

Guidelines for Advanced Training for Physicians in Critical Care



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Guidelines for Advanced Training for Physicians in Critical Care

American College of Critical Care Medicine
of the Society of Critical Care Medicine

The terms used to describe physician trainees of various levels are currently in evolution. A number of primary boards are currently using the term, *resident*, to refer to physicians in subspecialty as well as primary specialty training programs. However, since the American College of Critical Care Medicine of the Society of Critical Care Medicine have developed separate curricula for primary specialty and subspecialty residents, we will use the term, *advanced trainee*, to refer to the latter in the current document. The term will replace the term, *fellow*, for consistency with the trend of the primary boards.

I. Director Qualifications

The director of an advanced training program for physicians in critical care:

- A. Demonstrates a commitment to critical care.

The director demonstrates a commitment to advanced training and practice in critical care medicine by the development of an educational curriculum recognized by the ACGME¹ as an accredited program in critical care. A commitment to the interest and well-being of the patients, as well as the trainees, should also be demonstrated.

- B. Has the interest, authority, and time required to fulfill teaching responsibilities in order to develop, implement, and achieve the educational goals of the training program.

The director has the time available to teach trainees in the program, as well as interact with other advanced training directors for physicians in critical care, in order to maintain the quality of all institutional programs. A prior and continuing commitment to the principles and practices of educational theory and methodologies should be demonstrated.

- C. Has the proper training and experience in the management of critically ill patients and administration of critical care units.

The director achieves certification in his/her primary specialty and in the subspecialty of critical care and has had active experience in unit administration.

- D. Maintains active clinical involvement in the practice of critical care.

The director should be an intensivist² with a substantial time commitment to the clinical practice of critical care, not only to maintain his/her knowledge base, but also to serve as a role model for trainees.

- E. Maintains continuing education in critical care.

The director maintains his/her own continuing education by reading appropriate literature and participating in conferences on national and regional levels relating to critical care.

- F. Exhibits active interest in medical research related to critical care.

The director should actively participate in and provide an environment conducive to basic science and clinical research, and should encourage his/her trainees to participate in and publish results of research, and engage in scientific presentations.

II. Program Content

The Council of the Society of Critical Care Medicine has revised its guidelines for advanced training for physicians in critical care in 1973, 1986, and 1991. These guidelines have again been reviewed to ensure that the recommendations remain current. The following is a listing of cognitive and procedural skills that are fundamental to the training of specialists in critical care, regardless of whether a training program is based in surgery, anesthesiology, pediatrics or internal medicine. Directors may choose to include additional cognitive or procedural skills to augment this listing in order to suit their goals for advanced training for physicians in critical care. These guidelines should only be used as recommendations for training directors to use in the development of each program. They are not intended to constrain any training program nor are they intended to mandate the inclusion of all listed cognitive or procedural skills in the content of a training program. Each director determines the content of his/her program in accordance with ACGME criteria. Ultimately, the cognitive material to be tested for subspecialty certification is the prerogative of the specialty board administering a certifying examination in critical care.

There is enough of a distinct additional cognitive database required for the practice of pediatric critical care to warrant a supplemental listing of special skills for those training in this field. These special skills are listed separately.

It is the responsibility of the training director to assure that all trainees are capable of managing and caring for the critically ill. This responsibility will involve exposure to both primary care and consultative experiences. It is incumbent upon the training director to provide an environment in which the trainee has enough significant patient care responsibilities to develop both patient care and procedural skills.

Research must be encouraged in all two- and three-year programs and to the extent possible in one-year programs as well. All trainees must appreciate the need for ongoing research in the field and should cooperate with research efforts of department/division members.

It is the responsibility of the training directors to assure that each trainee develops procedural skills. Because of prior training and experience, each trainee will require a different degree of supervision and variability in the number of procedures required to achieve proficiency.

Recommendations

A. Specific Credentials

Each trainee should achieve provider and/or instructor status in one or more of the following:

1. Advanced Cardiac Life Support (ACLS)
2. Advanced Trauma Life Support (ATLS) - optional
3. Pediatric Advanced Life Support (PALS) or Advanced Pediatric Life Support (APLS)
4. Fundamental Critical Care Support (FCCS) - optional

B. Cognitive

Acquisition of the following cognitive skills by trainees could be assured by the training director through the use of any of a number of techniques, including didactic sessions, journal clubs or illustrative case reports.

