# ASSOCIATION OF PEDIATRIC SURGERY TRAINING DIRECTORS

## PEDIATRIC SURGERY TRAINING CURRICULUM

### 1. Head and neck

Demonstrate knowledge of, and the capacity to manage patients in relation to the different patterns of disease, natural history and responses to treatment of head and neck disease in children. This will include:

- congenital lesions: thyroglossal duct cyst, branchial cleft cysts; sinuses and other remnants; cystic hygromas / lymphangiomas, hemangiomas
- salivary glands : tumors, hemangiomas, inflammation/calculi, ranula
- neck masses: inflammatory (acute and chronic lymphadenitis, atypical mycobacteria); tumors (lymphoma, rhabdomyosarcoma, neuroblastoma, teratoma, nasopharyngeal tumors); congenital torticollis,
- cranial trauma: diagnosis and emergency management including indications for increased intracranial pressure (ICP) monitoring, Glasgow Coma Scale (GCS)
- cervical trauma: injuries to the esophagus, trachea, blood vessels; airway management; tracheostomy; recognition and emergency management of cervical spine fractures

### 2. Non-Cardiac Thoracic Surgery

Demonstrate knowledge of, and the capacity to manage patients in relation to the different patterns of disease, natural history, and responses to treatment of non-cardiac chest conditions in children. This will include:

- esophageal atresia and tracheoesophageal fistula (TEF): embryology, classification, diagnosis, treatment, complications with their treatment, esophagoscopy
- esophageal achalasia, webs, stenosis (congenital and acquired), duplications
- acquired esophageal conditions: gastroesophageal (GE) reflux, Barrett's esophagus, hiatal hernia, achalasia, strictures, perforations (cervical, distal), foreign bodies, lye ingestion, replacement, foreign bodies.
- pulmonary: neonatal and pediatric pulmonary physiology, pulmonary function and studies, mechanical ventilation.
- general pulmonary and pleural pathophysiology: pulmonary edema, restrictive and obstructive disease, ARDS, pneumonia, RSV, empyema, benign and malignant effusions.
- congenital lung lesions: cystic adenomatoid malformation (CCAM), pulmonary sequestration, lobar emphysema, blebs and spontaneous pneumothorax; hypoplasia and pulmonary hypertension (ECMO)
- acquired lung lesions: emphysema, abscess/pneumatocele, empyema, chylothorax, pulmonary metastases, infiltrates in immunosuppressed patients, lung complications in cystic fibrosis (CF).
- congenital airway lesions: stenosis, vascular rings and compression, broncho- and tracheomalacia, indications for and technique of laryngo-tracheo-bronchoscopy
- acquired airway lesions: bronchial adenoma (carcinoids, etc.); recognition of foreign body aspiration and endoscopic retrieval, epiglotitis and croup.
- mediastinal lesions: cysts, tumors according to location (anterior, middle, posterior)
- chest wall conditions: pectus excavatum and carinatum; tumors; reconstruction, trauma, flail chest
- diaphragmatic conditions: congenital diaphragmatic hernia (Bochdalek, Morgagni); diaphragmatic eventration and phrenic nerve palsy;

**3. Abdomen**

Demonstrate knowledge of, and the capacity to manage patients in relation to the different patterns of disease, natural history, and responses to treatment of abdominal disease in children. This will include:

