

Authors: [Mark I Neuman, MD, MPH](#), [Richard M Ruddy, MD](#)

Section Editors: [Gary R Fleisher, MD](#), [Jan E Drutz, MD](#), [Melvin B Heyman, MD, MPH](#)

Deputy Editor: [James F Wiley, II, MD, MPH](#)

#### Contributor Disclosures

All topics are updated as new evidence becomes available and our [peer review process](#) is complete.

**Literature review current through:** Dec 2017. | **This topic last updated:** Jan 09, 2017.

**INTRODUCTION** — The emergent evaluation of children with acute abdominal pain, including a brief description of life-threatening and common causes, will be discussed here.

The evaluation and management of children with chronic abdominal pain is reviewed separately. (See ["Chronic abdominal pain in children and adolescents: Approach to the evaluation"](#) and ["Functional abdominal pain in children and adolescents: Management in primary care"](#).)

**BACKGROUND** — Among children, abdominal pain is a frequent, nonspecific symptom that is typically associated with self-limited conditions such as gastroenteritis, constipation, and viral illnesses. The challenge for the clinician is to identify patients with abdominal pain who may have the following:

- Serious, potentially life-threatening conditions, such as an acute abdomen from appendicitis or bowel obstruction (as can occur from volvulus, intussusception, or adhesions); acute manifestations of inflammatory bowel disease, pancreatitis, hepatitis or intra-abdominal mass.
- Extra-abdominal infections that require specific treatment (such as streptococcal pharyngitis, urinary tract infection, or pneumonia)
- Unusual manifestations of less common diseases (such as Hirschsprung disease or primary bacterial peritonitis with nephrotic syndrome)
- Diabetic ketoacidosis

In observational series describing children with abdominal pain evaluated in outpatient clinics or emergency departments, 22 percent had diagnoses that required surgery or treatment with antibiotics [1,2]. Clinical experience suggests that in most outpatient settings, the proportion of children with serious conditions is lower.

Developmental considerations that must be recognized when evaluating infants and children with acute abdominal pain include the following:

- Conditions that cause abdominal pain may occur more commonly at specific ages (such as volvulus among neonates and intussusception among older infants and toddlers) ([table 1](#)).
- Infants and young children often cannot describe or localize their symptoms. In addition, they may be anxious about interactions in the healthcare setting, making identification of important physical findings challenging.

For most children, the etiology of abdominal pain can be identified with a careful history, either single or repeated physical examinations, and (in some cases) selective ancillary testing. Unavoidably, a small number of patients who may present early in the course of an illness (such as appendicitis) or with subtle and/or atypical signs do not receive the definitive diagnosis on the initial evaluation [2]. Consequently, repeat examination and reliable follow-up are essential components of the evaluation and management of children with acute abdominal pain.

**CAUSES** — The causes of acute abdominal pain in children are summarized here ([table 1](#)). A more detailed discussion can be found separately. (See "[Causes of acute abdominal pain in children and adolescents](#)".)

Life-threatening causes of abdominal pain may be associated with specific clinical features. (See "[Causes of acute abdominal pain in children and adolescents](#)", [section on 'Life-threatening causes'](#).)

- Trauma - Intraabdominal injuries can be life-threatening (such as hemorrhage from solid organ laceration or fluid loss, organ ischemia from vascular injury, and infection from perforated hollow viscus). Typical mechanisms include motor vehicle crashes, falls, and child abuse.
- Obstruction and peritoneal irritation - These clinical features are associated with serious intraabdominal conditions that require prompt diagnosis and treatment. Conditions that cause obstruction and/ or peritonitis include the following:
  - For neonates presenting with bilious vomiting, volvulus (as a complication of malrotation) and necrotizing enterocolitis should be considered.
  - Intussusception (invagination of a part of the intestine into itself, causing obstruction) usually occurs among children two months to two years of age. Colicky abdominal pain, usually with vomiting, is a typical feature of intussusception.
  - Among children of all ages, appendicitis can cause peritoneal irritation and focal tenderness. It occurs most commonly in children >5 years of age. (See "[Acute appendicitis in children: Clinical manifestations and diagnosis](#)".)
  - Less commonly, obstruction caused by adhesions from previous surgery or inflammation, complications of Hirschsprung disease, perforated ulcer, or primary bacterial peritonitis (usually as a complication of nephrotic syndrome) may present with abdominal pain.
- Incarcerated inguinal hernia is an extraabdominal cause of abdominal pain that can be life-threatening. Myocarditis and pericarditis are rare extraabdominal causes of abdominal pain.
- Systemic life-threatening conditions that can be associated with abdominal pain include diabetic ketoacidosis and hemolytic uremic syndrome.
- Among postmenarchal females, life-threatening conditions within the reproductive tract that can cause abdominal pain include pelvic inflammatory disease with tubo-ovarian abscess and ruptured ectopic pregnancy.

Common conditions that are associated with acute abdominal pain include viral gastroenteritis, systemic viral illness, streptococcal pharyngitis, lobar pneumonia, and urinary tract infections. Frequent causes of chronic or recurrent abdominal pain include colic (among neonates) and constipation. (See "[Causes of acute abdominal pain in children and adolescents](#)", [section on 'Common causes'](#).)

Other causes of abdominal pain include gastrointestinal and non-gastrointestinal conditions. (See "[Causes of acute abdominal pain in children and adolescents](#)", [section on 'Other causes'](#).)

- Gastrointestinal conditions that may present with abdominal pain include inflammatory bowel disease (more often Crohn disease than ulcerative colitis), cholelithiasis, cholecystitis (more common among children with predisposing conditions such as hemolytic anemia or cystic fibrosis or among older adolescents), pancreatitis, dietary protein allergy (typically in neonates and infants), malabsorption, and intraabdominal abscess (as from perforated appendicitis).
- Conditions outside of the gastrointestinal tract may cause abdominal pain. These include immunoglobulin A vasculitis (Henoch-Schönlein purpura) (usually with a distinctive purpuric rash over

the lower extremities and buttock), vasoocclusive crisis with sickle cell syndromes, urolithiasis (typically with colicky pain and flank tenderness), some tumors, and toxic ingestions (such as lead or iron).

- Ovarian and testicular torsion, similar to volvulus and intussusception, present with pain from ischemia, often with vomiting and are genitourinary causes of abdominal pain.

**EVALUATION** — The first goal of the evaluation of children with abdominal pain is to identify life-threatening conditions that require emergent interventions. Once this has been accomplished, other causes of abdominal pain can often be identified through deliberate evaluation with careful attention to the clinical features of the illness (such as the child's age and gender, history of trauma, pattern of the pain, related symptoms, physical findings, and selected diagnostic studies) ([algorithm 1](#) and [algorithm 2](#)).