1. Cardiovascular Physiology, Pathology, Pathophysiology, and Therapy
 - a. Shock and its complications
 - b. Myocardial infarction and its complications
 - c. Cardiac rhythm and conduction disturbances; indications for and types of pacemakers
 - d. Pulmonary embolism - thrombus, air, fat, amniotic
 - e. Pulmonary edema; cardiogenic, noncardiogenic
 - f. Cardiac tamponade and other acute pericardial diseases
 - g. Acute and chronic life threatening valvular disorders
 - h. Acute aortic and peripheral vascular disorders including A-V fistulae
 - i. Acute complications of cardiomyopathies and myocarditis
 - j. Vasoactive and inotropic therapy
 - k. Pulmonary hypertension and cor pulmonale
 - l. Complications of angioplasty
 - m. Principles of oxygen transport and utilization
 - n. Hemodynamic effects caused by ventilatory assist devices
 - o. Thrombolytic and anticoagulant therapy

- p. Perioperative management of patient undergoing cardiovascular surgery
- q. Recognition, evaluation and management of hypertensive emergencies and urgencies

C. Respiratory Physiology, Pathology, Pathophysiology and Therapy

- 1. Acute respiratory failure
 - a. Hypoxemic respiratory failure including acute respiratory distress syndrome
 - b. Hypercapnic respiratory failure
 - c. Acute on chronic respiratory failure
- 2. Status asthmaticus
- 3. Smoke inhalation, airway burns
- 4. Aspiration
- 5. Flail chest, chest trauma, pulmonary contusion
- 6. Bronchopulmonary infections
- 7. Upper airway obstruction
- 8. Near drowning
- 9. Pulmonary mechanics and gas exchange
- 10. Oxygen therapy
- 11. Hyperbaric oxygenation
- 12. Mechanical ventilation
 - a. Pressure and volume ventilators
 - b. Positive end-expiratory pressure, intermittent mandatory ventilation, continuous positive airway pressure, high frequency ventilation, inverse ratio ventilation, pressure support ventilation, negative pressure ventilation, differential lung ventilation, pressure control, and non-invasive ventilation
 - c. Indications for and hazards of mechanical ventilation
 - d. Barotrauma volutrauma
 - e. Criteria for weaning and weaning techniques
 - f. Extracorporeal membrane oxygenation

- g. Permissive hypercapnia
- h. Liquid ventilation
- 13. Airway maintenance
 - a. Emergency airway management
 - b. Endotracheal intubation
 - c. Tracheostomy - open and percutaneous
 - d. Long-term intubation vs. tracheostomy
- 14. Ventilatory muscle physiology, pathophysiology and therapy including polyneuropathy of the critically ill, prolonged effect of neuromuscular blockers
- 15. Pleural Diseases
 - a. Empyema
 - b. Massive effusion
 - c. Pneumothorax
 - d. Hemothorax
- 16. Pulmonary hemorrhage and massive hemoptysis
- 17. Nitric oxide

D. Renal Physiology, Pathology, Pathophysiology and Therapy

- 1. Renal regulation of fluid balance and electrolytes
- 2. Renal failure: Prerenal, renal, and postrenal
- 3. Derangements secondary to alterations in osmolality and electrolytes
- 4. Acid-base disorders and their management
- 5. Principles of hemodialysis, peritoneal dialysis, ultrafiltration, continuous arteriovenous hemofiltration (CAVH), and continuous veno-venous hemofiltration (CVVH)
- 6. Interpretation of urine electrolytes
- 7. Evaluation of oliguria
- 8. Drug dosing in renal failure
- 9. Rhabdomyolysis

E. CNS Physiology, Pathology, Pathophysiology and Therapy

1. Coma
 - a. Metabolic
 - b. Traumatic
 - c. Infectious
 - d. Mass lesions
 - e. Vascular-anoxic or ischemic
 - f. Drug induced
2. Hydrocephalus
3. Psychiatric emergencies
4. Perioperative management of patient undergoing neurological surgery
5. Brain death evaluation and certification
6. Diagnosis and management of persistent vegetative states
7. Management of increased intracranial pressure (ICP) including ICP monitors
8. Status epilepticus
9. Neuromuscular disease causing respiratory failure
 - a. Guillian-Barré
 - b. Amyotrophic Lateral Sclerosis
 - c. Myasthenia Gravis
10. Nontraumatic intracranial bleed
 - a. Subarachnoid
 - b. Intracerebral
 - c. Others