- gastrointestinal physiology: secretion, absorption, motility, blood supply; continence, defecation; short bowel syndrome, intestinal adaptation
- general gastrointestinal pathophysiology; physiologic testing (manometry, pH study) upper and lower GI endoscopy indications and recognition of findings, ascities
- gastric conditions: pyloric stenosis (including physiologic disturbances), antral web; spontaneous perforation, gastric volvulus, antral dysmotility; stress ulcer, gastritis and other forms of acid/peptic disease
- duodenal conditions: atresia, stenosis, webs (including windsock variant); diverticula, duplications; peptic ulcer
- small intestinal conditions: malrotation, jejunoileal atresia / stenosis, meconium ileus and equivalent; meconium peritonitis, Meckel's diverticulum and related vitelline duct anomalies; necrotizing enterocolitis (NEC); intussusception; duplications, mesenteric cysts; neoplasms; Crohn's disease; congenital bands, mesenteric defects, bowel obstruction
- colonic conditions: appendicitis; inflammatory bowel disease, typhlitis; meconium plug syndrome, intestinal pseudo-obstruction; Hirschsprung's disease, neuronal intestinal dysplasia; colonic atresia, polyps (juvenile, familial, adenomatous)
- anorectal conditions: imperforate anus (associated with cloaca, all levels and variants), fissures, abscesses, fistulae, condylomata, rectal prolapse; constipation, fecal incontinence, anal stenosis and rectal duplications, sacral anomalies.
- hepatic conditions: congenital and acquired liver cysts, trauma, tumors (see oncology section); portal hypertension; liver abscess
- biliary conditions: biliary atresia, biliary hypoplasia; bile duct perforation, choledochal cyst; gallstones, acute/chronic cholecystitis; physiologic jaundice, neonatal and pediatric cholestatic syndromes; portal hypertension, liver transplantation (indications, complications, results)
- splenic conditions: hereditary spherocytosis, thalassemia, sickle cell disease; red blood count (RBC) enzyme deficiencies (pyruvate-kinase, hexose-kinase); other hemolytic anemias, idiopathic thrombocytopenic purpura (ITP); Gaucher's disease, splenic cyst, lymphangioma, abscess
- pancreatic conditions: cystic fibrosis; pancreas divisum, annular pancreas; pancreatitis (trauma, lipid, steroid, drug induced, gallstone induced, ductal anomaly); congenital cysts, pseudocysts, tumors, hyperinsulinism
- abdominal wall conditions and defects: gastroschisis, omphalocele and variants; all hernias (umbilical, inguinal, epigastric, femoral, etc.); vitelline duct remnants; umbilical granulomas, exstrophy
- abdominal trauma: intestinal trauma, lap belt injury; hepatic trauma (operative and non-operative management, hemophilia); splenic trauma (non-operative management, indications for surgery, splenorrhaphy, partial splenectomy, vaccines, prophylactic antibiotics, splenectomy risks)

**4. Genitourinary Tract Conditions**

Demonstrate knowledge of, and the capacity to manage patients in relation to the different patterns of disease, natural history, and responses to treatment of genitourinary conditions in children. This will include:

- penis: phimosis, paraphimosis, balanitis, circumcision (indications and contra-indications, including complications and their treatment), hypospadias
- inguinoscrotal area: cryptorchidism, varicocele, hydrocele, acute scrotum (torsion, etc.)

- bladder: exstrophy (bladder, cloacal); urachal anomalies, reflux, urinary tract infection
- kidney: cystic renal diseases, ureteral duplications, posterior urethral valves
- gonadal tumors: testicular (benign and malignant, including teratomas), other germ cell and non-germ cell tumors, paratesticular rhabdomyosarcoma, metastatic i.e. leukemia
- trauma: kidney, ureter, bladder with adequate knowledge of pelvic fractures and urethral injuries
- renal failure: dialysis and complications (access)

**5. Gynecologic Conditions**

Demonstrate knowledge of, and the capacity to manage patients in relation to the different patterns of disease, natural history, and responses to treatment of gynecologic conditions in children. This will include:

- congenital conditions: cloaca, vaginal atresia, hemato/hydro(metro)colpos, bifid vagina, duplex uterus, urogenital sinus
- inflammatory conditions: pelvic inflammatory disease, vulvovaginitis, vulvar abscess, fusion labia minora
- traumatic/mechanical conditions: vaginal laceration, child abuse; torsion (normal ovary, cyst, tumor)
- neoplastic conditions: ovarian cysts (follicular, teratomatous, carcinomatous, serous, mucinous); ovarian solid tumors (yolk sac, teratoma, carcinoma, theca/lutein, arrhenoblastoma, dysgerminoma); vaginal and uterine tumors (yolk sac, rhabdomyosarcoma); vulvar lesions (cysts, nevi, hemangioma)

**6. Disorders of sexual differentiation**

Pediatric surgeons will, in collaboration with other health professionals, care for children with disorders of sexual differentiation. They must therefore demonstrate the genetic and molecular knowledge of, and the capacity to manage patients with these conditions based different patterns of disease, natural history, responses to treatment and ethical implications of gender assignment. This will include patients with adrenogenital syndrome (variants, enzyme deficiencies, diagnosis and treatment), mixed gonadal dysgenesis, true- and pseudo- hermaphroditism, testicular feminization syndrome and its variants, and gonadal tumors that may develop in these patients.