**History** — Key historical variables that may assist in identifying a specific cause of abdominal pain include history of trauma, prior abdominal surgery, fever, vomiting, location of the abdominal pain, and the pattern of symptoms. A gynecologic history (including last menstrual period and sexual activity) should be obtained for pubertal girls.

**Trauma** — Abdominal trauma (typically sustained in motor vehicle crashes, auto-pedestrian collisions, or falls) can cause life-threatening injuries (such as solid organ injury or perforated viscus). A history of trauma may not be forthcoming for infants and children who have sustained inflicted injuries. (See "[Overview of blunt abdominal trauma in children](#)" and "[Physical child abuse: Recognition](#)", section on 'Visceral injuries'.)

Although symptoms of abdominal injury typically occur immediately, they may be delayed with some injuries (such as left shoulder pain from a slowly expanding splenic hematoma, vomiting from obstruction as the result of a duodenal hematoma, or bowel perforation associated with a lap seatbelt injury). (See "[Overview of blunt abdominal trauma in children](#)", section on 'Specific injuries'.)

**Characteristics of abdominal pain** — Infants and children younger than two years of age with abdominal pain usually cannot describe or localize pain. This limitation leads to both over and under attribution of symptoms to "abdominal pain." Parents may infer that the child has abdominal pain from symptoms such as drawing the legs up or inconsolability. The preschool child may be able to describe pain and other symptoms, although descriptions may not be consistently reliable. Above five years of age, children can typically characterize the onset, frequency, duration, and location of their symptoms.

Specific diagnoses may be associated with the following characteristic patterns of pain:

- Appendicitis – Periumbilical, migrating to the right lower abdomen
- Appendiceal rupture (early), ovarian torsion – Acute, severe, focal
- Intussusception – Intermittent, colicky
- Gastroenteritis – Diffuse or vague
- Hepatitis and cholecystitis – Right upper quadrant
- Gastritis, gastric ulcer disease – Epigastric
- Pancreatitis – Steady periumbilical and/or subxiphoid pain, often radiating to the back
- Renal stone – Flank pain radiating to mid to lower lateral abdomen

For children with localized peritoneal irritation (as with advanced appendicitis), pain can be aggravated by movement (such as, coughing, hopping, traveling in the car or walking). In comparison, patients with visceral pain may writhe with discomfort. Improvement in pain after a bout of emesis may occur with conditions localized to the small bowel [3]. Pain relief after a bowel movement suggests a colonic condition including chronic constipation.

## Associated symptoms

- **Fever** – Children with abdominal pain frequently have fever. In an observational series describing children evaluated for abdominal pain in outpatient settings, 64 percent had a history of fever [2]. Patients with appendicitis often have fever, which may be initially low grade. Most children with abdominal pain and fever, however, have infectious etiologies such as gastroenteritis, viral syndromes, and pharyngitis [1,2].

Bacterial infections that may be associated with abdominal pain include:

- Streptococcal pharyngitis (often with sore throat, headache, and vomiting), although children with viral pharyngitis can also have abdominal pain (see "[Group A streptococcal tonsillopharyngitis in children and adolescents: Clinical features and diagnosis](#)", section on 'Clinical features')
  - Urinary tract infections (sometimes with vomiting or, less often, diarrhea in younger children) (see "[Urinary tract infections in infants and children older than one month: Clinical features and diagnosis](#)", section on 'Clinical presentation')
  - Lower lobe pneumonia (usually with respiratory symptoms such as tachypnea or cough, but without abdominal tenderness on examination) [4] (see "[Community-acquired pneumonia in children: Clinical features and diagnosis](#)", section on 'Clinical presentation')
  - Pelvic inflammatory disease (in postmenarchal, sexually active females) (see "[Pelvic inflammatory disease: Clinical manifestations and diagnosis](#)", section on 'Clinical features')
- **Vomiting** – Vomiting is frequently reported among children with abdominal pain. In the previously noted series, 42 percent of patients had a history of vomiting [2].

Children with vomiting and abdominal pain (particularly in the absence of diarrhea) should be carefully evaluated for life-threatening conditions such as bowel obstruction or appendicitis with peritonitis

- Volvulus must be excluded as the cause of bilious emesis and apparent abdominal pain in a neonate. (See "[Intestinal malrotation in children](#)", section on 'Clinical presentation'.)
  - With intussusception, vomiting (initially non-bilious, but becoming bilious as the obstruction progresses) may occur following episodes of pain. (See "[Intussusception in children](#)", section on 'Clinical manifestations'.)
  - Small bowel obstruction may develop as the result of many conditions, including postoperative or postinflammatory adhesions. Worldwide, ascariis infection is a common cause of small bowel obstruction. (See "[Ascariis](#)", section on 'Complications'.)
  - Nausea and vomiting are typically present among children with appendicitis, ovarian and testicular torsion, pancreatitis, and severe inflammatory bowel disease. (See "[Acute appendicitis in children: Clinical manifestations and diagnosis](#)", section on 'Clinical manifestations'.)
- **Diarrhea** – The following conditions can be associated with diarrhea (see "[Approach to diarrhea in children in resource-rich countries](#)"):
    - Children with diarrhea and abdominal pain usually have viral gastroenteritis.
    - Urinary tract infections can cause diarrhea.
    - Diarrhea (typically mucoid stools, rather than profuse, watery diarrhea) may develop from appendicitis, usually with abscess formation.
    - Children with intussusception may have bloody stools, sometimes mixed with mucus (currant jelly). In addition, intussusception may be preceded by viral gastroenteritis (particularly from adenovirus).

(See ["Intussusception in children", section on 'Clinical manifestations'](#) and ["Intussusception in children", section on 'Pathogenesis'](#).)

- Bloody diarrhea suggests infectious enteritis, hemolytic uremic syndrome (HUS), or inflammatory bowel disease.

Other symptoms that may suggest the etiology of abdominal pain include cough (pneumonia), sore throat (pharyngitis), dysuria (urinary tract infection), polyuria (diabetic ketoacidosis), and hematuria (urinary tract infection, urolithiasis, hemolytic uremic syndrome, immunoglobulin A vasculitis [IgAV; Henoch-Schönlein purpura (HSP)]).

