

THE AMERICAN BOARD OF PEDIATRICS®

CONTENT OUTLINE

Pediatric Gastroenterology

**Subspecialty In-Training, Certification, and
Maintenance of Certification (MOC) Examinations**

INTRODUCTION

This document was prepared by the American Board of Pediatrics Subboard of Pediatric Gastroenterology for the purpose of developing in-training, certification, and maintenance of certification examinations. The outline defines the body of knowledge from which the Subboard samples to prepare its examinations. The content specification statements located under each category of the outline are used by item writers to develop questions for the examinations; they broadly address the specific elements of knowledge within each section of the outline.

Pediatric Gastroenterology

Each Pediatric Gastroenterology exam is built to the same specifications, also known as the blueprint. This blueprint is used to ensure that, for the initial certification and in-training exams, each exam measures the same depth and breadth of content knowledge. Similarly, the blueprint ensures that the same is true for each Maintenance of Certification exam form. The table below shows the percentage of questions from each of the content domains that will appear on an exam. Please note that the percentages are approximate; actual content may vary.

	Content Categories	Initial Certification and In-Training	Maintenance of Certification (MOC)
1.	Common Gastrointestinal Topics	22%	25%
2.	Gastrointestinal Signs and Symptoms; Pathophysiology	10%	10%
3.	Normal Anatomy, Physiology, and Development	4%	4%
4.	Clinical Manifestations and Management of Diseases of the Mouth	1%	1%
5.	Clinical Manifestations and Management of Diseases of the Esophagus	6%	6%
6.	Clinical Manifestations and Management of Diseases of the Stomach and Duodenum	7%	7%
7.	Clinical Manifestations and Management of Diseases of the Intestine	8%	8%
8.	Miscellaneous Diseases Affecting the Gastrointestinal Tract	4%	4%
9.	Clinical Manifestations and Management of Diseases of the Liver	9%	9%
10.	Disorders of the Bile Ducts and Gallbladder	3%	3%
11.	The Pancreas	3%	3%
12.	Diagnostic Studies	4%	4%
13.	Gastrointestinal Motility	3%	3%
14.	Nutrition	8%	8%
15.	Psychological Considerations	2%	2%
16.	Ethical Considerations	1%	1%
17.	Core Knowledge in Scholarly Activities	5%	2%

Gastroenterology

1. Common Gastrointestinal Topics

A. Functional constipation and encopresis

1. Understand the pathophysiology of functional constipation and encopresis
2. Be aware of factors that contribute to functional constipation (eg, dietary, psychological, pharmacologic)
3. Be able to diagnose functional constipation based on history and physical findings
4. Know the long-term outcomes of functional constipation
5. Know how to manage/treat functional constipation (laxatives, stool softeners, bulk agents, behavioral modification)
6. Know the side effects of laxatives, stool softeners, and bulk agents
7. Understand the pharmacology and mechanism of action of various laxative preparations

B. Celiac disease

1. Know the pathogenesis of celiac disease, including immunologic features and genetics
2. Recognize the wide range of clinical manifestations of celiac disease
3. Recognize the risk factors and conditions associated with celiac disease
4. Know the diagnostic tests and other laboratory abnormalities commonly found in celiac disease
5. Know the morphologic and histologic features of untreated celiac disease
6. Understand the treatment of celiac disease
7. Know the assessment of therapeutic success in a patient with celiac disease
8. Know the long-term complications of celiac disease

C. Short-bowel syndrome

1. Know the causes of short-bowel syndrome
2. Understand the various methods to assess intestinal function in infants with short-bowel syndrome
3. Understand the mechanism of immediate and late intestinal adaptation in short-bowel syndrome
4. Plan the short- and long-term therapy of an infant with short-bowel syndrome including addressing nutritional needs
5. Understand the indications for intestinal transplantation in a patient with short-bowel syndrome
6. Recognize the complications of short-bowel syndrome and their therapy (eg, parenteral nutrition-associated cholestasis, electrolyte disturbances, nutritional deficiencies)
7. Know the relative importance of resection length, loss of ileocecal valve, location of resection, and the role of the colon in a patient with short-bowel syndrome
8. Understand the indications for surgical management of short-bowel syndrome.

D. Functional gastrointestinal disorders (FGIDs)

1. Understand the pathophysiology of FGIDs
2. Recognize risk factors for FGIDs (eg, familial, postinfectious, obesity)
3. Be familiar with the symptoms-based criteria for FGIDs (eg, Rome criteria)
4. Recognize common extraintestinal manifestations of FGIDs (eg, sweating, pallor)
5. Recognize the psychological characteristics of children with FGIDs

6. Plan appropriate evaluation of a child with symptoms suggestive of an FGID
 7. Plan the treatment of a child with a FGID
 8. Know the long-term outcome of patients with FGIDs
- E. Inflammatory bowel disease (IBD)
1. Understand the pathogenesis of IBD
 2. Understand the epidemiology, genetics, and environmental risk factors of IBD
 3. Be able to distinguish Crohn from ulcerative colitis or indeterminate colitis
 4. Know the signs and symptoms of IBD, including extra-intestinal manifestations
 5. Know the laboratory tests used in diagnosing and monitoring
 6. Interpret radiologic findings in the diagnosis of IBD
 7. Know how to interpret endoscopic findings in IBD
 8. Know how to interpret histologic findings in IBD
 9. Recognize the complications of medical and surgical treatment of IBD
 10. Recognize and manage toxic megacolon in an IBD patient
 11. Know the long-term outcome of patients with IBD
 12. Know how to manage IBD and its complications (eg, nutritionally, medically, surgically)
 13. Understand the mechanism of action of the drugs used to treat IBD (eg, corticosteroids, 5-aminosalicylic acid, biologic agents, immunomodulators, antibiotics)
 14. Know the side effects of drugs used in the treatment of IBD
- F. Eosinophilic esophagitis (EOE)
1. Know the pathophysiology of EoE
 2. Recognize the presentation and clinical features of eosinophilic esophagitis
 3. Recognize the endoscopic and histologic features of eosinophilic esophagitis
 4. Plan the management of a patient with eosinophilic esophagitis, with an understanding of the principles guiding dietary and pharmacologic therapy
 5. Know the short- and long-term complications of EoE and its management (eg, stricture, impaction, candidal esophagitis, esophageal perforation)
- G. *Helicobacter pylori* infection
1. Know the mechanisms by which *H. pylori* infection causes disease
 2. Understand the risk factors for *H. pylori* infection
 3. Identify the symptoms associated with *H. pylori* infection
 4. Know how to diagnose *H. pylori* infection
 5. Plan the management of a patient with *H. pylori* infection, including recurrent *H. pylori*
 6. Know the diseases associated with *H. pylori* (gastritis, ulcer, gastric carcinoma, MALT)
- H. Gastroesophageal reflux and esophagitis
1. Know the pathogenesis of gastroesophageal reflux
 2. Know the spectrum of symptoms and presentations of gastroesophageal reflux disease at various ages
 3. Recognize the endoscopic and histologic features of reflux esophagitis
 4. Be familiar with the tests diagnostic of esophageal reflux and their limitations
 5. Plan the management of a patient with gastroesophageal reflux, with an understanding of the principles guiding dietary, medical, and surgical therapy