**7. Endocrine Anomalies**

Pediatric surgeons will, in collaboration with other health professionals, care for children with endocrine anomalies. They must therefore demonstrate knowledge of, and the capacity to manage patients with these conditions based on different patterns of disease, natural history, and responses to treatment. This will include:

- thyroid: hyperthyroidism (diagnosis, medical therapy, management of thyroid storm, preparation for surgery, surgical techniques); thyroiditis; tumors (role of FNAC [fine-needle aspiratory cytology], other diagnostic techniques; therapy by type, multiple endocrine neoplasia syndromes); management of thyroid mass following neck irradiation; postoperative management (hypocalcemia, respiratory distress, recurrent nerve palsy, follow-up for malignancy), papillary and follicular tumors, medullary carcinoma.

- parathyroid conditions: hypoparathyroidism; hyperparathyroidism (primary, secondary, tertiary)
- breast conditions: neonatal hypertrophy, mastitis; gynecomastia; nipple discharge; fibroadenoma, fibrocystic disease; cystosarcoma phyllodes; premature thelarche
- gastrointestinal problems: gut hormones; all endocrine disorders affecting the gastrointestinal tract
- pancreatic conditions: hyperinsulinism (newborn - adenoma vs. neonatal pancreatic dysplasia, diagnosis, medical and surgical treatment; older child - adenoma, hyperplasia); Tumors (islet cell tumors, VlPoma, gastrinoma including Zollinger-Ellison (Z-E) syndrome); (see gastrointestinal and

trauma sections)

- adrenal conditions: adrenocortical tumors (aldosteronoma - Conn's syndrome ; Cushing's syndrome -hyperplasia vs. carcinoma ; virilizing tumors) ; pheochromocytoma (diagnosis, sites including extra-adrenal, bilateral, localization techniques, surgery - perioperative blood pressure control, technique, search for multiple/extra-adrenal tumors); (see section on tumors)

**8. Oncology**

Pediatric surgeons will, in collaboration with other health professionals, care for children with cancer. They must therefore demonstrate knowledge of, and the capacity to manage patients with these conditions based on the different patterns of disease, natural history, and responses to treatment. This will include:

- general principles: oncogenes, DNA-flow cytometry (diploid, aneuploid); paraneoplastic and tumor-associated syndromes (e.g., opsomyoclonus); hyperthermia, immunotherapy, radiation biology, immunosuppression and opportunistic infections, cancer nutrition, chemotherapy and drug action; surgical complications of chemotherapy and bone marrow transplantation
- renal tumors: Wilms' tumor, mesoblastic nephroma, nephroblastomatosis, adenocarcinoma, rhabdoid tumor, and renal cell carcinoma
- adrenal tumors: neuroblastoma, ganglioneuroblastoma, carcinoma
- liver tumors: benign (hemangioma, hemangiomatosis, hemangioendothelioma, hamartoma, adenoma, focal nodular hyperplasia [FNH]); malignant (hepatoblastoma, hepatocellular carcinoma)
- soft tissue sarcomas and other tumors: rhabdomyosarcoma (all sites; principles of therapy according to site/histology), fibrosarcoma, leiomyosarcoma, liposarcoma, neurofibromas
- teratomas: sacrococcygeal and gonadal tumors with embryology, pathology, familial teratomas, associated syndromes; other teratoma sites
- lymphoma: Hodgkin's Disease; Non-Hodgkin's Disease, including pathology (surface markers), sites, patterns of presentation including post-transplantation lymphoproliferative disease (PTLD)
- bone tumors: osteogenic sarcoma and Ewing's sarcoma (including peripheral neuroectodermal tumors [PNET]) as they relate to pediatric surgical intervention (rib resection, lung metastases, etc.)