### Past medical history

- Bowel obstruction from adhesions can occur among children who have had abdominal surgery. (See ["Causes of acute abdominal pain in children and adolescents", section on 'Adhesions with intestinal obstruction'](#).)
- Children with Hirschsprung disease can develop complications such as obstruction and fulminant enterocolitis. (See ["Emergency complications of Hirschsprung disease", section on 'Enterocolitis'](#).)
- Cholecystitis may be the cause of abdominal pain for older adolescents or children with predisposing conditions such as sickle cell disease or cystic fibrosis. (See ["Cystic fibrosis: Clinical manifestations and diagnosis", section on 'Hepatobiliary disease'](#) and ["Overview of the clinical manifestations of sickle cell disease", section on 'Hepatobiliary complications'](#).)
- Abdominal pain may be the manifestation of vasoocclusive crisis (VOC) for children with sickle cell disease. Other emergent conditions should be considered as suggested by specific findings (such as peritoneal signs or focal right lower quadrant pain), by a pattern of pain that is not typical of VOC for this patient, or for a child whose symptoms do not improve with hydration and analgesia. (See ["Overview of the clinical manifestations of sickle cell disease", section on 'Acute painful episodes'](#).)
- Children with diabetic ketoacidosis may have abdominal pain. (See ["Clinical features and diagnosis of diabetic ketoacidosis in children and adolescents", section on 'Signs and symptoms'](#).)
- Primary bacterial peritonitis occurs with increased frequency among children with nephrotic syndrome or may present in patients with chronic ascites (eg, chronic liver disease, portal vein obstruction, or chylous ascites). (See ["Complications of nephrotic syndrome in children", section on 'Infection'](#).)

**Physical examination** — A comprehensive physical examination, including vital signs, a detailed abdominal examination, and a focused extra-abdominal examination are essential for the evaluation of the child with acute abdominal pain.

**Appearance** — Appearance and hydration should be noted. Patients with hypovolemia (as with abdominal injury, volvulus, or intussusception) or peritonitis (as from perforated appendicitis) may have signs of poor perfusion (see ["Assessment of perfusion in pediatric resuscitation"](#)). Children with peritonitis typically prefer to lie still, while those with biliary or renal colic may writhe in pain. Children with jaundice may have hepatitis or hemolysis. However, children with intussusception early in the course of their disease may appear quite well in between painful episodes of peristalsis.

**Vital signs** — Abnormal vital signs may provide a clue to the diagnosis:

- Fever suggests infection (such as gastroenteritis, urinary tract infection, pneumonia, or pharyngitis). Although many children with appendicitis are febrile, fever is neither sensitive nor specific for this condition [5].
- Tachypnea can be a sign of respiratory illness (such as pneumonia) or metabolic acidosis (causing deeper and sometimes rapid breathing in children with dehydration from gastroenteritis, diabetic

ketoacidosis, peritonitis, or intestinal obstruction).

- Hypotension in a child with acute abdominal pain can develop from intravascular volume loss (as with hemorrhage from injury, gastroenteritis, or capillary leak from bowel obstruction with volvulus or intussusception) or peritonitis (as with perforated appendicitis).

**Abdominal examination** — The abdomen should be examined when the child is quiet and cooperative, in a position of comfort (such as a caretaker's lap), and before more anxiety provoking or uncomfortable parts of the examination (such as ears and throat). (See ["The pediatric physical examination: Chest and abdomen", section on 'Abdomen'](#).)

The following features should be noted:

- Distention may be the result of obstruction or a mass.
- Bowel sounds may be decreased (as with an ileus in response to peritoneal irritation from appendicitis) or increased (as with gastroenteritis or bowel obstruction).
- Pain may be localized with gentle palpation performed in all four quadrants. Considerations include:
  - Children can be asked to point with one finger to the spot that hurts the most.
  - Reproducible focal tenderness suggests an intraabdominal inflammatory process.
  - Serious causes of abdominal pain are less likely for otherwise healthy children who are not uncomfortable with deep palpation throughout the abdomen, who have no focal tenderness, and who have no extraabdominal findings.
- Among older children, tenderness can sometimes be localized to the abdominal wall by demonstrating that tenderness to palpation is exacerbated when the child lifts her head off of the table.
- Percussive tenderness, rebound, and involuntary guarding are most often signs of peritoneal irritation (as with appendicitis or cholecystitis). Other findings that may be noted with percussion include increased tympany (as with distended bowel), dullness (as with a mass), and shifting dullness (as with ascites).

Rectal examination (to assess for local tenderness, mass, constipation, and hematochezia) is generally recommended as part of the evaluation for abdominal pain. It may be uncomfortable and may be of low yield to identify serious conditions. Observational evidence suggests that rectal examination may have low utility either for diagnosing appendicitis among children with abdominal pain or for identifying injuries among trauma patients [\[1,6-10\]](#).

Findings on rectal examination that should be noted include:

- Hard stool in the rectal vault supports the diagnosis of constipation, but does not prove that this common condition is responsible for a given episode of acute abdominal pain.
- Blood in the stool can be seen in a variety of conditions, including intussusception, inflammatory bowel disease, inflamed Meckel's diverticulum, dietary protein allergy, infectious enteritis, and constipation with anal fissure.
- Uterine or adnexal tenderness or masses (suggesting a gynecologic source for abdominal pain) may rarely be noted on rectal examination.

**General examination** — Extraabdominal findings on physical examination can provide important information regarding the cause of abdominal pain.

- Pharyngeal erythema and/or exudate can be seen with pharyngitis.

- Crackles (Rales), focal, decreased breath sounds, or egophony on auscultation of the chest are suggestive of pneumonia.
- Muffled heart sounds or a rub may be seen with pericarditis, a gallop rhythm may occur in myocarditis, and tachycardia is typically a feature of both conditions.
- Flank tenderness may be a sign of pyelonephritis or urolithiasis.
- Tender scrotal swelling suggests testicular torsion or incarcerated hernia.
- Bruising suggests trauma. Petechiae and/or purpura may be seen with IgAV (HSP) and can present with abdominal pain prior to presence of the rash.
- A characteristic rash occurs with scarlet fever or IgAV (HSP).
- Jaundice may be observed in children with hepatitis, gall bladder disease with obstruction, or hemolysis (as with sickle cell disease).

Sexually active females with lower abdominal pain should generally receive bimanual pelvic examinations to look for signs of pelvic inflammatory disease, adnexal masses or cysts, uterine pathology, or ectopic pregnancy. (See ["The gynecologic history and pelvic examination"](#).)

**Ancillary studies** — Children with abdominal pain who are otherwise healthy, well-appearing, and have normal physical examinations typically do not require ancillary studies. Those whose repeat examinations continue to be unremarkable and who tolerate feeding can usually be discharged with reliable medical follow-up.

Laboratory and radiographic studies should be performed when history and/or physical examination demonstrate focal findings or suggest concerning diagnoses (such as injury, appendicitis, bowel obstruction, or infection). The choice of tests should be based upon the age of the child and the diagnoses under consideration.