6. Understand the role of H₂-receptor antagonists and proton pump inhibitors (PPIs), including mechanism of action and pharmacologic properties
 7. Understand the side effects of H₂-receptor antagonists and PPIs
 8. Be aware of the natural history of gastroesophageal reflux in infancy and childhood
 9. Recognize the postoperative complications and long-term prognosis associated with antireflux surgery
 10. Understand the definition, pathogenesis, diagnosis, and management of Barrett esophagus
- I. Nonalcoholic fatty liver disease (NAFLD)
1. Know the pathophysiology of NAFLD
 2. Understand the epidemiology of and risk factors for NAFLD
 3. Plan the evaluation of a patient with suspected NAFLD
 4. Plan the management of a patient with NAFLD
 5. Know the long-term complications of NAFLD
- J. Autoimmune hepatitis (AIH)
1. Know the pathophysiology of AIH
 2. Identify the clinical features of autoimmune chronic hepatitis
 3. Understand the laboratory and histologic findings in autoimmune hepatitis types 1 and 2
 4. Plan the treatment of a patient with autoimmune hepatitis
 5. Distinguish autoimmune chronic active hepatitis from other causes of liver disease (eg, primary sclerosing cholangitis, non-A, non-B, non-C viral hepatitis)
- K. Pancreatitis
1. Understand the pathophysiology of acute and chronic pancreatitis
 2. Understand the causes of acute and chronic pancreatitis in childhood
 3. Recognize the clinical manifestations of acute and chronic pancreatitis
 4. Be able to diagnose pancreatitis based on laboratory studies
 5. Identify acute and chronic pancreatitis on radiographic studies (eg, computed tomography, ultrasonography, endoscopic retrograde cholangiopancreatography [ERCP], magnetic resonance cholangiopancreatography [MRCP])
 6. Know the complications associated with acute and chronic pancreatitis (eg, sepsis, hyperlipidemia, hyperglycemia, hypocalcemia, pseudocyst, exocrine insufficiency, pain, malignancy)
 7. Plan the management of a patient with acute and or chronic pancreatitis and its complications (eg, medical, surgical)
- L. Endoscopy: diagnostic
1. Recognize endoscopic abnormalities of the gastrointestinal tract
 2. Know the technique to perform gastrointestinal endoscopy, including proper patient preparation
 3. Know the limitations of radiographic contrast studies versus endoscopic evaluation of gastrointestinal disorders
 4. Know the appropriate indications, contraindications, risks, and benefits for gastrointestinal endoscopy including therapeutic technologies
 5. Recognize and manage complications resulting from endoscopic procedures (eg, upper gastrointestinal endoscopy, sigmoidoscopy, colonoscopy)

6. Know the indications and contraindications for capsule endoscopy and the associated complications

M. Endoscopy: therapeutic

1. Plan the endoscopic therapy of a patient with gastrointestinal bleeding (eg, arteriovenous malformation [AVM], polyp, ulcer, varix)
2. Know the indications for and complications of endoscopic dilation of strictures (eg, small intestine, bile duct, esophagus) and endoscopic retrograde cholangiopancreatography

N. Parenteral nutrition

1. Understand how to formulate the content of parenteral nutrition
2. Know the indications for the use of parenteral nutrition
3. Understand the complications of parenteral nutrition including nutrient deficiencies, and effects on the gut and liver
4. Know the risks and complications associated with central venous lines
5. Be familiar with the laboratory tests to monitor the progress of patients receiving parenteral nutrition
6. Know the factors contributing to the pathogenesis of cholestasis associated with parenteral nutrition

2. **Gastrointestinal Signs and Symptoms; Pathophysiology**

A. Failure to thrive

1. Understand the causes and mechanisms of failure to thrive
2. Know the typical signs and symptoms present in patients with failure to thrive
3. Know the various tests and growth parameters useful in differentiating among various causes of growth failure
4. Recognize the common nongastrointestinal causes of failure to thrive (eg, Williams syndrome, growth hormone deficiency, renal tubular acidosis, gonadal dysgenesis, etc)
5. Understand the concept of, and rationale behind, the energy and protein requirements of catch-up growth

B. Vomiting and regurgitation

1. Understand the various factors (eg, metabolic, anatomic, infectious, inflammatory, neuromuscular) associated with vomiting
2. Know the physiologic (motor) changes that occur during nausea and vomiting, including efferent and afferent neuronal control
3. Be aware of the tests to differentiate disorders associated with vomiting
4. Be aware of the various causes of vomiting in childhood and adolescence (eg, brain tumor, metabolic liver disease, anatomic obstruction, psychiatric, neurologic)
5. Plan diagnostic age-appropriate evaluation of a patient who is vomiting

C. Acute abdominal pain

1. Understand the innervation of the viscera and the concept of referred pain
2. Recognize the major pathologic processes producing pain in the abdomen (eg, obstruction, inflammation)
3. Recognize the importance of and how to perform careful, repeated physical examinations in the evaluation of abdominal pain
4. Recognize the extra-intestinal problems that cause abdominal pain (eg, gynecologic, urologic, musculoskeletal, pulmonary)

5. Recognize and differentiate between various causes of pain by location in the abdomen (eg, lower quadrant, epigastric, right upper quadrant)
 6. Be able to select appropriate diagnostic screening tests in the child with abdominal pain
 7. Know how the differential diagnosis of abdominal pain varies with age
- D. Chronic abdominal pain
1. Formulate a differential diagnosis for a patient with chronic abdominal pain
 2. Differentiate between organic and non-organic causes of recurrent abdominal pain based on signs and symptoms
 3. Understand the evaluation of a patient with chronic abdominal pain
 4. Be familiar with prognostic factors that predict outcome for a patient with chronic abdominal pain
- E. Colic and gas
1. Know the sources of intestinal gas
 2. Formulate an appropriate differential diagnosis for fussiness in an infant (eg, colic)
 3. Devise an appropriate evaluation of fussiness in an infant
 4. Plan the management of an infant with colic
- F. Diarrhea
1. Understand the mechanisms of, how to evaluate for, and treatment of secretory and osmotic diarrhea
 2. Understand the mechanisms of, how to evaluate for, and treatment of inflammatory diarrhea
 3. Know the differential diagnosis, evaluation and management of chronic diarrhea of infancy (including microvillous inclusion disease [MVID], autoimmune enteropathy, tufting enteropathy)
 4. Know the signs and symptoms and plan the management of chronic nonspecific diarrhea of childhood (toddler diarrhea)
 5. Understand the basic mechanisms of fluid and electrolyte transport and disorders of transport causing diarrhea
 6. Understand the indications for and plan the use of prebiotic, probiotic, and symbiotic agents in the management of diarrheal disorders
 7. Understand the adverse effects associated with prebiotic, probiotic, and symbiotic agents
 8. Understand the pharmacology of antidiarrheal drugs
 9. Interpret results of stool analysis (eg, electrolytes, leukocytes, ova and parasites, occult blood)
- G. Malabsorption
1. Recognize, evaluate, and treat various causes of malabsorption (eg, pancreatic insufficiency, mucosal damage, inborn errors of enterocyte enzyme deficiency, abetalipoproteinemia)
 2. Recognize the conditions that produce villous atrophy, dysmotility, bacterial contamination, and immune deficiency with accompanying malabsorption
 3. Recognize and treat conditions that produce bile acid malabsorption
 4. Formulate a differential diagnosis for a patient in whom intestinal malabsorption is suspected
 5. Plan a diagnostic evaluation of a patient in whom malabsorption is suspected