**9. Critical Care**

Pediatric surgeons, in coordination with pediatric intensivists and other health professionals, will care for critically ill children. They must therefore demonstrate knowledge of, and the capacity to manage patients with these conditions based on the different patterns of disease, natural history, and responses to treatment. This will include:

- fluids and electrolytes: maintenance requirements, management of dehydration, third-space loss; renal output, acid-base equilibrium; correction of perioperative electrolyte disturbances
- shock: hypovolemic (hemodynamic monitoring, resuscitation, crystalloid vs. colloid), cardiogenic (inotropic agents, etc.), septic (hyperdynamic state, fluid resuscitation, Swan-Ganz monitoring, antibiotics)
- cardiovascular: monitoring, heart failure, pharmacologic treatment
- pulmonary physiology: normal lung function and volumes, ventilation/perfusion abnormalities; ventilators (pressure vs. volume cycled, positive end-expiratory pressure [PEEP], continuous positive airway pressure [CPAP], intermittent mandatory ventilation [IMV], high frequency and jet ventilation); adult respiratory distress syndrome [ARDS]
- nutrition: normal caloric requirements by age group, carbohydrate, fat and protein contributions and concentrations, vitamins, trace elements, minerals; nutritional assessment techniques; enteral vs. parenteral nutrition; enteral formulas, defined diets; parenteral nutrition (peripheral vs. central

solutions, techniques, complications), influence of disease on nutritional requirements (trauma, burns)
- coagulation: normal coagulation cascade; management of specific coagulation disorders (hemophilia, von Willebrand's disease, diffuse intravascular and consumptive coagulopathy, fibrinolysis, sick platelet syndrome, idiopathic thrombocytopenia purpura, thrombosis; effects of heparin, anti-platelet agents, thrombolytics
- infection and immunity: nosocomial infections, wound infections (strep, clostridia, mixed, etc), varicella, hemolytic–uremic syndrome, congenital immunodeficiency syndromes and acquired (AlDS, acquired immunodeficiency syndrome)
- anesthesia: inhalation agents, muscle relaxants, recognition and management of malignant hyperthermia; differential diagnosis and treatment of cardiac arrest during surgery; management of postoperative pain in infants and children
- extra-corporeal membrane oxygenation (ECMO): indications in neonates and older children, techniques of cannulation, monitoring, and complications

**10. Trauma and Burns**

Pediatric surgeons, in coordination with other health professionals, will care for critically injured children. They must therefore demonstrate knowledge of, and the capacity to manage patients with these conditions based on the different patterns of injury, impending disability, and responses to treatment. This will include:

- trauma: demographics, epidemiology; recognizable patterns of injury (i.e., seat belt syndrome, patterns of child abuse); initial priorities; principles of operative and non-operative management of head, neck, chest, abdomen, pelvis, genitourinary and extremity trauma
- trauma management; initial assessment, venous access, cardiac tamponade and contusion, tension pneumothorax, aortic and other vascular disruption
- head injury, intracranial pressure (monitoring and treatment), intracranial hematomas, skull fracture, nerve injury.
- thoracic trauma (as above)_
- abdominal trauma : blunt and penetrating, all grades of hepatic and splenic injury, pancreatic contusion and transaction (all forms of evaluation and management) gastrointestinal and genitourinary, seat belt injury.
- musculoskeletal: pelvic fractures, long bone fractures and stabilization, dislocations and complications, compartment pressures
- soft tissue: tetanus, snake bite, crush injury and rhabdomyolysis, wound infection
- burns: pathophysiology of severe burn injury; airway evaluation and management fluid resuscitation (initial and maintenance); electrical burns, escharotomy, nutritional management, excision and grafting, topical agents and dressings, allo- and zenografts
- battered children and patterns of injury, child abuse
- Injury prevention

**11. Neonatology**

Pediatric surgeons will, in coordination with neonatologists and other health professionals, care for premature and ill newborns. They must therefore demonstrate knowledge of and the capacity to manage patients with these conditions based on the different patterns of disease, natural history, and responses to treatment. This will include:
- physiology of the premature infant: comparison with small for gestational age infants, complications, fluid requirements, thermal neutrality, response to cold, metabolic rate, renal function, hepatic immaturity, formulas and caloric requirements, etc.