**Laboratory studies** — Specific studies that may be considered include:

- White blood cell count (WBC) – An elevated WBC suggests infection or inflammation (such as appendicitis), although a normal WBC does not exclude these processes (see ["Acute appendicitis in children: Clinical manifestations and diagnosis"](#), section on 'Laboratory testing'). WBC >20,000 suggests perforated appendicitis, appendiceal abscess, or lobar pneumonia [11,12].
- Hematocrit – For children with bleeding, hematocrits that are initially normal establish baselines for serial measurements but may be misleading (eg, in situations of dehydration). Anemia with abnormal red cell morphology can be seen with hemoglobinopathies (sickling) and hemolytic uremic syndrome (microangiopathic changes). Children with hemolytic uremic syndrome also have thrombocytopenia. (See ["Clinical manifestations and diagnosis of Shiga toxin-producing Escherichia coli \(STEC\) hemolytic uremic syndrome \(HUS\) in children"](#), section on 'Clinical and laboratory manifestations'.)
- Serum chemistries – Among children with upper abdominal pain, abnormal liver enzyme tests, lipase or amylase measurements suggest hepatitis, cholecystitis, or pancreatitis, respectively. Metabolic acidosis can occur with dehydration, intestinal obstruction, peritonitis, or diabetic ketoacidosis (DKA). An elevated blood glucose in the setting of acidosis is also consistent with DKA.
- A urine dipstick evaluation (for blood, nitrites, leukocyte esterase, glucose, ketones, and protein) should be obtained for most children with abdominal pain. A formal urinalysis should be sent when the dipstick is abnormal. Hematuria can occur with urolithiasis, IgAV (HSP), hemolytic uremic syndrome, and urinary tract infection (UTI). Pyuria usually indicates a UTI, but a small number of WBCs (10 to 20 WBCs/hpf) can be seen with appendicitis (presumably when inflammation irritates the bladder wall).

Children with DKA have glucosuria and ketonuria. A child with nephrotic syndrome and bacterial peritonitis typically has proteinuria.

- Urine pregnancy testing should generally be performed for postmenarchal females with abdominal pain. (See ["Clinical manifestations and diagnosis of early pregnancy", section on 'Urine pregnancy test'](#).)
- Rapid streptococcal antigen testing or bacterial throat culture – Children with abdominal pain and pharyngeal findings should usually receive rapid screening tests and/or throat cultures for group A beta hemolytic Streptococcus. (See ["Group A streptococcal tonsillopharyngitis in children and adolescents: Clinical features and diagnosis", section on 'Diagnosis'](#).)

**Imaging** — Imaging is an essential component of the evaluation of some children with acute abdominal pain who have concerning clinical features such as trauma, peritoneal irritation, signs of obstruction, masses, distension, or focal tenderness and/or pain. Children with a typical clinical presentation for acute appendicitis are likely to have appendicitis. In this circumstance, we encourage clinicians to consult a surgeon with experience caring for children prior to obtaining imaging studies. (See ["Acute appendicitis in children: Clinical manifestations and diagnosis", section on 'Imaging'](#).)

- **Plain radiography** – In most instances, plain images are **not** helpful for providing a specific diagnosis for abdominal pain. They may serve a limited role in some children as follows:
  - Abdominal films may demonstrate signs of obstruction (such as air fluid levels, distended bowel, or sentinel bowel loops) or perforation (such as free air) ([image 1](#)).
  - Fluid-filled loops of small bowel can be seen with gastroenteritis.
  - A fecalith in the right lower quadrant of a child with abdominal pain suggests the diagnosis of appendicitis, although this finding is not frequently observed. (See ["Acute appendicitis in children: Diagnostic imaging", section on 'Plain radiographs'](#).)
  - Although not routinely indicated for the evaluation of functional constipation, children with acute abdominal pain due to constipation may have increased stool noted with abdominal radiography. The absence of at least moderate amounts of stool excludes this diagnosis as an explanation for acute abdominal pain. (See ["Constipation in infants and children: Evaluation", section on 'Imaging'](#).)
  - For children who may have midgut volvulus, an upper GI contrast series is the best examination to visualize the duodenum ([image 2](#)). (See ["Intestinal malrotation in children", section on 'Diagnosis'](#).)
  - Although obstruction or mass effect may be seen on plain film, ultrasound is the best diagnostic test for intussusception. In addition, contrast enema (air or [barium](#)) can diagnose and often reduce an intussusception ([image 3](#) and [image 4](#) and [image 5A-B](#)). (See ["Intussusception in children", section on 'Nonoperative reduction'](#).)
  - A chest radiograph may reveal basilar pneumonia or signs of myocarditis (cardiomegaly) as the cause of abdominal pain.
- **Ultrasonography (US)** – Because it has the advantage of no radiation exposure and can be performed at the bedside, ultrasonography may be useful for several conditions that cause abdominal pain in children including the following:
  - Gallstones.
  - Genitourinary conditions (eg, ovarian torsion, ruptured ovarian cyst, and testicular torsion). (See ["Ovarian and fallopian tube torsion", section on 'Ultrasound'](#) and ["Causes of scrotal pain in children"](#).)



[and adolescents](#)", [section on 'Role of imaging'](#) and ["Evaluation and management of ruptured ovarian cyst"](#), [section on 'Laboratory tests'](#).)

- Intussusception ([image 6](#)). (See ["Intussusception in children"](#), [section on 'Ultrasonography'](#).)
- Appendicitis, although the utility of US for diagnosing appendicitis depends upon the experience of the ultrasonographer, and may also vary based upon a child's body mass index ([image 7](#) and [image 8](#) and [table 2](#)). (See ["Acute appendicitis in children: Diagnostic imaging"](#), [section on 'Imaging approach'](#) and ["Acute appendicitis in children: Diagnostic imaging"](#), [section on 'Test performance'](#).)
- As part of a focused abdominal sonography for trauma (FAST examination) in a trauma patient with blunt injury, a negative FAST examination by an experienced ultrasonographer may exclude significant intraabdominal hemorrhage as the explanation for shock. (See ["Trauma management: Approach to the unstable child"](#), [section on 'FAST \(Focused Assessment with Sonography for Trauma\)'](#).)
- **Computed tomography** – The radiation exposure of an abdominal CT in children can be significant. Alternative imaging modalities such as ultrasound or magnetic resonance imaging (MRI) can frequently provide diagnostic certainty without radiation exposure. For example, ultrasound prior to or instead of CT is often of good utility (eg, children with suspected nephrolithiasis or suspected appendicitis), especially in young children. Similarly, MRI provides excellent imaging of the gut without radiation exposure. When an abdominal CT is performed, the clinician should consider a focused examination as well as ensure that CT scanning parameters are appropriate for children in their institution. (See ["Acute appendicitis in children: Diagnostic imaging"](#), [section on 'Focused CT'](#) and ["Acute appendicitis in children: Diagnostic imaging"](#), [section on 'CT scanning parameters'](#).)

Computed tomography (CT) **with** contrast is useful for the evaluation of patients with acute abdominal pain when a wide variety of diagnoses are being considered (such as appendicitis [particularly complex], pancreatitis, intraabdominal abscess, blunt abdominal trauma, and for the evaluation of an intraabdominal mass). As an example, CT has high sensitivity and specificity for diagnosing appendicitis and is the most sensitive imaging test for pediatric nephrolithiasis. (See ["Acute appendicitis in children: Diagnostic imaging"](#), [section on 'Test performance'](#) and ["Clinical features and diagnosis of nephrolithiasis in children"](#), [section on 'Imaging'](#) and ["Overview of blunt abdominal trauma in children"](#), [section on 'Abdominal and pelvic CT'](#).)

