinical Science
  - a. Craniosynostosis repairs
  - b. Cleft repairs
  - c. Hypoplasia repairs
  - d. Syndactyly repairs
  - e. Tissue flaps and tissue expanders
  - f. Vascular malformations
  - g. Mandibular repairs

**F. Ophthalmology**

- 1. General Considerations

- a. Physiology
  - b. Pharmacology of ophthalmologic medications
2. Clinical Science
- a. Enucleations
  - b. Retinopathy of prematurity
  - c. Trauma
  - d. Tear duct probing
  - e. Strabismus repair

**G. Orthopedic Surgery**

1. Coexisting Diseases
- a. Cardiopulmonary disease
  - b. Congenital malformations
  - c. Myopathic disease
  - d. Neuromuscular disease
  - e. Oncologic disease
  - f. Systemic disease
2. Clinical Science
- a. Anterior, posterior, and combined spine fusion
  - b. Chest wall reconstruction
  - c. Tourniquet management

**H. Trauma and Burns**

1. Trauma
- a. Age-related mechanisms and associated injuries
  - b. Incidence, patterns, implications of abuse
  - c. Management of the polytrauma victim
  - d. Hypothermia and submersion injury
2. Burns
- a. Types, mechanisms, locations and implications of injuries
  - b. Inhalation injuries/airway management
  - c. Fluid resuscitation and calculating burn surface area
  - d. Anesthetic and pain management of the burn patient

**IV. CLINICAL SCIENCE OF ANESTHESIA**

**A. Evaluation and Preoperative Preparation of the Pediatric Patient (See Specific Disease States)**

1. Normal developmental milestones
2. Evaluation of Coexisting Disease
- a. Cerebral palsy
  - b. Cystic fibrosis
  - c. Down syndrome
  - d. Gastro-esophageal reflux
  - e. Latex allergy
  - f. Mediastinal masses
  - g. Reactive airway disease
  - h. Upper respiratory tract infections
  - i. Congenital heart disease
  - j. Autism spectrum disorders
3. Physical Examination



4. Laboratory Testing
  5. Psychosocial Preparation of the Patient and Family
  6. Parental Presence and Pharmacologic Preparation for Anesthetic Induction
  7. Fasting Requirements
  8. Age-Related Differences in Anesthetic Risk
  9. Informed Consent
- B. General Considerations of the Perioperative Period**
1. Fluid, Electrolyte, and Glycemic Management
  2. Positioning
  3. Thermoregulation
  4. Transfusion Therapy and Blood Conservation Techniques
- C. Regional Anesthesia and Analgesia**
1. Pharmacology and Toxicity of Local Anesthetics
  2. Central Neuraxial Blockade: Indications, Contraindications, Techniques, Adjuvants, and Controversies
  3. Peripheral Nerve Blockade: Indications, Contraindications, Techniques, Adjuvants, and Controversies
- D. General Anesthesia**
1. Stages and Signs of Anesthesia
  2. Induction Techniques
  3. Airway Management
    - a. Indications, techniques, limitations, and devices for mask ventilation
    - b. Indications, techniques, limitations, and devices for endotracheal intubation
    - c. Management of the difficult airway
    - d. Methods for single lung ventilation and lung separation
- E. Complications of Anesthesia**
1. Airway Obstruction
  2. Inadequate Vascular Access
  3. Iatrogenic trauma / positioning injury
  4. Hypotension
  5. Hypertension
  6. Dysrhythmias
  7. Cardiac Arrest
  8. Anaphylactic and Anaphylactoid Reactions
  9. Awareness and Recall Under Anesthesia
  10. Psychosocial Complications
- F. Special Techniques and Situations**
1. Controlled Hypotension
  2. Controlled Hypothermia
  3. Surgery on ECMO
  4. Management of Laparoscopic Surgery
  5. Anesthesia for Satellite and Remote Locations
  6. Perioperative Management of the Intensive Care Unit Patient
- G. Postoperative Period**
1. Management and Diagnosis of Pain, Anxiety and Emergence Agitation
  2. Respiratory, Cardiovascular, and Neurologic Consequences of Anesthesia
  3. Post Operative Nausea and Vomiting
  4. Management of the Post Anesthetic Care Unit

## **H. Monitored Anesthesia Care and Sedation**

### **I. Acute and Chronic Pain Management**

## **V. SPECIAL PROBLEMS OR ISSUES**

### **A. Special Surgical Procedures**

### **B. Professional Issues**

1. Ethical and Legal Obligations of Pediatric Anesthesia Care and Research
2. Teaching, Supervision, and the Anesthesia Care Team
3. Practice-based Learning and Improvement
4. Continuous Quality Improvement