- Congenital and acquired cardiac anomalies: VACTERL, implications of cyanotic and noncyanotic lesions, patent ductus arteriosus, coarctation
- hyperbilirubinemia: physiology, phototherapy, exchange transfusion, cholestasis hypoglycemia, hypocalcemia
- intracranial bleeding: staging, techniques of diagnosis, site of blood, management, outcome
- newborn respiratory distress syndrome: etiology, diagnosis, treatment, complications
- neonatal sepsis: immune status (comparison of premature and full-term infant), diagnostic workup, bacteriology, treatment, pharmacokinetics, TORCH infections

**12. Skin and Subcutaneous Tissues**

It is important for pediatric surgeons to demonstrate knowledge of and the capacity to manage patients in relation to the different patterns of disease, natural history, and responses to treatment of cutaneous and subcutaneous conditions in children. This will include skin and subcutaneous lesions (nevi, nevus sebaceous, pilomatrixoma, juvenile melanoma; vascular malformations and their classification (with associated syndromes and conditions), lipoma; dermoid and epidermoid cyst), ingrown toenails and paronychia; and pilonidal sinus and abscess.

**13. Transplantation**

Pediatric surgeons will, in collaboration with other health professionals, be involved in the care of children with organ transplants or awaiting transplantation. They must therefore demonstrate knowledge of the indications for pediatric liver, kidney, small bowel transplants, and of immunosuppressive agents (effects and complications).

**14. Fetal Medicine**

Pediatric surgeons are an integral part of the prenatal evaluation of parents and infants with a known surgical disease. Pediatric surgeons participate in a number of ways in this prenatal management.

- Prenatally diagnosed surgical conditions: pediatric surgeons are often involved in counseling of future parents of fetuses with gastroschisis, omphalocele, congenital diaphragmatic hernia, cystic adenomatoid malformation of the lung (CCAM), pulmonary sequestrations, congenital tumors (teratomas), ovarian and abdominal masses and cysts, esophageal atresia, and others. Counseling includes a description of the condition and its scope, treatment options, complications and long-term outcome.
- Conditions that may require immediate intervention at birth, in particular those lesions and conditions that may compromise the airway and breathing of the fetus: the surgeon plays a central role in the planning and performance of ex-utero, intrapartum (EXIT) procedures, in conjunction with members of the maternal-fetal medicine, neonatology and anesthesia departments; planning includes prenatal, preoperative imaging and discussions regarding timing of the intervention.
- Many more indications for fetal surgery have been proposed over the last two decades; although most have not stood the test of time and are no longer considered appropriate, the pediatric surgeon needs to know these conditions and understand the rationale for fetal intervention, the reasons for failure of this approach and the current treatment options and outcomes. Conditions include congenital diaphragmatic hernia, myelomeningocele, congenital hydrocephalus, hypoplastic left (and right) heart syndrome and aortic (pulmonary) stenosis, urinary tract obstruction and abdominal wall defects.

**PRIMARY SKILLS OBJECTIVES**

By the end of training, the resident should have acquired and demonstrated the following generic skills, as they apply to a pediatric surgical practice. Please refer to the Resident Evaluation Form for an outline of the management and procedural examples for competency based achievement as the residency progresses

*a. Surgical Skills*

- The resident is expected to be able to perform independently the full spectrum of operative interventions related to the primary pediatric surgery conditions listed above. Several additional areas of skill expertise are listed below.

*b. Trauma*

The Pediatric Surgery resident is expected to:

- function as a trauma team leader
- function as the operating surgeon for pediatric multiple trauma patients, and as supervising surgeon in an operating room in which several specialty groups may be working simultaneously, if required
- have primary responsibility for the non-operative care of the trauma patient including burns
- be able to obtain airway and vascular access in the trauma patient, and perform appropriate diagnostic procedures

*c. Endoscopy*

The resident should be familiar with the indications, techniques and complications of:

- laryngoscopy, bronchoscopy
- esophagoscopy
- thoracoscopy
- laparoscopy
- cystoscopy
- proctosigmoidoscopy

The resident must also know the basics of cystoscopy and vaginoscopy as applied to the treatment of ambiguous genitalia and imperforate anus.

*d. Other Procedures*

The resident should be familiar with the indications, techniques and complications of:

- central line insertion or other vascular cannulation (temporary and long-term, implantable ports, ECMO)
- tracheostomy, gastrotomies and other enterostomies, pleural and peritoneal based shunts, intestinal and airway dilatation techniques

**COMPETENCY BASED OBJECTIVES**

The resident is expected to demonstrate an appreciation of the unique psychological needs of pediatric patients and their families and must be able to deal effectively and compassionately with family members. They should develop an understanding of the ethical principles as related to the complex issue of congenital abnormalities and as applied to children undergoing medical treatment, participating in research, etc. They should demonstrate an appreciation of the economic factors that influence decision making and the impact of such factors on families. They are expected to be aware of legal issues regarding consent, confidentiality and refusal of treatment.