6. Be able to recognize, evaluate, and treat primary or secondary enzyme deficiencies
- H. Gastrointestinal bleeding
1. Recognize the causes of gastrointestinal bleeding in different locations (eg, upper vs lower intestine) and age groups
 2. Assess the hemodynamic status of a patient with acute gastrointestinal bleeding as well as the need for transfusion
 3. Understand the basis of tests that evaluate for the presence of occult blood
 4. Know how to identify the source of gastrointestinal bleeding (eg, endoscopy, angiography, radionucleotide scans)
 5. Plan the management of a patient with acute gastrointestinal bleeding
- I. Abdominal mass
1. Formulate an age-dependent differential diagnosis of an abdominal mass
 2. Recognize the physical findings associated with abdominal masses, and distinguish from other causes of abdominal distention (eg, infection, neoplasms, trauma, fecal impaction, ascites)
- J. Jaundice
1. Know the mechanisms of bilirubin production in early life and differences that occur during the achievement of maturity
 2. Understand the mechanisms of hepatic bilirubin uptake, metabolism, and excretion
 3. Know the various causes of jaundice (eg, hemolysis, cardiac disease, parenteral nutrition, medications)
 4. Formulate a differential diagnosis for jaundice in an infant, child, or adolescent
- K. Liver failure
1. Understand the use of laboratory studies in identifying and diagnosing hepatic failure in infants and children (eg, coagulation studies)
 2. Distinguish between hepatic and nonhepatic coagulopathy in a patient with hepatic failure
 3. Understand the stages of hepatic coma
 4. Understand the clinical and laboratory findings of hepatorenal syndrome and how to differentiate from other renal conditions (eg, acute tubular necrosis)
 5. Diagnose and manage symptoms of hepatic failure
 6. Understand the clinical features of hepatopulmonary syndrome
 7. Identify the infectious causes of fulminant hepatic failure in infancy, childhood and adolescence
 8. Identify the metabolic causes of hepatic failure in infancy, childhood, and adolescence
 9. Identify the pharmacologic causes of hepatic failure
 10. Formulate a differential diagnosis of hepatic failure, including metabolic, anatomic, and cardiovascular causes
- L. Dysphagia
1. Understand the mechanisms responsible for dysphagia
 2. Formulate a differential diagnosis for dysphagia
 3. Plan the evaluation of and identification of causes of dysphagia (eg, using history, imaging, endoscopy, motility)
- M. Hepatomegaly
1. Understand the mechanisms responsible for hepatomegaly
 2. Formulate an age-specific diagnosis for hepatomegaly in an infant, child, or adolescent

3. Plan diagnostic evaluation for a patient with hepatomegaly

N. Ascites

1. Plan the evaluation and management of ascites or peritonitis
2. Know the clinical manifestations and causes of peritonitis
3. Recognize clinical clues to the etiology of ascites
4. Understand the components in the laboratory analysis of ascites fluid and how they aid in the diagnosis (eg, peritonitis, portal hypertension, pancreatitis)

3. **Normal Anatomy, Physiology, and Development**

A. Anatomy (gross and microscopic) and embryology

1. Know the normal blood supply to the gut, the liver, and the extrahepatic biliary tree
2. Understand the normal development of the caudal part of the foregut (esophagus, stomach, duodenum, liver, and gallbladder), midgut (intestines, colon), and hindgut (rectum)
3. Understand the normal development of the enteric nervous system
4. Identify characteristic functional and histologic differences in the normal esophagus, stomach, proximal duodenum, jejunum and ileum, and colon

B. Immunology and inflammation of the gastrointestinal tract

1. Know the characteristics and functions of different intestinal epithelial cells (eg, intraepithelial lymphocytes, mucosal lymphocytes, lymphoid cells in Peyer patches)
2. Distinguish between the characteristics of immune function in the human immature and mature gastrointestinal tract
3. Know how breast-feeding influences immune function in the gut
4. Understand how cytokines mediate inflammation and how their modulation may affect disease processes
5. Understand the secretory IgA immune system
6. Recognize the role of growth factors in mediating inflammation and cytotoxic responses

C. The gut as an endocrine organ

1. Understand the stimuli responsible for the secretion of, and mechanism of action of, gastrointestinal hormones
2. Know the functions of the gut-derived polypeptides
3. Know the location of hormone-secreting cells in the gastrointestinal tract
4. Understand the role of enteric flora on intestinal morphology and function
5. Know the mechanisms that prevent bacterial overgrowth in the small intestine (eg, motility, acid secretion, mucus, immunologic factors)
6. Identify the organisms that are the predominant constituent of the gastrointestinal flora
7. Understand the composition of the microbiome and understand its role in health and disease

D. Gastric function

1. Know the anatomic features of the stomach (gross, microscopic, neuromuscular)
2. Understand the normal gastric secretory processes
3. Know how to evaluate gastric secretory processes

E. Digestive and absorptive function

1. Understand the developmental sequence of digestive function
2. Understand the digestion and absorption of fat, carbohydrates, and protein
3. Understand the absorption of vitamins, minerals, and bile acids

- F. Hepatobiliary system, hepatic structure, and function
 - 1. Understand the concept of physiologic immaturity of hepatic function (eg, excretory function, bilirubin metabolism, bile acid metabolism, taurine as an essential amino acid in infancy)
 - 2. Know the pathways of hepatic drug metabolism
 - 3. Know the normal histology of liver tissue, including age-related differences
 - 4. Know the various biochemical parameters useful to assess hepatic integrity
 - 5. Understand hepatic carbohydrate metabolism
 - 6. Understand hepatic synthesis and metabolism of fatty acids and the role of the liver in lipid transport
 - 7. Know serum proteins synthesized by the liver
- G. Exocrine pancreas: structure and function
 - 1. Understand the stimuli causing pancreatic secretion
 - 2. Be aware of age-related deficiency in exocrine pancreatic function
 - 3. Know the mechanisms of pancreatic enzymes and how they are activated
 - 4. Know the co-factors necessary for pancreatic enzyme function
- 4. **Clinical Manifestations and Management of Diseases of the Mouth**
 - A. Diseases of the oral cavity
 - 1. Know and recognize the oral lesions commonly associated with nutritional deficiency
 - 2. Know and recognize the oral lesions commonly associated with gastrointestinal disease
 - B. Disorders of deglutition
 - 1. Know the normal developmental pattern of sucking in preterm and term infants
 - 2. Know how to manage disorders of deglutition in preterm infants and children
 - 3. Understand and recognize the differential diagnosis of dysfunctional swallowing in the pediatric patient (eg, neuromuscular disorders, food refusal, systemic disorders, infection, psychological disorders)
 - 4. Understand the clinical assessment of a child with impaired deglutition (eg, motility studies, pH studies, observation of feeding)
- 5. **Clinical Manifestations and Management of Diseases of the Esophagus**
 - A. Congenital anomalies
 - 1. Understand embryology of the congenital esophageal anomalies
 - 2. Recognize the clinical manifestations of esophageal anomalies (eg, vascular rings, webs, fistulas)
 - 3. Plan the management of a patient with an esophageal anomaly (eg, tracheoesophageal fistula [TEF], web, stricture)
 - B. Motor disorders
 - 1. Be aware of the pathophysiology and management of achalasia and cricopharyngeal achalasia
 - 2. Know the association of systemic or endocrine diseases with motor disorders of the esophagus (eg, scleroderma)
 - 3. Plan the evaluation of a patient with an esophageal motor disorder
 - 4. Be familiar with medical and surgical treatment of esophageal motility disorders
 - C. Infections
 - 1. Be able to diagnose and treat infections of the esophagus in otherwise healthy children