F. Metabolic and Endocrine Effects of Critical Illness

1. Colloid osmotic pressure
2. Alimentation
 - a. Enteral and parenteral
 - b. Evaluation of nutritional needs including indirect calorimetry
3. Endocrine
 - a. Disorders of thyroid function (thyroid storm, myxedema coma, sick euthyroid syndrome)
 - b. Adrenal crisis
 - c. Disorders of antidiuretic hormone metabolism

- d. Diabetes mellitus
 - (1) Ketotic and nonketotic hyperosmolar coma
 - (2) Hypoglycemia
- e. Pheochromocytoma
- f. Insulinoma
- g. Disorders of calcium and magnesium balance

G. Infectious Disease Physiology, Pathology, Pathophysiology and Therapy

- 1. Antibiotics
 - a. Antibacterial agents including aminoglycosides, penicillins, cephalosporins and quinolones
 - b. Antifungal agents
 - c. Antituberculosis agents
 - d. Antiviral agents
 - e. Agents for parasitic infections
- 2. Infection control for special care units
 - a. Development of Antibiotic Resistance
 - b. Universal Precautions
 - c. Isolation and Reverse Isolation
- 3. Anaerobic infections
- 4. Systemic Inflammatory Response Syndrome (SIRS)
- 5. Tetanus
- 6. Hospital acquired and opportunistic infections in the critically ill
- 7. Adverse reactions to antimicrobial agents
- 8. ICU support of the immunosuppressed patient
 - a. Acquired Immune Deficiency Syndrome (AIDS)
 - b. Transplant
 - c. Oncologic
- 9. Infectious risks to health care workers
- 10. Evaluation of fever in the ICU patient

H. Physiology, Pathology, Pathophysiology and therapy of Acute Hematologic and Oncologic Disorders

- 1. Acute defects in hemostasis
 - a. Thrombocytopenia/thrombocytopathy
 - b. Disseminated intravascular coagulation
- 2. Anticoagulation; fibrinolytic therapy

3. Principles of blood component therapy
 - a. Platelet transfusion
 - b. Packed red blood cells
 - c. Fresh frozen plasma
 - d. Specific coagulation factor concentrates
 - e. Albumin, plasma protein fraction
 - f. Stroma-free hemoglobin
 - g. White blood cell transfusion
 - h. Cryoprecipitate
4. Acute hemolytic disorders including thrombotic microangiopathies
5. Acute syndromes associated with neoplastic disease and antineoplastic therapy
6. Sickle cell crisis
7. Plasmapheresis
8. Prophylaxis against thromboembolic disease

I. Physiology, Pathology, Pathophysiology and Therapy of Acute Gastrointestinal (GI)/ Genitourinary (GU)/ Obstetric-Gynecological (Ob-Gyn) Disorders

1. Acute pancreatitis with shock
2. Upper gastrointestinal bleeding including variceal bleeding
3. Lower gastrointestinal bleeding
4. Acute and fulminant hepatic failure
5. Toxic megacolon
6. Acute perforations of the gastrointestinal tract
7. Ruptured esophagus
8. Acute inflammatory diseases of the intestine
9. Acute vascular disorders of the intestine, including mesenteric infarction
10. Obstructive uropathy, acute urinary retention
11. Urinary tract bleeding
12. Toxemia of pregnancy; amniotic fluid embolism, HELLP Syndrome, ovarian hyperstimulation
13. Hydatidiform mole
14. Perioperative management of surgical patients
15. Stress ulcer prophylaxis

16. Drug dosing in hepatic failure
17. Acalculous cholecystitis
18. Post-operative complications including fistulas, wound infection, and evisceration

J. Environmental Hazards

1. Drug overdose and withdrawal
 - a. Barbiturates
 - b. Narcotics
 - c. Salicylates
 - d. Alcohols
 - e. Cocaine
 - f. Tricyclic Antidepressants
 - g. Acetaminophen
 - h. Others
2. Temperature Related Injuries
 - a. Hyperthermia
 - b. Hypothermia

3. Envenomation

K. Immunology and Transplantation

1. Principles of transplantation (organ donation, procurement, maintenance of organ donors, preservation, transportation, allocation, implantation, national organization of transplantation activities)
2. Immunosuppression
3. Organ transplantation: indications and postoperative care

L. Trauma, Burns

1. Initial approach to the management of multisystem trauma
2. CNS trauma (brain and spinal cord)
3. Skeletal trauma including the spine and pelvis
4. Chest trauma - blunt and penetrating
5. Abdominal trauma, blunt and penetrating
6. Crush injury
7. Burns
8. Electrical injury