Helical CT is the most sensitive imaging test for renal or ureteral stones in children. Low dose protocols may provide adequate resolution for identifying most calculi or alternative diagnoses, with significant reduction in radiation. (See ["Clinical features and diagnosis of nephrolithiasis in children"](#), [section on 'Imaging'](#).)

- **Magnetic resonance imaging** – In most patients, magnetic resonance imaging (MRI) is not used for urgent evaluation of children with abdominal pain. However, some studies suggest that MRI without contrast has similar diagnostic accuracy for appendicitis as CT and has the advantage of not exposing a child to ionizing radiation. MRI may be preferred in settings with adequate experience in the use of this modality for the detection of appendicitis, and with the resources to rapidly obtain and interpret the study. (See ["Acute appendicitis in children: Diagnostic imaging"](#), [section on 'Magnetic resonance imaging \(MRI\)'](#).)

**ANALGESIA** — We recommend that children with acute abdominal pain receive effective analgesia, as indicated by their degree of discomfort.

The practice of providing analgesia to patients undergoing evaluation for acute abdominal pain has been controversial in the past. Classic teaching is that opiates can alter examination findings, potentially

complicating the diagnostic process. Furthermore, several survey studies have suggested that substantial practice variation exists with regard to the use and timing of analgesia in this setting [13-15].

Three clinical trials have concluded that [morphine](#) analgesia in children with acute abdominal pain provides significant pain reduction without affecting the examination or the ability to identify those with surgical conditions [16-18]. Nevertheless, observational data indicate that children evaluated in the emergency department for abdominal pain may not receive adequate analgesia [19,20].

**ALGORITHMIC APPROACH** — Most children with acute abdominal pain who have conditions that require emergent diagnosis and treatment can be effectively identified with a systematic approach that considers age, the presence of worrisome clinical features, and selected ancillary studies ([table 1](#) and [algorithm 1](#) and [algorithm 2](#)).

**Trauma** — The first step in the evaluation of abdominal pain in children is to identify those who have sustained trauma. For this population, injury is the likely cause of abdominal pain and a specific approach to the evaluation is required. Mechanisms typically associated with significant injury (such as solid organ laceration or perforated viscus) include motor vehicle crashes, motor vehicle pedestrian collisions, falls, and physical assault (including child abuse). (See "[Overview of blunt abdominal trauma in children](#)".)

Rapid, aggressive stabilization and evaluation are indicated for children with the following:

- Unstable vital signs at presentation
- Obvious serious or multiple injuries
- High risk mechanism of injury (penetrating injury, severe blunt trauma, fall from higher than 20 feet, ejection from a vehicle, impact velocity more than 30 miles per hour)

Identification of specific injuries, when clinically indicated, typically requires imaging:

- Focused abdominal sonography for trauma (FAST examination) may detect free fluid (usually blood) in the abdomen. (See "[Initial evaluation and management of blunt abdominal trauma in adults](#)", section on '[Ultrasound](#)'.)
- Solid organ injuries are generally diagnosed with abdominal computed tomography, whereas plain radiographs may demonstrate signs of a perforated viscus (although normal plain radiography does not exclude perforation).

**Signs of obstruction or peritoneal irritation** — Signs of obstruction (such as abdominal distention and/or bilious vomiting), history of prior abdominal surgery (predisposing to adhesions which may cause obstruction), and peritoneal irritation (such as guarding, percussive tenderness, and rebound) are clinical features associated with serious intraabdominal conditions that require prompt diagnosis and treatment.

In every case where clinical findings suggest obstruction or peritonitis, either treatment must be initiated (such as laparotomy for suspected appendicitis) or diagnostic steps must be undertaken to identify a cause. Supportive care (such as monitoring, intravenous isotonic crystalloid fluids, analgesia, and often parenteral antibiotics) should be provided while results from ancillary studies are pending. Hospital admission for observation and serial examinations should occur for any patient with signs of obstruction and/or peritoneal irritation for whom a cause cannot be identified.

- **Obstruction** – Life-threatening causes of abdominal pain as the result of bowel obstruction include the following:
  - Volvulus (most often in neonates). An upper GI contrast series is the imaging study of choice. Ultrasonography may demonstrate findings suggestive of malrotation, but a normal study does not exclude the diagnosis. (See "[Intestinal malrotation in children](#)", section on '[Diagnosis](#)'.)

- Intussusception (usually two months to two years of age). Plain radiographs of the abdomen are commonly normal, but may show frank intestinal obstruction, a mass effect from an intussusceptum, or distended loops of bowel with absence of colonic gas. The diagnosis may be confirmed with ultrasound performed by an experienced ultrasonographer. Contrast enema (air or [barium](#)) can diagnose and often reduce an intussusception. (See ["Intussusception in children", section on 'Evaluation'](#) and ["Intussusception in children", section on 'Nonoperative reduction'](#).)
- **Peritoneal irritation** – The following conditions should be considered in children with abdominal pain and signs of peritoneal irritation:
  - Necrotizing enterocolitis (NEC) occurs rarely among term neonates who have been discharged from nurseries. Such infants typically have preexisting illnesses associated with poor mesenteric perfusion (such as congenital heart disease) or have hypoperfusion such as from protracted diarrhea. Abdominal radiography may demonstrate signs of ileus or characteristic findings such as pneumatosis intestinalis ([image 9](#)). (See ["Clinical features and diagnosis of necrotizing enterocolitis in newborns", section on 'Diagnosis'](#).)
  - Appendicitis occurs more often among children over five years of age, but can also be the cause of abdominal pain and peritoneal irritation in infants and younger children. (See ["Acute appendicitis in children: Clinical manifestations and diagnosis", section on 'Clinical manifestations'](#).)
  - Rarely, an ingested foreign body may become lodged within the GI tract, causing tissue damage or bowel perforation. The vast majority of foreign bodies (even sharp ones) that progress beyond the gastroesophageal junction pass uneventfully through the gastrointestinal tract and out with the stool, requiring no intervention. Exceptions include button batteries that may lodge in the esophagus and require emergency removal. (See ["Button and cylindrical battery ingestion: Clinical features, diagnosis, and initial management", section on 'Clinical features'](#) and ["Foreign bodies of the esophagus and gastrointestinal tract in children"](#).)

In addition, case reports have described volvulus following the ingestion of small magnets. (See ["Causes of acute abdominal pain in children and adolescents", section on 'Foreign body ingestion'](#).)