2. Be able to diagnose and treat infections of the esophagus in immunocompromised children (eg, herpes, *Candida*)
- D. Other
 1. Know pathophysiology, identification, and treatment of caustic and medication-related injuries of the esophagus
 2. Recognize the clinical manifestations of and treat esophageal foreign bodies
 3. Know the clinical manifestations and treatment of retching injuries (eg, prolapse, gastropathy, Mallory-Weiss tear, Boerhaave syndrome)
 4. Recognize the causes and clinical manifestations of esophageal diverticula
6. **Clinical Manifestations and Management of Diseases of the Stomach and Duodenum**
 - A. Congenital anomalies
 1. Know the clinical presentation, evaluation, and management of congenital anomalies of the stomach and duodenum
 - B. Non-*Helicobacter pylori*-related gastroduodenitis
 1. Understand the mechanisms that protect the gastroduodenal mucosa from chemical irritation
 2. Formulate a differential diagnosis in a patient in whom gastroduodenitis is suspected
 3. Plan the diagnostic evaluation of a patient in whom gastritis is suspected, and manage appropriately (eg, cytomegalovirus [CMV], hypertrophic gastropathy)
 4. Recognize and treat systemic disorders that can cause gastroduodenitis (eg, Crohn disease, chronic granulomatous disease, central nervous system injury)
 5. Recognize and treat the causes of erosive and nonerosive gastropathy
 6. Be able to recognize and diagnose generalized gastric inflammation endoscopically and histologically
 - C. Peptic ulcer
 1. Understand the pathophysiology of childhood acid-peptic disease
 2. Understand the pathologic conditions that affect the neuroendocrine regulation of the stomach
 3. Understand the diagnosis and management of acid-peptic disease in childhood
 4. Understand the factors that affect the prognosis for peptic ulcer disease in a child
 5. Recognize complications of peptic ulcer disease
 6. Recognize clinical manifestations of acid-peptic disease
 - D. Trauma and foreign substances
 1. Know causes, clinical presentation, evaluation, and management of corrosive gastritis
 2. Recognize the signs and symptoms, evaluation, and management of duodenal hematoma
 3. Know the causes and clinical presentation of gastrointestinal perforation
 - E. Motor disorders, including pyloric stenosis
 1. Know how to recognize, evaluate and manage pyloric stenosis
7. **Clinical Manifestations and Management of Diseases of the Intestine**
 - A. Congenital anomalies
 1. Know how to recognize and evaluate malrotation and volvulus
 2. Recognize associated congenital anomalies of the gastrointestinal tract in children with common congenital syndromes (eg, Down syndrome, VATER)
 3. Recognize the clinical manifestations of gastroschisis, omphalocele, and associated conditions and manage appropriately

B. Infections

1. Bacterial infections

- a. Understand the mechanisms of action of bacterial pathogens
- b. Order appropriate diagnostic tests for common bacterial pathogens of the small intestine and colon
- c. Recognize the clinical manifestations of bacterial infections of the gastrointestinal tract
- d. Plan the therapy for common bacterial infections of the gastrointestinal tract
- e. Know the risk factors for and pathogenesis of *Clostridium difficile* enterocolitis
- f. Know the clinical manifestations of pseudomembranous enterocolitis
- g. Know how to diagnose pseudomembranous enterocolitis (eg, cultures, studies for toxins, polymerase chain reaction, endoscopy)
- h. Plan management for a patient with recurrent *C. difficile* enteritis (including how to prevent spread of the disease)
- i. Compare the clinical and laboratory characteristics of antibiotic-associated diarrhea with those of pseudomembranous enterocolitis

2. Viral infections

- a. Understand the pathophysiology of viral gastroenteritis
- b. Know the signs and symptoms of viral gastroenteritis
- c. Know how to diagnose and manage viral gastroenteritis

3. Fungal infections

- a. Recognize fungal pathogens of the small intestine
- b. Recognize the risk factors for intestinal fungal infections
- c. Know the appropriate therapy for intestinal fungal infections

4. Parasitic infections

- a. Know how to treat parasites of the intestine
- b. Know the clinical symptoms, diagnosis, and management of parasitic infections (eg, giardiasis, *Ascaris*, tapeworm, hookworm, whipworm)
- c. Recognize that the stool may contain harmless commensal organisms, and manage appropriately

C. Other inflammatory disorders (not IBD)

1. Know the clinical manifestations, diagnostic approaches, and management of non-inflammatory disorders of the intestine, including protein-losing enteropathy, Behçet, Henoch-Schönlein purpura, hemolytic-uremic syndrome, lymphocytic colitis, typhilitis, and drugs

D. Necrotizing enterocolitis

1. Recognize the risk factors for, how to evaluate for, and manage necrotizing enterocolitis
2. Know the short- and long-term complications of necrotizing enterocolitis

E. Neoplasms (excluding tumors of liver and pancreas)

1. Be familiar with the types and locations of malignancy of the intestine, and know their relative importance throughout infancy and childhood
2. Know how to diagnose gastrointestinal neoplasms in children, including the use of endoscopy and imaging
3. Understand risk factors for carcinoma of the colon