M. Monitoring, Bioengineering, Biostatistics

1. Prognostic indices, severity and therapeutic intervention scores
2. Principles of electrocardiographic monitoring, measurement of skin temperature and resistance, transcutaneous measurements
3. Invasive hemodynamic monitoring
 - a. Principles of strain gauge transducers
 - b. Signal conditioners, calibration, gain, adjustment
 - c. Display techniques
 - d. Principles of arterial, central venous and pulmonary artery pressure catheterization and monitoring
 - e. Assessment of cardiac function and derived hemodynamic parameters
4. Noninvasive hemodynamic monitoring
5. Electrical safety
6. Thermoregulation
7. CNS brain monitoring (intracranial pressure, cerebral blood flow, cerebral metabolic rate, EEG, jugular venous bulb oxygenation, transcranial doppler)
8. Respiratory monitoring (airway pressure, intrathoracic pressure, tidal volume, pulse oximetry, dead space-tidal volume ratio, compliance, resistance, capnography, pneumotachography)
9. Metabolic monitoring (oxygen consumption, carbon dioxide production, respiratory quotient)
10. Use of computers in critical care units

N. Administrative and Management Principles and Techniques

1. For training subsequent trainees in critical care medicine
2. Organization and staffing of critical care units
3. Standards for special care units, Joint Commission on Accreditation of Healthcare Organizations
4. Medical record keeping in special care units
 - a. Problem-oriented record approach
 - b. System-structures record approach
 - c. Manual versus mechanical (computer) record generation
 - d. Organization of physician, nursing, technical and laboratory records within special care units
5. Priorities in the care of the critically ill or injured

6. Collaborative practice principles
7. Participation in relevant hospital committees
8. Design of special care units
9. Emergency medical systems in prehospital care
10. Performance improvement, principles and practices
11. Principles of triage and resource allocation
12. Utilization management
 - a. Case management
 - b. Clinical practice guidelines
13. Critical pathway development
14. Electronic data base
15. Medical economics: essential principles of health care reimbursement
 - a. Health care legislation
 - b. Managed care
16. Budget development and management

O. Pharmacokinetics and Dynamics: Drug Metabolism and Excretion in Critical Illness

1. Uptake metabolism and excretion of common drugs
 - a. Antibiotics
 - b. Antiarrhythmics
 - c. Chemotherapeutic agents
 - d. Neuromuscular blockers
 - e. Sedatives
 - f. Analgesics
 - g. Others

P. Ethical and Legal Aspects of Critical Care Medicine

1. Death and dying
2. The ethical decision-making process
3. Forgoing life-sustaining treatment and orders not to resuscitate
4. Principles of pain management
5. Use of surrogate decision-makers, especially in the vulnerable population
6. Major ethical principles

7. Futile care
8. Treatment of the handicapped and mentally retarded
9. Rights of patients, the right to refuse treatment
10. Living wills, advance directives; durable power of attorney

Q. Principles of Research in Critical Illness

1. Study design
2. Biostatistics
3. Grant funding and protocol writing
4. Manuscript preparation

R. Psychosocial Aspects: awareness of the physiological and social effects of life-threatening illness on patients and families

III. Procedural Skills

The definition of competency to perform the listed procedures must include knowledge of the indications, contraindications and complications of these interventions:

A. Airway Management

1. Maintenance of open airway in nonintubated, unconscious, paralyzed patients
2. Intubation (oral, nasotracheal)
3. Cricothyrotomy, transtracheal catheterization, tracheostomy

B. Breathing, Ventilation

1. Ventilation by bag and mask
2. Suction techniques
3. Chest physiotherapy, incentive spirometry
4. Fiberoptic laryngo-tracheo-bronchoscopy
5. Management of pneumothorax (needle, chest tube insertion, drainage systems)
6. Monitoring airway pressures
7. Operation of mechanical ventilators
8. Measurement of endotracheal tube cuff pressures
9. Interpretation of sputum gram stain

10. Performance of bedside pulmonary function tests
11. Application of appropriate oxygen therapy
12. Application of end tidal CO₂ detectors, pulse oximetry, oximetric pulmonary artery catheters
13. X-ray interpretation

C. Circulation

1. Arterial puncture and blood sampling
2. Insertion of monitoring lines
 - a. Central venous
 - b. Arterial
 - c. Pulmonary artery catheters
3. Pericardiocentesis
4. Management of arterial and venous air embolism
5. Transvenous pacemaker insertion
6. Cardiac output determinations by the thermodilution technique
7. Obtain 12-lead ECG
8. Use of infusion pumps for vasoactive drugs
9. Cardioversion
10. Application and regulation of intra-aortic assist devices
11. Application of noninvasive cardiovascular monitoring
12. Transcutaneous pacing/defibrillation