  - Children with ascites caused by poorly controlled idiopathic nephrotic syndrome liver disease, or portal venous thrombosis may develop spontaneous bacterial peritonitis. (See ["Complications of nephrotic syndrome in children", section on 'Bacterial infection'](#).)
  - Cholecystitis and pancreatitis are unusual causes of abdominal pain among children (see ["Acute cholecystitis: Pathogenesis, clinical features, and diagnosis"](#) and ["Clinical manifestations and diagnosis of acute pancreatitis"](#)). Children with cholecystitis are usually >5 years of age and often have predisposing conditions such as hemoglobinopathies or cystic fibrosis. Causes of pancreatitis among children include trauma, infection, structural anomalies, metabolic or genetic causes, and some medications (such as [tetracycline](#), L-asparaginase, valproic acid, and steroids) [21,22]. (See ["Clinical manifestations and diagnosis of chronic and acute recurrent pancreatitis in children", section on 'Further evaluation for the cause'](#).)
  - Meckel's diverticulum may cause abdominal pain mimicking an acute abdomen, but is more typically associated with painless rectal bleeding. (See ["Lower gastrointestinal bleeding in children: Causes and diagnostic approach", section on 'Meckel's diverticulum'](#).)
  - Perforation of a peptic ulcer is an unusual cause of abdominal pain and peritoneal irritation among children, particularly those <10 years of age. (See ["Peptic ulcer disease: Clinical manifestations and diagnosis", section on 'Ulcer complications'](#).)

**Focal physical findings** — Patients with no apparent injuries and no evidence of obstruction or obvious peritonitis may have serious intraabdominal conditions such as intussusception or appendicitis. At this point, however, the likelihood of serious disease is lower, permitting a more deliberate evaluation. This should include a search for extraabdominal conditions that may cause abdominal pain and abdominal findings (such as a mass or focal tenderness) that suggest an intraabdominal process, neither of which may be obvious, particularly in a young, frightened, or uncooperative child.

**Extraabdominal** — Children with abdominal pain require a full physical examination, looking for signs of systemic illness and for disease in areas adjacent to the abdomen. Specific attention should be focused on the vital signs, the skin, pharynx, the chest, the heart, and the genital region. (See ['Physical examination'](#) above.)

- Immunoglobulin A vasculitis (IgAV; Henoch-Schönlein purpura [HSP]) often causes abdominal pain ([table 3](#)). Patients generally have a typical ecchymotic rash over the lower extremities and buttocks ([picture 1A-B](#)). Pain may develop before the rash in some cases. Intussusception may rarely develop as a complication of IgAV (HSV). (See ["IgA vasculitis \(Henoch-Schönlein purpura\): Clinical manifestations and diagnosis"](#).)
- Children with streptococcal pharyngitis often have abdominal pain, in addition to pharyngeal irritation and exudate, although those with viral pharyngitis may also have abdominal pain. (See ["Group A streptococcal tonsillopharyngitis in children and adolescents: Clinical features and diagnosis"](#), section on ['Clinical features'](#).)
- Lower lobe pneumonia or pleural effusion may cause diaphragmatic irritation and abdominal pain. Usually, children will have fever and abnormal findings on chest examination (such as tachypnea, nasal flaring, crackles (rales), and/or dullness to percussion).
- Myocarditis and pericarditis may present with abdominal pain. It may be the result of poor cardiac output with mesenteric insufficiency or secondary to distension of the liver from heart failure. The pain usually manifests in the right upper quadrant and is accompanied by a tender liver edge on abdominal palpation.
- Children with testicular or ovarian torsion or incarcerated inguinal hernias may complain of abdominal pain. (See ["Causes of scrotal pain in children and adolescents"](#), section on ['Testicular torsion'](#) and ["Inguinal hernia in children"](#).)

**Mass** — Careful palpation of the abdomen may identify an abdominal mass, suggesting the following diagnoses:

- A mass in the right abdomen suggests intussusception, although most children with intussusception do not have this finding. (See ["Intussusception in children"](#), section on ['Clinical manifestations'](#).)
- Malignant solid tumors are rare causes of abdominal pain in previously healthy children. Pain typically develops with bleeding into the tumors. More often, tumors present as painless masses. Wilms' tumor and neuroblastoma occur more commonly in infants, whereas leukemic or lymphomatous involvement of the liver, spleen, or retroperitoneal lymph nodes occurs more often in older children. Other causes include hepatic tumors, ovarian tumors, soft tissue sarcomas, and vascular malformations. (See ["Clinical assessment of the child with suspected cancer"](#), section on ['Abdominal masses'](#).)
- Children with intraabdominal abscesses are typically febrile and may have had previous abdominal surgery. (See ["Fever of unknown origin in children: Etiology"](#), section on ['Intraabdominal abscess'](#).)
- Constipation can cause abdominal pain with an abdominal mass. Associated clinical features include prior episodes of constipation, hard stool in the rectal vault, large amounts of stool on abdominal radiographs, and absence of other concerning signs or symptoms. (See ["Constipation in infants and children: Evaluation"](#).)

**Focal tenderness** — Focal tenderness on physical examination must be identified whenever possible, because this finding may be the only indication of serious intraabdominal pathology. Localized tenderness on physical examination may indicate the following causes for abdominal pain:

- Right lower quadrant abdominal tenderness in otherwise healthy children suggests appendicitis, although children without focal tenderness may on occasion also have appendicitis, particularly early in the course of disease. (See "[Acute appendicitis in children: Clinical manifestations and diagnosis](#)", [section on 'Clinical manifestations'](#).)
- Ovarian torsion can cause localized lower abdominal tenderness that may be indistinguishable from appendicitis when the right ovary is involved. It may occasionally occur without producing focal tenderness. Patients are typically nauseous, as with appendicitis. Although it commonly occurs as the result of an ovarian cyst, ovarian torsion can develop in a normal ovary. (See "[Ovarian and fallopian tube torsion](#)", [section on 'Clinical presentation'](#).)
- Cholecystitis and pancreatitis can cause right upper quadrant and epigastric or periumbilical tenderness, respectively. (See "[Acute cholecystitis: Pathogenesis, clinical features, and diagnosis](#)" and "[Clinical manifestations and diagnosis of acute pancreatitis](#)".)
- Urolithiasis may cause severe colicky flank pain which radiates into the lower abdomen. On palpation there is tenderness in the flank and lower abdomen. Pyelonephritis may cause flank tenderness with fever and/or dysuria.

**Colicky pain** — Intussusception should be considered for all children two months to two years of age with diffuse, colicky, severe abdominal pain and for those with predisposing conditions (such as IgAV [HSP] and Peutz-Jeghers syndrome) regardless of findings on physical examination (including overall appearance and the presence or absence of blood in the stool). Colicky abdominal pain is sometimes described among children with a bowel obstruction.

Imaging studies that can confirm the diagnosis include ultrasound and contrast enema. Contrast enema, usually air, should be obtained initially for patients in whom there is a high index of suspicion for intussusception because this study may be diagnostic and therapeutic. Abdominal plain radiographs and ultrasound may be useful when the diagnosis is uncertain (as is often the case), provided that these studies do not significantly delay the definitive diagnosis and treatment of intussusception. (See "[Intussusception in children](#)", [section on 'Evaluation'](#) and "[Intussusception in children](#)", [section on 'Nonoperative reduction'](#).)