F. Gastrointestinal polyps

1. Recognize the clinical presentation of various types of gastrointestinal polyps that occur in children
 2. Know the accepted methods of treating gastrointestinal polyps
 3. Understand inheritance and/or genetic defects in the intestinal polyposis syndromes and plan surveillance and management
 4. Identify the histologic characteristics and malignant potential of childhood gastrointestinal polyps
- G. Appendicitis
1. Recognize the typical historical and physical findings in acute appendicitis through laboratory testing and imaging
 2. Recognize the complications of acute appendicitis (eg, perforation, abscess)
- H. Protein-losing enteropathies
1. Recognize the clinical symptoms and biopsy findings of protein-losing enteropathy
 2. Recognize the laboratory findings associated with protein-losing enteropathy
 3. Know the clinical situations in which protein-losing enteropathy occurs and formulate a differential diagnosis based on age of the patient
 4. Plan the management of a patient with protein-losing enteropathy (eg, intestinal lymphangiectasia)
- I. Acute obstruction
1. Know the causes of acute intestinal obstruction in children of various ages (eg, meconium ileus, volvulus, intussusception, etc)
 2. Recognize acute intestinal obstruction by physical examination and on imaging studies
 3. Devise a management plan for a child with acute intestinal obstruction
 4. Identify congenital intestinal abnormalities associated with maternal polyhydramnios
- J. Perianal lesions
1. Recognize and treat various perianal lesions (eg, sexual abuse, anal fissure, infections, abscess, zinc deficiency, hemorrhoids, rectal prolapsed, Crohn)
 2. Know how to evaluate and manage patients with congenital anal anomalies (eg, high vs low imperforate anus)
- K. Nonfunctional constipation and Hirschsprung disease
1. Know the organic causes of constipation, including anatomic, endocrinologic, metabolic, and neuropathic
 2. Understand the pathophysiologic mechanisms and genetics of Hirschsprung disease
 3. Know the causes, clinical manifestations, diagnostic approaches, and management of Hirschsprung disease
 4. Be familiar with the complications/prognosis of Hirschsprung disease
- L. Intussusception
1. Recognize the causes, clinical manifestations, diagnostic approaches, and management of intussusceptions
 2. Identify the radiologic manifestations of intussusceptions (eg, plain-film, contrast, ultrasound, computed tomography)
 3. Know the complications/prognosis of intussusceptions
8. **Miscellaneous Diseases Affecting the Gastrointestinal Tract**
- A. Gastrointestinal allergy
1. Know the gastrointestinal manifestations of food allergy
 2. Be aware of the risk factors for gastrointestinal allergy

3. Know the dietary and medical treatment of food allergy
 4. Recognize the influence of age on acquisition and resolution of food allergy
 5. Recognize the contribution of the gastrointestinal immune system to gastrointestinal diseases (eg, mast cells)
 6. Understand how to differentiate between the various types of gastrointestinal allergy (eg, functional protein-induced enterocolitis syndrome, IgE-mediated allergy, eosinophilic disorders)
- B. Endocrine disorders
1. The gut in systemic endocrinopathies
 - a. Recognize the gastrointestinal manifestations of systemic endocrine disorders (eg, hypothyroidism, hyperthyroidism, Cushing syndrome, adrenal insufficiency, hypoparathyroidism, hyperparathyroidism, and multiple endocrine neoplasia syndrome)
 - b. Plan appropriate diagnostic evaluation for a patient with gastrointestinal complications of an endocrine disorder (eg, bacterial overgrowth, gastric paresis, malabsorption, celiac disease)
 2. Secretory tumors affecting the gut
 - a. Recognize the major features and inheritance of multiple endocrine neoplasia syndrome
- C. Drug-induced bowel injury
1. Know the effects of various drugs upon the bowel (eg, antiemetics, antibiotics, corticosteroids, nonsteroidal anti-inflammatory drugs, antispasmodics, antidiarrheals, and medications to treat constipation)
- D. Radiation enteritis
1. Understand the pathophysiology of radiation injury to the intestine (immediate and long-term)
 2. Know the appropriate management and long-term prognosis for radiation injury to the intestine
- E. Trauma and foreign bodies
1. Know the abdominal lesions associated with blunt abdominal trauma
 2. Know the most common locations in the gastrointestinal tract where foreign bodies may impact and obstruct
 3. Recognize manifestations and plan the management for ingestions of specific types of foreign bodies (eg, coins, batteries, sharp elongated objects, meat, magnets, bezoar)
- F. The intestine in immune deficiency
1. Know which immune deficiency disorders leave a patient susceptible to opportunistic intestinal pathogens
 2. Formulate a differential diagnosis of immunodeficiencies that may cause gastrointestinal symptoms (eg, T-cell deficiency, graft-versus-host disease, chronic granulomatous disease, acquired immune deficiency syndrome, IgA deficiency, drug-induced)
 3. Understand the difference between viral infections in immunocompetent hosts and immunocompromised hosts
- G. Factitious disorder (Münchhausen syndrome) imposed on another

1. Recognize the variety of clinical presentations of factitious disorder (Münchausen syndrome) imposed on another (eg, apnea, gastrointestinal bleeding, vomiting, diarrhea, failure to thrive)
2. Recognize the characteristics of caretakers of patients with factitious disorder (Münchausen syndrome) imposed on another
3. Plan the evaluation of a patient with suspected factitious disorder (Münchausen syndrome) imposed on another
- H. Gastrointestinal manifestations of specific systemic disorders
 1. Recognize the gastrointestinal manifestations of specific chronic systemic disorders (eg, connective tissue, cardiac, renal, hematologic, pulmonary, bone marrow transplant, cystic fibrosis)
9. **Clinical Manifestations and Management of Diseases of the Liver**
 - A. Cholestatic liver disease
 1. Neonatal cholestasis
 - a. Plan the evaluation of an infant with conjugated hyperbilirubinemia
 - b. Know the indications for surgery in a patient with neonatal cholestasis
 - c. Recognize the clinical and histologic features of various causes of neonatal cholestasis
 2. Cholestasis beyond the neonatal period
 - a. Plan the evaluation of a child (non-neonate) with conjugated hyperbilirubinemia
 - b. Know the nutritional consequences and treatment of chronic cholestasis (eg, vitamin deficiency, fat malabsorption, impaired carbohydrate metabolism)
 - c. Plan the therapy of a patient with pruritus associated with intrahepatic cholestasis
 - d. Recognize the clinical, laboratory, and radiographic features of disorders of the biliary tract (eg, Caroli disease, sclerosing cholangitis, congenital hepatic fibrosis, bile duct paucity, choledochal cyst)
 - e. Understand the implications of the patterns of inheritance for cholestatic disorders
 - f. Plan the medical, endoscopic (ie, endoscopic retrograde cholangiopancreatography) and surgical management of conditions associated with disorders of the intra- and extrahepatic bile ducts (eg, sclerosing cholangitis, bile duct stricture, perforation, choledochal cyst, biliary atresia)
 - g. Understand the prognosis for infants and children with cholestatic/biliary disorders
 - B. Viral hepatitis
 1. Recognize and understand the serologic and histologic diagnosis of congenital infections of the liver
 2. Know the risk factors for and modes of transmission of viral hepatitis
 3. Plan the management of a child with non-hepatitis B/hepatitis C viral hepatitis
 4. Understand the pathophysiology and structure of hepatitis B virus (HBV) and hepatitis C virus (HCV) infection
 5. Know the risk factors for and modes of transmission of hepatitis B and C
 6. Recognize the clinical manifestations of hepatitis B and C
 7. Plan the preventive management of a hepatitis B surface antigen (HBsAg)-positive pregnant woman and the management of her infant
 8. Plan the management of an infant born to an HBV- or HCV-positive mother
 9. Understand the methods for diagnosis of hepatitis B and C
 10. Plan the management for a patient with hepatitis B or C