The resident should communicate effectively with the hospital's physicians, nurses, other health professionals and health-related agencies. He/she should be able to act in a consultative role with other physicians and health professionals. The resident should demonstrate high standards of ethical behavior and respect the dignity of patients and colleagues, including their age, culture, disabilities, ethnicity, gender and sexual orientation. They should demonstrate integrity, honesty, compassion and empathy in caring for the patients. He/she is expected to maintain comprehensive, timely and legible medical records.

**1) Patient Care**

*General Requirements*:

- Provide care that is compassionate, appropriate, and effective for the treatment of surgical problems of infants and children. Obtain and synthesize relevant history from patients, their families and the community.
- Establish a therapeutic relationship with patients and their family and discuss appropriate information with the health care team.
- Listen effectively.
- Demonstrate effective communication skills.
- Maintain adequate records.

*Specific Requirements*:

- Demonstrate an appreciation of the unique psychological needs of pediatric patients.
- Demonstrate an appreciation of the unique relationship between pediatric patients and their families and be able to deal effectively and compassionately with family members by establishing therapeutic relationships.

**2) Interpersonal and Communication Skills**

*General Requirements*:

- Consult effectively with other physicians and health care professionals.
- Contribute effectively to other interdisciplinary team activities.

*Specific Requirements*:

- Effectively use the team approach in the management of critically and chronically ill patients, such as newborns with congenital anomalies and children with cancer, inflammatory bowel disease, or transplantation.

**3) Practice-Based Learning and Improvement**

*General Requirements*:

- Utilize resources effectively to balance patient care, learning needs, and outside activities.
- Allocate finite health care resources wisely.
- Work effectively and efficiently in a health care organization.
- Utilize health care technology to optimize patient care, life-long learning and other activities.

*Specific Requirements*:
- Demonstrate an appreciation of the economic factors that influence decision-making and the impact of such factors on families.
- Understand the principles and practice of quality assurance and improvement, and actively participate in hospital-based quality assurance and improvement programs.

**4) Systems-Based Practice**

*General Requirements*:
- Identify the important determinants of health affecting patients and the larger context and system of health care with the ability to effectively call on system resources to provide care that is of optimal value.
- Contribute effectively to improved health of patients and communities and importantly, injury prevention.
- Recognize and respond to those issues where advocacy is appropriate.

*Specific Requirements*:
- As an example, the resident should be knowledgeable about appropriate use of car safety restraints according to the child's size (i.e. rear-facing infant seats, forward-facing car seats, booster seats, lap-shoulder belts).
- Contribute to health-maintenance advocacy for children, including such areas as travel safety, helmet use, children operating machinery or motorized vehicles and accessibility to firearms.

**5. Medical Knowledge**

*General Requirements*:
- Develop, implement and monitor a personal continuing education strategy.
- Critically appraise sources of medical information to formulate evidence based practices.
- Facilitate learning of patients, house staff/students and other health care professionals through formal and informal teaching opportunities.
- Understand and appreciate the patterns of study and review that will constantly update the knowledge, technical skills and innovations that will maintain competence in the future.

*Specific Requirements*:
- Contribute to development of new knowledge to foster the academic growth of the specialty of Pediatric Surgery by participating in scholarly work.

**6. Professionalism**

*General Requirements*:
- Deliver the highest quality care with integrity, honesty and compassion.
- Exhibit appropriate personal and interpersonal professional behaviors.
- Practice medicine ethically consistent with one's obligations as a physician.

*Specific Requirements*:

- Demonstrate sensitivity to age, gender, culture and ethnicity in dealing with patients and their families.
- Understand the ethical principles as related to the complex issue of congenital abnormalities and as applied to children submitted to medical treatment, research, etc.
- Recognize the importance of maintenance of competence and evaluation of outcomes.
- Understand the legal issues related to consent, confidentiality, and refusal of treatment