**Nonspecific symptoms** — Children with abdominal pain who have not been injured and have no signs of obstruction, peritoneal irritation, evidence of extraabdominal diseases, focal findings, or a pattern of pain suggestive of intussusception typically have infections, systemic illnesses, or a variety of minor problems (such as constipation).

For children with severe nonspecific abdominal pain, the following diagnoses, even without other distinguishing features, are possible:

- Intussusception (age two months to two years, intermittent pattern)
- Ovarian torsion or ruptured ovarian cyst (female)

Infections that may present with abdominal pain include:

- Viral or bacterial gastroenteritis (usually with diarrhea) and systemic viral syndromes (such as influenza).
- Pneumonia and pharyngitis (to a lesser extent) can occasionally cause abdominal pain with a paucity of findings in the chest or pharynx, respectively.

- Intraabdominal abscess (as from a ruptured appendix) may cause fever and abdominal pain without focal tenderness, particularly in a young child.
- Children with hepatitis may be anicteric early in their course.
- Young children with urinary tract infections may not have dysuria, particularly if they have pyelonephritis.

Abdominal pain can be a nonspecific feature of a number of conditions that typically have other distinguishing clinical or laboratory features. These include:

- Diabetic ketoacidosis (Kussmaul respirations, fruity breath, polyuria, glucosuria, ketonuria, weight loss)
- Hemolytic uremic syndrome (pallor, petechiae, microangiopathic anemia, thrombocytopenia, renal failure)
- IgAV (HSP) ([table 3](#))
- Pancreatitis (elevated amylase and lipase levels)
- Urolithiasis (hematuria)
- Iron intoxication (occult blood in stool, foreign body on abdominal plain radiography) ([table 4](#))
- Hepatitis (jaundice, hyperbilirubinemia)

Children with chronic or recurrent abdominal pain must always be evaluated carefully for other causes, particularly when the pattern is not typical or symptoms do not respond to the usual treatment. As an example, a child with sickle cell disease and abdominal pain who does not improve with hydration and analgesia as expected in patients with vasoocclusive crisis may have appendicitis or gall bladder disease. An approach to children with chronic abdominal pain is reviewed elsewhere. (See "[Chronic abdominal pain in children and adolescents: Approach to the evaluation](#)", section on 'Etiology'.) Conditions to consider include:

- Among neonates, colic is a diagnosis of exclusion that can often be distinguished from other causes of prolonged crying with a careful history and physical examination ([table 5](#)). In young infants for whom the diagnosis is uncertain, a one to two hour period of observation in which no symptoms are observed and normal feeding occurs provides support for the diagnosis of colic. (See "[Infantile colic: Clinical features and diagnosis](#)", section on 'Evaluation'.)
- Infants with dietary protein allergy may develop irritability that is interpreted as abdominal pain. They typically pass blood-tinged stools and mucus, but do not have diarrhea. (See "[Food protein-induced proctocolitis of infancy](#)".)
- Children with conditions that cause malabsorption (such as celiac disease and carbohydrate malabsorption) may have recurrent abdominal pain. (See "[Epidemiology, pathogenesis, and clinical manifestations of celiac disease in children](#)", section on "'Classical' gastrointestinal symptoms' and '[Chronic abdominal pain in children and adolescents: Approach to the evaluation](#)', section on 'Etiology'.)
- Abdominal pain may be a typical manifestation of vasoocclusive crises for children with sickle cell syndromes. (See "[Overview of the clinical manifestations of sickle cell disease](#)", section on 'Acute painful episodes' and "[Overview of variant sickle cell syndromes](#)".)
- Intermittent abdominal pain is a classic feature of lead poisoning in children with high exposure. (See "[Childhood lead poisoning: Clinical manifestations and diagnosis](#)", section on 'Clinical manifestations'.)

- Inflammatory bowel disease (more often Crohn disease than ulcerative colitis) may present with intermittent abdominal pain. Associated features may include diarrhea, hematochezia, and weight loss. (See ["Clinical manifestations of Crohn disease in children and adolescents", section on 'Presenting symptoms'](#) and ["Management of mild to moderate ulcerative colitis in children and adolescents", section on 'Clinical manifestations'](#).)
- Constipation and functional abdominal pain are diagnoses of exclusion for children with recurrent abdominal pain without other concerning features. An abdominal radiograph to confirm the presence of at least moderate amounts of stool, although often performed, does not correlate well with the diagnosis of constipation and is not a routine part of evaluation of children not previously diagnosed with constipation who present with acute pain, particularly in the emergency department [23]. (See ["Chronic abdominal pain in children and adolescents: Approach to the evaluation", section on 'Etiology'](#).)

**Adolescent females** — For adolescent girls, an algorithmic approach must include diagnoses related to reproductive organ development and function ([algorithm 2](#)). Urine pregnancy testing should generally be performed for postmenarchal females with abdominal pain, whether or not sexual activity is reported.

Visual inspection may detect imperforate hymen in adolescent females with abdominal pain, abdominal mass, and primary amenorrhea in association with advanced sexual maturation (Tanner stage IV or V). An imperforate hymen is the simplest defect that results in primary amenorrhea and is typically associated with cyclic pelvic pain and a perirectal mass from sequestration of blood in the vagina (hematocolpos). Similar findings can be seen with defects in perineal development, which can result in absence of the distal third of the vagina and therefore absence of an outflow tract. Both of these conditions are diagnosed by physical examination. An imperforate hymen is easily corrected with surgery. (See ["Diagnosis and management of congenital anomalies of the vagina"](#).)

In addition to the conditions discussed above, the following should also be considered:

- Additional diagnoses to consider for postmenarchal sexually active girls with abdominal pain who have signs of peritoneal irritation with no history of trauma include pelvic inflammatory disease (PID) and ruptured ectopic pregnancy. A bimanual pelvic examination may identify cervical motion tenderness or an adnexal mass. Pelvic ultrasonography is the imaging modality typically used to identify tuboovarian abscess and ectopic pregnancy. (See ["Pelvic inflammatory disease: Clinical manifestations and diagnosis"](#) and ["Ectopic pregnancy: Clinical manifestations and diagnosis"](#).)
- For a postmenarchal female with no history of trauma and no peritoneal signs, an abdominal mass may represent an intrauterine pregnancy or hydrometrocolpos in a patient with imperforate hymen. Ovarian torsion or a ruptured ovarian cyst typically causes focal pain. (See ["Ovarian and fallopian tube torsion", section on 'Clinical presentation'](#).)
- Pregnancy (intrauterine or ectopic) must be considered as a cause of abdominal pain in postmenarchal females, whether or not sexual activity is reported. (See ["Pregnancy in adolescents", section on 'Diagnosis of pregnancy'](#).)
- Dysmenorrhea may be the cause of recurrent abdominal pain that develops during menses. (See ["Primary dysmenorrhea in adolescents"](#).)