11. Know the role of liver transplantation for treatment of chronic hepatitis B or C infection
12. Know the long-term considerations related to the hepatitis carrier state (eg, hepatocellular carcinoma)
- C. Bacterial, parasitic, and other infections of the liver
 1. Recognize the clinical manifestations of bacterial, parasitic or fungal infection of the liver (eg, liver abscess, Fitz-Hugh-Curtis)
 2. Understand the pathogenesis and treatment of bacterial, parasitic, or fungal liver disease
 3. Recognize the radiologic and histologic findings associated with bacterial, parasitic, and fungal infections of the liver
- D. Drug-induced liver injury
 1. Understand the mechanisms of drug-induced liver injury
 2. Differentiate among the characteristic clinical features associated with drug-induced liver injury
 3. Know the laboratory and histologic findings for drug-induced liver injury (eg, acetaminophen, antituberculous drugs, anticonvulsants, methotrexate)
 4. Know how to treat drug-induced liver injury (eg, acetaminophen, antituberculous drugs, anticonvulsants, methotrexate)
- E. Liver tumors
 1. Know the risk factors associated with various liver tumors
 2. Recognize the clinical features of hepatic malignancy in childhood
 3. Recognize the characteristic findings on radiographic imaging in a patient with various lesions of the liver (eg, vascular, fatty, cystic)
 4. Interpret the laboratory findings associated with hepatic malignancies in childhood (eg, hepatoblastoma, hepatocellular carcinoma)
- F. Noncholestatic hyperbilirubinemia
 1. Plan treatment and know the prognosis for a child with Crigler-Najjar type I and II syndrome
 2. Differentiate the pathogenesis, histology, and clinical manifestations of hyperbilirubinemia due to Crigler-Najjar (type I and type II) and Dubin-Johnson, Gilbert, and Rotor syndromes
 3. Plan the evaluation of an adolescent patient with noncholestatic hyperbilirubinemia
- G. Disorders of carbohydrate metabolism
 1. Know the types of inherited disorders of hepatic carbohydrate metabolism (glycogen storage disease)
 2. Know the clinical manifestations of inherited disorders of carbohydrate metabolism
 3. Interpret the laboratory and histologic findings in patients with inherited disorders of carbohydrate metabolism
 4. Know the long-term consequences of inherited disorders of carbohydrate metabolism (eg, hepatocellular carcinoma, growth failure, cirrhosis)
 5. Know how to treat disorders of carbohydrate metabolism
- H. Disorders of amino acid metabolism
 1. Know the causes, clinical manifestations, diagnostic approaches, and management of tyrosinemia
- I. Disorders of lipid metabolism

1. Understand the pathogenic mechanisms responsible for the clinical features associated with medium chain acyl-CoA dehydrogenase deficiency
 2. Recognize clinical features and plan diagnosis for a disorder of fatty acid oxidation
- J. Urea cycle defects
1. Know the causes, clinical manifestations, diagnosis, and management of a suspected urea cycle defect
- K. Alpha-1-antitrypsin deficiency
1. Recognize the clinical and histologic features of alpha-1-antitrypsin deficiency
 2. Plan the evaluation of a patient with suspected alpha-1-antitrypsin deficiency
 3. Understand the genotypic and phenotypic features of alpha-1-antitrypsin deficiency
 4. Know the pathogenesis and possible clinical outcome of patients with alpha-1-antitrypsin deficiency
- L. Wilson disease
1. Know the molecular defect/pathophysiology of Wilson disease
 2. Recognize the various clinical manifestations of Wilson disease (eg, hemolytic anemia, liver failure, neurologic involvement, Kayser-Fleischer rings)
 3. Plan diagnostic laboratory evaluation of Wilson disease, including genetic testing, and know the limitation of these tests
 4. Plan the management of a patient with symptomatic or asymptomatic Wilson disease
 5. Recognize and manage the treatment complications of Wilson disease
 6. Plan the diagnostic evaluation to exclude Wilson disease among family members of a patient with newly diagnosed Wilson disease
- M. Other familial hepatocellular cholestatic disorders
1. Understand the genetics and pathogenesis of progressive familial intrahepatic cholestasis and benign recurrent intrahepatic cholestasis
 2. Know the clinical manifestations and diagnostic criteria of the various forms of progressive familial intrahepatic cholestasis
 3. Plan the management of a patient with progressive familial intrahepatic cholestasis
 4. Know the prognosis for a patient who has progressive familial intrahepatic cholestasis
 5. Know the diagnostic criteria for Alagille syndrome
 6. Plan the management of a patient with Alagille syndrome
 7. Recognize the prognosis for a patient with Alagille syndrome
 8. Know the clinical manifestations, diagnostic criteria, and prognosis of liver disease caused by congenital disorders of glycosylation
- N. Peroxisomal disorders
1. Recognize the clinical and laboratory features of disorders of peroxisomal metabolism (eg, Zellweger syndrome, Refsum disease, adrenal leukodystrophy)
 2. Plan the diagnostic evaluation of an infant with a suspected disorder of peroxisomal metabolism
- O. Other metabolic disorders (eg, bile acid, iron storage)
1. Disorders of bile acid metabolism
 - a. Know the controlling mechanisms for hepatic bile acid synthesis
 - b. Recognize the clinical and biochemical manifestations of inborn errors of bile acid metabolism (eg, familial neonatal cholestasis, peroxisomal disorders, familial giant cell hepatitis)
 - c. Plan the management of a patient with a disorder of bile acid metabolism

2. Iron storage diseases
 - a. Recognize the clinical and histologic manifestations of neonatal iron storage disease
 - b. Formulate a differential diagnosis of liver disease in a patient with clinical features suggestive of disorders of iron metabolism (eg, hemochromatosis)
 - c. Plan the management of a patient with iron storage disease
 - d. Plan the evaluation and management of a patient with a family history of hemochromatosis
3. Lipid storage disease
 - a. Recognize the clinical and laboratory manifestations of lipid storage disease
 - b. Formulate an appropriate management plan for a patient with a lipid storage disease
- P. Vascular diseases
 1. Identify the possible etiologies and risk factors of Budd-Chiari syndrome
 2. Recognize the clinical, laboratory, and radiologic features of Budd-Chiari syndrome and distinguish from other causes of ascites
 3. Plan the management of a patient with Budd-Chiari syndrome
 4. Recognize the clinical manifestations resulting from acquired vascular disorders of the liver (eg, tumor, veno-occlusive disease, congenital portosystemic shunt)
 5. Understand the clinical, radiographic, histologic features and management of hepatic hemangioma and hemangioendothelioma
- Q. Systemic conditions affecting the liver
 1. Recognize the liver biopsy findings of various systemic conditions that effect the liver and formulate a differential diagnosis based on biopsy findings (eg, constrictive pericarditis, graft vs host, veno-occlusive disease, Caroli, sarcoid)
 2. Recognize nonhepatic causes of abnormal liver tests (eg, bone, muscle)
- R. Cirrhosis and portal hypertension
 1. Understand the mechanisms for the extrahepatic and intrahepatic causes of portal hypertension
 2. Recognize the clinical, laboratory, and imaging features of intra- and extrahepatic portal hypertension
 3. Plan the management of a child with portal hypertension and its extrahepatic complications
- S. Liver transplantation
 1. Know the indications and contraindications for liver transplantation in the pediatric age population
 2. Understand the prognosis and prognostic factors for pediatric patients undergoing liver transplantation
 3. Recognize the clinical and laboratory findings indicating that a patient should be referred for liver transplant evaluation
 4. Plan the interim management of a patient who is awaiting liver transplantation
 5. Plan the evaluation of a patient who has undergone liver transplantation and develops a complication (eg, abnormal liver function tests, viral infection, Epstein-Barre virus-related lymphoma)
 6. Know the mechanism of action and common complications of the drugs most frequently used to treat patients who have undergone liver transplantation