### **C. Principles of Biostatistics and Pediatric Study Design**

### **D. Substance Abuse**

### **E. Ethics and Medico-Legal Issues**

1. Professionalism: definitions and teaching
  - a. Disclosure of errors or adverse events
  - b. Professional behavior: honesty, integrity, compassion, respect, altruism, conflicts of interest, response to marketing
  - c. Recognizing limitations in expertise and need to seek guidance
  - d. Personal role in reporting unsafe conditions and fitness for work
  - e. Recognizing and responding to unprofessional behavior
  - f. Evidence-based practice
2. Patient autonomy and decision making
  - a. Principles of informed consent and shared decision making
  - b. Advance Directives, Do Not Resuscitate (DNR) Orders, medical orders for life-sustaining treatment
  - c. Health care proxy laws and limitations
  - d. Patients Refusing Transfusion or Other Treatments
3. Legal and regulatory issues
  - a. Elements of medical malpractice: duty, breach of duty, causation, damages
  - b. Legal actions and consequences, National Practitioner Data Bank, Closed Claims findings, professional liability insurance
  - c. Understanding laws related to controlled substances, including opioids and cannabinoids
  - d. Patient privacy issues: principles of confidentiality, access to records, protected health information
  - e. The Health Insurance Portability and Accountability Act (HIPAA)
4. Primary Certification, Recertification, Maintenance of Certification and Related Issues (Professional Standing, Lifelong Learning, Cognitive Knowledge, Clinical Practice Assessment, Systems-Based Practice)
5. Research ethics
  - a. Principles of justice, autonomy, beneficence, nonmaleficence
  - b. Ethical standards in research design: scientific validity, fair subject selection, favorable risk-benefit profile

- c. Review and implementation of trials, the institutional review board
- d. Informed consent in research
- e. Conflicts of interest and financial disclosure

- 6. Clinician wellness and self-care
  - a. Diagnosis and treatment of burnout
  - b. Sleep deprivation
  - c. Adaptations for clinical disability
  - d. Substance abuse

## **F. Practice Management**

- 1. Costs of medical/anesthesia care
  - a. Understanding principles of healthcare funding and payment
  - b. Cost-conscious practice
- 2. Efficient OR staffing and scheduling
  - a. Subspecialization issues: pediatrics, cardiac, regional, obstetric coverage
  - b. Anesthesia care team and scope of practice
- 3. Population health: perioperative surgical home and enhanced recovery
  - a. Population based health determinants, resources to improve access
  - b. Health care disparities between populations
- 4. Clinical informatics
  - a. Electronic medical record systems: costs and benefits
  - b. Artificial intelligence and machine learning
- 5. Documentation, coding, and billing
  - a. Compliance with documentation requirements
  - b. Accuracy, clarity, specificity of medical records
  - c. Coding integrity, audits, and insurance denials

## **G. Quality Improvement and Patient Safety**

- 1. Definitions
  - a. Medical error, adverse events, sentinel events, misuse of medications and technology
  - b. Human factors and mindfulness
  - c. Systems thinking and technology design
- 2. Medication errors: assessment and prevention
  - a. Medication reconciliation
  - b. Information technology to reduce medication errors
- 3. Crisis Management and Teamwork
  - a. Simulation training
  - b. Crisis manuals and other cognitive aids
  - c. Teamwork training
  - d. Handoff communication
  - e. Preoperative and procedural checklists
- 4. Quality Improvement (QI) Basics
  - a. Design, Analysis, and implementation of QI projects

- b. Data collection
- c. QI metrics
- d. Patient satisfaction measurement
- e. Value-based care incentives, pay-for-performance
- 5. Performance Assessment
  - a. Individual benchmarking
  - b. Group and facility scorecards
  - c. Public reporting
    - 1. Federal Quality Payment Program
    - 2. Anesthesia registries
- 6. Change Management Methods
  - a. Peer review and morbidity and mortality Conferences
  - b. Lean Six Sigma
  - c. QI and the 5S process
  - d. Value stream mapping
  - e. Failure mode and effects analysis
  - f. Root cause analysis
- 7. Barriers to QI

#### **H. Diversity, Equity, and Inclusion (DEI) in Health Care**

- 1. Barriers
  - a. Systematic racism, colorism/shadeism, sexism, discrimination against sexual orientation, gender identity, language, national origin, ethnicity, religion, immigration/citizenship status, age, familial status, and disability
  - b. Bias; Implicit bias, microaggression, stereotype threat
- 2. Approaches to improvement; interventions at individual, inter-personal, community, organizational and policy levels; cultural and gender competency, upstander vs. bystander, allyship vs. performative action, tokenism vs. representation, assortativity vs. homophily
- 3. DEI in the workplace
- 4. DEI in academia
  - a. Leadership
  - b. Scholarship; Representation of diversity and race related topics in research, Importance of language in reports discussing racial inequities

#### **I. Healthcare Disparities**

- 1. Social determinants of health considerations in assessment and management of patients – race, language, education status, religion, housing, nutrition, geographic location, rural vs. urban, access to and quality of care, health coverage
- 2. Infant, child, and adolescent healthcare disparities
- 3. ICU disparities and outcomes