**INFORMATION FOR PATIENTS** — UpToDate offers two types of patient education materials, "The Basics" and "Beyond the Basics." The Basics patient education pieces are written in plain language, at the 5<sup>th</sup> to 6<sup>th</sup> grade reading level, and they answer the four or five key questions a patient might have about a given condition. These articles are best for patients who want a general overview and who prefer short, easy-to-read materials. Beyond the Basics patient education pieces are longer, more sophisticated, and more detailed. These articles are written at the 10<sup>th</sup> to 12<sup>th</sup> grade reading level and are best for patients who want in-depth information and are comfortable with some medical jargon.

Here are the patient education articles that are relevant to this topic. We encourage you to print or e-mail these topics to your patients. (You can also locate patient education articles on a variety of subjects by searching on "patient info" and the keyword(s) of interest.)

- Basics topic (see ["Patient education: Acute abdomen \(belly pain\) \(The Basics\)"](#))

## SUMMARY AND RECOMMENDATIONS

- For most children, the causes of abdominal pain are self-limited, minor conditions such as gastroenteritis, constipation, and other viral illnesses. Children who have experienced trauma or who have signs of bowel obstruction (such as abdominal distention and/or bilious vomiting) or peritoneal irritation (such as guarding, percussive tenderness, and rebound) may have serious conditions that require prompt diagnosis and treatment ([table 1](#)). (See ['Causes'](#) above and ["Causes of acute abdominal pain in children and adolescents"](#).)
- A systematic approach to the emergent evaluation of the child with acute abdominal pain that considers the patient's age and the presence of specific signs and symptoms, as well as selected ancillary studies, generally identifies those who have conditions that require emergent diagnosis and treatment. (See ['Evaluation'](#) above.)
- We recommend that children with acute abdominal pain receive effective analgesia, as indicated by their degree of discomfort, while they are being evaluated for a cause ([Grade 1B](#)). (See ['Analgesia'](#) above.)
- Algorithmic approaches to the evaluation of children ([algorithm 1](#)) and postmenarchal girls ([algorithm 2](#)) with acute abdominal pain are suggested. (See ['Algorithmic approach'](#) above.)
- Some patients with acute abdominal pain may **not** receive the definitive diagnosis on the first evaluation because they present early in the course (such as appendicitis) or with subtle and/or atypical signs. Repeat examination and reliable follow-up to identify clinical features are essential components of the evaluation and management of children with acute abdominal pain. (See ['Background'](#) above.)

Use of UpToDate is subject to the [Subscription and License Agreement](#).

## REFERENCES

1. Reynolds SL, Jaffe DM. Diagnosing abdominal pain in a pediatric emergency department. *Pediatr Emerg Care* 1992; 8:126.
2. Scholer SJ, Pituch K, Orr DP, Dittus RS. Clinical outcomes of children with acute abdominal pain. *Pediatrics* 1996; 98:680.
3. Leung AK, Sigalet DL. Acute abdominal pain in children. *Am Fam Physician* 2003; 67:2321.
4. Ravichandran D, Burge DM. Pneumonia presenting with acute abdominal pain in children. *Br J Surg* 1996; 83:1707.
5. Bundy DG, Byerley JS, Liles EA, et al. Does this child have appendicitis? *JAMA* 2007; 298:438.
6. Dickson AP, MacKinlay GA. Rectal examination and acute appendicitis. *Arch Dis Child* 1985; 60:666.
7. Andersson RE, Hugander AP, Ghazi SH, et al. Why does the clinical diagnosis fail in suspected appendicitis? *Eur J Surg* 2000; 166:796.
8. Shlamovitz GZ, Mower WR, Bergman J, et al. Poor test characteristics for the digital rectal examination in trauma patients. *Ann Emerg Med* 2007; 50:25.
9. Shlamovitz GZ, Mower WR, Bergman J, et al. Lack of evidence to support routine digital rectal examination in pediatric trauma patients. *Pediatr Emerg Care* 2007; 23:537.



10. Kristinsson G, Wall SP, Crain EF. The digital rectal examination in pediatric trauma: a pilot study. *J Emerg Med* 2007; 32:59.
11. Bachur R, Perry H, Harper MB. Occult pneumonias: empiric chest radiographs in febrile children with leukocytosis. *Ann Emerg Med* 1999; 33:166.
12. Murphy CG, van de Pol AC, Harper MB, Bachur RG. Clinical predictors of occult pneumonia in the febrile child. *Acad Emerg Med* 2007; 14:243.
13. Nissman SA, Kaplan LJ, Mann BD. Critically reappraising the literature-driven practice of analgesia administration for acute abdominal pain in the emergency room prior to surgical evaluation. *Am J Surg* 2003; 185:291.
14. Wolfe JM, Lein DY, Lenkoski K, Smithline HA. Analgesic administration to patients with an acute abdomen: a survey of emergency medicine physicians. *Am J Emerg Med* 2000; 18:250.
15. Tait IS, Ionescu MV, Cuschieri A. Do patients with acute abdominal pain wait unduly long for analgesia? *J R Coll Surg Edinb* 1999; 44:181.
16. Kim MK, Strait RT, Sato TT, Hennes HM. A randomized clinical trial of analgesia in children with acute abdominal pain. *Acad Emerg Med* 2002; 9:281.
17. Green R, Bulloch B, Kabani A, et al. Early analgesia for children with acute abdominal pain. *Pediatrics* 2005; 116:978.
18. Bailey B, Bergeron S, Gravel J, et al. Efficacy and impact of intravenous morphine before surgical consultation in children with right lower quadrant pain suggestive of appendicitis: a randomized controlled trial. *Ann Emerg Med* 2007; 50:371.
19. Kim MK, Galustyan S, Sato TT, et al. Analgesia for children with acute abdominal pain: a survey of pediatric emergency physicians and pediatric surgeons. *Pediatrics* 2003; 112:1122.
20. Goldman RD, Crum D, Bromberg R, et al. Analgesia administration for acute abdominal pain in the pediatric emergency department. *Pediatr Emerg Care* 2006; 22:18.
21. Kandula L, Lowe ME. Etiology and outcome of acute pancreatitis in infants and toddlers. *J Pediatr* 2008; 152:106.
22. Werlin SL, Kugathasan S, Frautschy BC. Pancreatitis in children. *J Pediatr Gastroenterol Nutr* 2003; 37:591.
23. Reuchlin-Vroklage LM, Bierma-Zeinstra S, Benninga MA, Berger MY. Diagnostic value of abdominal radiography in constipated children: a systematic review. *Arch Pediatr Adolesc Med* 2005; 159:671.

Topic 6434 Version 19.0