- T. Acute hepatic failure
 - 1. Know how to recognize and formulate a differential diagnosis of acute hepatic failure
 - 2. Formulate a management plan for a patient with acute hepatic failure
 - 3. Know the prognostic features of acute hepatic failure in children

10. Disorders of the Bile Ducts and Gallbladder

- A. Understand the pathogenesis of acute cholecystitis including stone types
- B. Recognize the clinical features of acute cholecystitis
- C. Plan the diagnostic evaluation of a patient with acute cholecystitis
- D. Plan the management of a patient with choledocholithiasis
- E. Plan the management of a patient with asymptomatic gallstone (eg, drugs, surgery, observation)
- F. Recognize the clinical and radiologic features of acalculous cholecystitis

11. The Pancreas

- A. Anatomy and embryology
 - 1. Understand the normal anatomy and embryology of the pancreas
- B. Function (exocrine)
 - 1. Know how to diagnose pancreatic exocrine insufficiency
 - 2. Understand the age-related changes in exocrine pancreatic function
 - 3. Know the causes of exocrine pancreatic insufficiency
- C. Congenital anomalies
 - 1. Understand the clinical presentations of various pancreatic congenital anomalies (eg, pancreas divisum, annular pancreas, pancreatic rest)
 - 2. Know how to diagnose various congenital pancreatic anomalies (eg, upper gastrointestinal series, endoscopy, endoscopic ultrasonography, computed tomography)
- D. Hereditary disorders of the pancreas
 - 1. Cystic fibrosis
 - a. Know the genetic basis, carrier rate, and mode of inheritance of cystic fibrosis
 - b. Recognize the sources of false-positive and false-negative tests for cystic fibrosis
 - c. Identify the clinical manifestations of meconium ileus (including its relationship to liver disease) and distal intestinal obstruction syndrome
 - d. Know the hepatic complications of cystic fibrosis
 - e. Recognize the nutritional complications of cystic fibrosis
 - f. Understand the genotypic and phenotypic relationships in cystic fibrosis
 - g. Know the indications for and use of pancreatic enzyme supplementation and their potential complications
 - 2. Other (including hereditary or familial pancreatitis)
 - a. Know the pattern of inheritance, pathogenesis, natural course, and treatment of hereditary pancreatitis.
 - b. Recognize the clinical characteristics of genetic syndromes involving the pancreas (eg, Johanson-Blizzard, Shwachman)

12. Diagnostic Studies

- A. Liver biopsy
 - 1. Judge the risk-benefit ratio of a percutaneous liver biopsy in various situations (eg, neonatal cholestasis, acute viral hepatitis, fulminant hepatic failure, rejection following liver transplantation)

2. Know the manifestations of the various complications possible following percutaneous liver biopsy
- B. Impedance / pH
 1. Esophageal monitoring (pH and impedance)
 - a. Understand the indications for esophageal pH probe and impedance testing
 - b. Understand the principles underlying pH and impedance testing
 - c. Know how to interpret pH and impedance studies
- C. Gastric function testing
 1. Know how to interpret gastric radionuclide scans (gastric-emptying scan)
- D. Breath testing
 1. Know the major indications for breath testing for the diagnosis of gastrointestinal disease
 2. Understand the technique and interpretation of breath testing in gastrointestinal disease
- 13. Gastrointestinal Motility**
 - A. Understand the physiology of motility (eg, esophageal, gastric, small intestinal, colonic, and anorectal) including neuronal and hormonal peptides
 - B. Understand the nonpeptide chemical neurotransmitters that modulate gastrointestinal motility (eg, acetylcholine, norepinephrine, dopamine, serotonin, nitrous oxide, etc)
 - C. Understand the role of the extrinsic nervous system and the enteric nervous system in modulating gastrointestinal motility
 - D. Know the clinical features and differential diagnosis of gastrointestinal dysmotility
 - E. Know how to manage gastrointestinal dysmotility disorders
 - F. Evaluate a patient in whom gastrointestinal dysmotility is suspected including interpretation of motility studies
 - G. Understand the differences between motility in the fed and fasted states
 - H. Know and understand the characteristics, pharmacology, site of action, and side effects of drugs that affect gastrointestinal motility
- 14. Nutrition**
 - A. Nutritional requirements
 1. Understand the differences in composition of human milk and cow milk-based formulas
 2. Understand the nutritional requirements of term and preterm infants, children, and adolescents
 3. Know the clinical signs and symptoms associated with vitamin, trace metal, and micronutrient deficiency
 4. Recognize that nutritional requirements change with illness and trauma
 5. Plan a complete nutritional program for a child requiring a special formula for enteral or parenteral nutrition
 6. Know the conditions commonly resulting in micronutrient deficiencies
 7. Know how drug therapy affects nutritional requirements
 - B. Nutritional assessment
 1. Be familiar with standard anthropometric measurements and their significance
 2. Understand the biochemical assessment of nutritional status (eg, electrolytes, protein, blood urea nitrogen, hematologic studies)
 3. Know the components of and how to calculate total energy expenditure
 4. Understand the relationship between body composition and energy expenditure

5. Know the influence of malnutrition on total body water and intravascular volume
- C. Special diets
 1. Understand the composition of formulas or special diets designed for specific gastrointestinal problems (eg, cholestasis, liver failure, cardiac disease)
 2. Know the indications for and side effects of medium-chain triglycerides in the diet of children
 3. Know the indications for and complications of medically prescribed diets (eg, ketogenic, modular)
 4. Understand the physiologic limits of protein, fat, and carbohydrate in the diet when it is either restricted or increased
- D. Enteral nutrition
 1. Know the principles governing the use of non-oral enteral diets ("tube feeding") in infants and children (eg, caloric density, caloric requirements)
 2. Know the indications for and complications of non-oral enteral diets ("tube feeding") in infants and children
- E. Obesity
 1. Understand the theories regarding the etiology of obesity, including epidemiology and pathophysiology
 2. Know the complications of and plan management for obesity in children
 3. Understand the contraindications for and complications of bariatric surgery
- F. Malnutrition
 1. Understand the environmental factors in addition to nutrient intake that influence the development of protein-energy malnutrition
 2. Recognize the clinical, physical and laboratory findings of malnutrition
 3. Know the accepted methods for treating a child with malnutrition
 4. Understand metabolic adaptation to malnutrition (energy and protein conservation)
 5. Understand the short and long-term effects of malnutrition (including effects on intestinal function)
 6. Formulate a plan for prevention of malnutrition in pathologic states prone to result in malnutrition