D. Central Nervous System

1. Lumbar puncture
2. Monitoring of modified EEG
3. Application of hypothermia

E. Renal

1. Manage peritoneal dialysis
2. Manage CAVH, CVVH
3. Insertion of hemodialysis catheters

F. Gastrointestinal Tract

1. Insertion of transesophageal devices
- *2. Prevention and management of upper gastrointestinal bleeding
3. Gastric tonometry

G. Hematology

- *1. Utilization of blood component therapy
- *2. Management of massive transfusions including rapid infusers
- *3. Autotransfusion
- *4. Proper ordering and interpretation of coagulation studies

H. Infection

1. ICU sterility techniques and precautions
2. Sampling, staining, interpretation of blood, sputum, urine, body fluids, and drainage

I. Metabolism, Nutrition

1. Enteral feeding access
2. Parenteral nutrition

J. Monitoring, Bioengineering

1. Utilization, zeroing, calibration of transducers
2. Use of amplifiers and recorders
3. Trouble-shooting equipment
4. Correcting basic electrical safety hazards

***While not procedures, these items represent specific management skills or calculations that are deemed important, requiring specific evaluation.**

K. Trauma

1. Temporary immobilization of fractures
- *2. Pneumatic anti-shock garment
3. Use of special beds, e.g., circle electric bed, roto bed, flexicare
4. Peritoneal lavage

L. Intensive Care Unit Laboratory

1. Blood gas analysis

IV. Patient Care Experience

Trainees must have at least 12 months of primary service experience in which the trainee has significant responsibility for patient management. Consultative experience alone does not provide the exposure necessary to train an intensivist.

Trainees must (at a minimum) be exposed to patients with:

A. Hemodynamic instability

1. Use of computer and calculators to determine derived parameters, including systemic and pulmonary vascular resistance, oxygen content, intrapulmonary shunt, alveolar - arterial gradients, oxygen transport and consumption
2. Dynamic ECG interpretation
3. Infusion of epinephrine, dopamine, norepinephrine, nitroglycerine, dobutamine, isoproterenol, nitroprusside and other vasoactive drugs
4. Thrombolytic therapy
5. Fluid resuscitation

B. Respiratory insufficiency and failure

1. Indications, applications, techniques, criteria, and physiological effects of positive end-expiratory pressure; intermittent positive pressure breathing; intermittent mandatory ventilation; continuous positive airway pressure; pressure support ventilation. Airway pressure release ventilation, pressure control, noninvasive ventilation
2. Use of intermittent positive pressure breathing therapy, bronchodilators, humidifiers
3. Weaning techniques
4. Sedation, analgesia, neuromuscular blockade

* While not procedures, these items represent specific management skills or calculations that are deemed important, requiring specific evaluation.

- C. Acute neurological insult including those with elevated intracranial pressure**
 - 1. Management of intracranial pressure monitors and intracranial hypertension
- D. Acute renal insufficiency and failure**
- E. Acute life-threatening endocrine and/or metabolic derangements**
- F. Drug overdose and poisonings**
- G. Coagulation disorders**
- H. Serious infections including sepsis**
 - Interpretation of antibiotic levels, sensitivities
- I. Nutritional inadequacy and failure**
 - Monitoring and assessment of metabolism and nutrition
- J. Acute trauma**

In order to properly prepare the intensivist to function in the multidisciplinary environment, it is necessary for all trainees to have patient care experience with both critically ill medical and surgical patients.

Interinstitutional cooperation among medical centers may be necessary to provide the trainee with adequate patient experience. Additional experiences may include:

- A. Neonatal intensive care patients**
- B. Neurosurgical intensive care patients**
- C. Invasive and noninvasive cardiology**
- D. Pulmonary function**
- E. Respiratory therapy**
- F. Burn patients**
- G. Dialysis**
- H. Shock/trauma**
- I. Operating room anesthesia**
- J. Coronary care patients**
- K. Pediatric intensive care patients**
- L. Infectious disease**
- M. Pulmonary medicine**

- N. Nutritional support**
- O. Cardiovascular surgery patients**
- P. Transplant intensive care patients**
- Q. Obstetric intensive care patients**

V. Additional Requirements for Trainees in Pediatric Critical Care Medicine

In addition to the relevant items in the common core recommendations listed in the sections above, those training to care for children must also attain the following supplemental cognitive skills:

A. Cardiovascular: Physiology of the Transitional Circulation and Developmental Changes in the Cardiovascular System

1. Physiology, Pathology, Pathophysiology of Congenital heart disease
 - a. Obstructive
 - b. Cyanotic
 - c. Acyanotic
2. Perioperative management of children with congenital heart disease
3. Shunting through fetal circulatory pathways as a maladaptive response to lung disease and secondary pulmonary hypertension
4. Diagnosis and emergency management of life threatening rhythm disturbances in children
5. Kawasaki disease
6. Age and size specific doses for cardioversion and drug dosing

B. Respiratory: Developmental Changes in Respiratory Tract Anatomy, Physiology and in the Mechanics of Breathing

1. Bronchopulmonary dysplasia
2. Ondine's syndrome
3. Sudden infant death syndrome
4. Bronchiolitis, croup, bacterial tracheitis and epiglottitis
5. Pertussis and its complications
6. Cystic fibrosis
7. Congenital or acquired anomalies of the lung or airway causing stridor
8. Therapy
 - a. Cuffed versus uncuffed endotracheal tubes

- b. Nasal versus oral intubation
- c. Criteria for tracheostomy
- d. High frequency ventilation
- e. Pediatric oxygen hoods and bag-valve-mask
- f. Extracorporeal membrane oxygenation

C. Renal: Developmental Changes in Renal Function

- 1. Hemolytic uremic syndrome
- 2. Congenital anomalies and disorders of function
- 3. Fluid and electrolyte requirements according to age and weight

D. CNS: Age Related Changes in Coma Scoring and Neurologic Function and Intracranial Dynamics

- 1. Congenital CNS and cranial malformations requiring surgery
 - a. Meningomyelocele with hydrocephalus
 - b. Craniosynostosis
 - c. Ventriculo-peritoneal shunt failure
- 2. Congenital neuromuscular disorders requiring mechanical ventilation
- 3. Status epilepticus in children
- 4. Intraventricular hemorrhage
- 5. Reye's syndrome
- 6. Subdural effusions both traumatic and septic
- 7. Age related differences in mechanisms of intracranial hypertension .
- 8. Age related differences in diagnosis of brain death

E. Metabolic/Endocrine: Developmental Changes in Metabolism and Endocrine Function

- 1. Inborn errors of metabolism
- 2. Variability with age of caloric and nitrogen requirements
- 3. Proper formulation of pediatric parenteral alimentation

F. Infectious Disease

- 1. Group B streptococcal and Escherichia coli meningitis and pneumonia
- 2. Chlamydial pneumonia
- 3. Neonatal herpes infections
- 4. Epiglottitis, bacterial tracheitis

5. Pediatric AIDS/HIV

G. Hematological

1. Sickle cell and its complications including acute chest syndrome
2. Complications associated with therapy for childhood leukemias and tumors
3. Developmental changes in normal values
4. Developmental changes in immunocompetence
5. Neonatal bleeding disorders
6. Complications of bone marrow transplant
 - a. Venous-occlusive disease
 - b. Graft vs. host disease

H. GI/GU/Ob-Gyn

1. Congenital abnormalities - perioperative physiology and management of:
 - a. Omphalocele, gastroschisis, tracheoesophageal fistula, esophageal atresia, diaphragmatic hernia, Hirschsprung's disease
2. Acquired abnormalities common in pediatrics
 - a. Necrotizing enterocolitis, diarrheal dehydration, hyperbilirubinemia

I. Trauma/Burns

1. Child abuse, shaken baby syndrome, sexual abuse

J. Monitoring

1. Pediatric modifications of adult technology including pulse oximeters, exhaled CO₂ monitors, Swan-Ganz catheters, automatic BP cuffs

K. Administration of a Pediatric Intensive Care Unit

L. Pharmacokinetics: Age-related Differences in Drug Metabolism and Toxicity

M. Ethical/Legal

1. Child abuse and neglect statutes
2. Baby Doe legislation
3. Withholding/withdrawing care in Pediatrics

N. Psychosocial

1. Understand age appropriate concept of death in children
2. Normal and delayed growth and development

O. Economics

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These guidelines have been developed by the American College of Critical Care Medicine and thereafter reviewed and approved by the Society of Critical Care Medicine's Council. These guidelines reflect the official opinion of the Society of Critical Care Medicine and do not necessarily reflect, and should not be construed to reflect, the views of certifying bodies, regulatory agencies or other medical review organizations.

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