15. Psychological Considerations

- A. General
 1. Plan the management of a patient with nonretentive fecal soiling
 2. Recognize the indications for psychological referral for a child with gastrointestinal disease
 3. Plan the management of a patient with feeding refusal
 4. Plan the management of a patient with psychogenic dysphagia or vomiting
- B. Eating disorders
 1. Recognize the clinical, laboratory, and psychiatric findings characteristic of anorexia nervosa
 2. Plan the management of a child with eating disorders
 3. Recognize that refeeding syndrome may complicate the phase of nutritional rehabilitation in a patient with feeding disorders
 4. Know the complications of feeding disorders

16. Ethical Considerations

- A. Understand the informed consent process (for procedures, risks, alternatives, potential complications) for various procedures
 - B. Understand the ethical issues involved in providing nutrition support
 - C. Understand the ethical principles involved in applying specialized diagnostic tests (eg, genetic testing) and therapies (eg, transplantation, short-bowel section, gastrostomy tube placement)
 - D. Understand the ethical principles involved in professional conduct and responsibility
 - E. Understand the principles involved in patient confidentiality
- 17. Core Knowledge in Scholarly Activities**
- A. Principles of use of biostatistics in research
 - 1. Types of variables
 - a. Distinguish types of variables (eg, continuous, categorical, ordinal, nominal)
 - b. Understand how the type of variable (eg, continuous, categorical, nominal) affects the choice of statistical test
 - 2. Distribution of data
 - a. Understand how distribution of data affects the choice of statistical test
 - b. Differentiate normal from skewed distribution of data
 - c. Understand the appropriate use of the mean, median, and mode
 - d. Understand the appropriate use of standard deviation
 - e. Understand the appropriate use of standard error of the mean
 - 3. Hypothesis testing
 - a. Distinguish the null hypothesis from an alternative hypothesis
 - b. Interpret the results of hypothesis testing
 - 4. Statistical tests
 - a. Understand when to use and how to interpret the chi square test
 - b. Understand when to use and how to interpret tests comparing continuous variables between two groups (eg, t test, Mann Whitney U)
 - c. Understand when to use and how to interpret tests comparing continuous variables between three or more groups (eg, ANOVA, Kruskal-Wallis)
 - d. Understand when to use paired tests
 - e. Understand the appropriate use of parametric versus nonparametric tests
 - f. Interpret a p value
 - g. Interpret a p value when multiple comparisons have been made
 - h. Interpret a confidence interval
 - i. Identify a type I error
 - j. Identify a type II error
 - 5. Measurement of association and effect
 - a. Understand how to interpret relative risk and absolute risk
 - b. Understand how to interpret odds ratio
 - c. Understand how to interpret number needed to treat or harm
 - d. Understand how to interpret hazard ratio
 - e. Understand when to use and how to interpret correlation coefficient
 - 6. Regression
 - a. Understand when to use and how to interpret regression analysis (eg, linear, logistic)
 - b. Understand when to use and how to interpret survival analysis (eg, Kaplan Meier)

7. Diagnostic tests
 - a. Recognize the importance of an independent "gold standard" in evaluating a diagnostic test
 - b. Interpret sensitivity and specificity
 - c. Interpret positive and negative predictive values
 - d. Understand how disease prevalence affects the positive and negative predictive value of a test
 - e. Interpret a receiver operating characteristic curve
8. Systematic reviews and meta-analysis
 - a. Understand the purpose of a systematic review
 - b. Understand the advantages of adding a meta-analysis to a systematic review
 - c. Interpret the results of a meta-analysis
- B. Principles of epidemiology and clinical research design
 1. Assessment of study design, performance and analysis (internal validity)
 - a. Recognize and understand the strengths and limitations of a cohort study, case control study, and randomized controlled clinical trial
 - b. Recognize the use and limitations of surrogate endpoints
 - c. Understand the use of intent-to-treat analysis
 - d. Understand how sample size affects the power of a study
 2. Assessment of generalizability (external validity)
 - a. Understand how nonrepresentative samples can bias results
 - b. Assess how the data source (eg, diaries, billing data, discharge diagnostic code) may affect study results
 3. Bias and confounding
 - a. Identify common strategies in study design to avoid or reduce bias
 - b. Identify common strategies in study design to avoid or reduce confounding
 4. Causation
 - a. Understand the difference between association and causation
 5. Incidence and prevalence
 - a. Distinguish disease incidence from disease prevalence
 6. Screening
 - a. Understand factors that affect the rationale for screening for a condition or disease (eg, prevalence, test accuracy, risk benefit, disease burden, presence of a presymptomatic state)
 7. Cost benefit, cost effectiveness, and outcomes
 - a. Interpret cost-effectiveness ratios
 - b. Distinguish costs from charges
 - c. Understand quality-adjusted life years
 8. Measurement
 - a. Understand the types of validity that relate to measurement (eg, face, construct, criterion, predictive, content)
 - b. Distinguish accuracy from precision
 - c. Understand when to use and how to interpret a kappa coefficient
- C. Ethics in research
 1. Professionalism and misconduct in research

- a. Identify and manage potential conflicts of interest in the funding, design, and/or execution of a research study
 - b. Identify various forms of research misconduct (eg, plagiarism, fabrication, falsification)
 - c. Know how, and to whom, to report concerns of research misconduct
- 2. Principles of research with human subjects
 - a. Understand and contrast the functions of an Institutional Review Board and a Data Safety Monitoring Board
 - b. Recognize the types of protections in designing research that might be afforded to children and other vulnerable populations
 - c. Understand the federal regulatory definitions regarding which activities are considered research and what constitutes human subjects research
 - d. Understand the federal regulatory definition of minimal risk and apply this to research involving children
 - e. Understand the ethical considerations of study design (eg, placebo, harm of intervention, deception, flawed design)
- 3. Principles of consent and assent
 - a. Understand what constitutes informed consent in research
 - b. Distinguish between consent and assent in research involving children
- D. Quality improvement
 - 1. Design of a project
 - a. Understand various models of quality improvement and recognize that all utilize a data-informed, iterative process using tests of change to achieve a stated aim
 - b. Understand that the aim of any quality improvement project should be specific, measurable, achievable, realistic, and time-limited
 - c. Understand strategies to optimize identification of key drivers and interventions to achieve a specific aim
 - d. Understand tools to facilitate completion of quality improvement work, including key driver diagrams and process maps
 - e. Understand each phase of a Plan-Do-Study-Act (PDSA) cycle
 - 2. Data and measurement
 - a. Differentiate between process, outcome, and balancing measures
 - b. Interpret a run chart and identify shifts, trends, and outliers in data
 - c. Differentiate between a run chart and a control chart
 - d. Differentiate between common cause and special cause variation