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Each practice guideline and technical standard, representing a policy statement by the College, has undergone a thorough consensus process in which it has been subjected to extensive review, requiring the approval of the Commission on Quality and Safety as well as the ACR Board of Chancellors, the ACR Council Steering Committee, and the ACR Council. The practice guidelines and technical standards recognize that the safe and effective use of diagnostic and therapeutic radiology requires specific training, skills, and techniques, as described in each document. Reproduction or modification of the published practice guideline and technical standard by those entities not providing these services is not authorized.

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Revised 2001 (Res. 29)  
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## **ACR PRACTICE GUIDELINE FOR THE PERFORMANCE OF PEDIATRIC CONTRAST EXAMINATION OF THE UPPER GASTROINTESTINAL TRACT**

### **PREAMBLE**

These guidelines are an educational tool designed to assist practitioners in providing appropriate radiologic care for patients. They are not inflexible rules or requirements of practice and are not intended, nor should they be used, to establish a legal standard of care. For these reasons and those set forth below, the American College of Radiology cautions against the use of these guidelines in litigation in which the clinical decisions of a practitioner are called into question.

The ultimate judgment regarding the propriety of any specific procedure or course of action must be made by the physician or medical physicist in light of all the circumstances presented. Thus, an approach that differs from the guidelines, standing alone, does not necessarily imply that the approach was below the standard of care. To the contrary, a conscientious practitioner may responsibly adopt a course of action different from that set forth in the guidelines when, in the reasonable judgment of the practitioner, such course of action is indicated by the condition of the patient, limitations on available resources, or advances in knowledge or technology subsequent to publication of the guidelines. However, a practitioner who employs an approach substantially different from these guidelines is advised to document in the patient record information sufficient to explain the approach taken.

The practice of medicine involves not only the science, but also the art of dealing with the prevention, diagnosis, alleviation, and treatment of disease. The variety and complexity of human conditions make it impossible to

always reach the most appropriate diagnosis or to predict with certainty a particular response to treatment.

Therefore, it should be recognized that adherence to these guidelines will not assure an accurate diagnosis or a successful outcome. All that should be expected is that the practitioner will follow a reasonable course of action based on current knowledge, available resources, and the needs of the patient to deliver effective and safe medical care. The sole purpose of these guidelines is to assist practitioners in achieving this objective.

### **I. INTRODUCTION**

This guideline was developed to guide physicians in the performance of upper gastrointestinal contrast examinations in pediatric patients. Contrast studies of the esophagus, stomach, and duodenum are performed in infants and children when specific symptoms and signs suggest abnormal anatomy or function of the upper gastrointestinal tract. Single-contrast examinations are frequently performed, but occasionally double-contrast examinations are indicated for the same reasons as in the adult population.

### **II. INDICATIONS AND CONTRAINDICATIONS**

Indications for gastrointestinal contrast examinations in children include, but are not limited to, the following clinical settings:

A. Infants who have had multiple episodes of pneumonia, episodes of apnea and bradycardia, or difficulties in feeding may need a contrast examination of the esophagus to investigate possible 1) fistula between the esophagus and the trachea; 2) anatomic causes or sequelae of esophageal/gastroesophageal reflux; 3) dysfunctional swallowing; or 4) esophageal obstruction, either intrinsic or extrinsic.

B. Children with signs and symptoms of airway obstruction may undergo an examination of the esophagus to investigate the possibility of a vascular ring or mass compressing the trachea, or other intrathoracic tracheal obstruction.

C. Infants with bilious or repeated vomiting, abdominal pain, or bloody stools may need an upper gastrointestinal series to investigate the possibility of malrotation, other causes of mechanical obstruction, or intrinsic diseases of the upper gastrointestinal tract.

D. Children may undergo an examination of the esophagus to diagnose or investigate the possibility of foreign body, inflammatory or infectious disease, stricture from caustic ingestion or reflux, mediastinal mass, or varices.

E. Older children may undergo an upper gastrointestinal series for the same indications as in the adult population, including pain, bleeding, suspected inflammatory bowel disease, or gastrointestinal obstruction. (See the [ACR Practice Guideline for the Performance of Esophagrams and Upper Gastrointestinal Examination in Adults](#).)

F. Although ultrasound may be preferred in the evaluation for pyloric stenosis due to its inherent lack of ionizing radiation, upper gastrointestinal examination remains an accurate alternative study.

Infants and children with suspected swallowing abnormality may need a contrast examination for evaluation of the swallowing mechanism (also known as a feeding study, oropharyngeal motility study, or modified barium swallow). Difficulty swallowing may be due to anatomic abnormalities in the oral cavity or neuromuscular disturbances.

All imaging facilities should have policies and procedures to reasonably attempt to identify pregnant patients prior to the performance of any examination involving ionizing radiation. If the patient is known to be pregnant, the potential radiation risk to the fetus and clinical benefits of the procedure should be considered before proceeding with the study. (1995, 2005 - ACR Resolution 1a)

### III. QUALIFICATIONS OF PERSONNEL

See the [ACR Practice Guideline for General Radiography](#).

#### A. Physician

In addition to the qualifications listed under the general radiography guideline the physician should have documented training in performing fluoroscopic examinations on infants and children. The physician shall be knowledgeable in imaging procedures, including upper gastrointestinal examinations and other medical imaging procedures (general radiography, fluoroscopy, computed tomography (CT), ultrasound, magnetic resonance imaging (MRI), and nuclear medicine), in order to choose the imaging procedure most appropriate to evaluate the patient's clinical signs and symptoms.

The physician shall also have documented training in the principles of radiation protection, the hazards of radiation exposure to both patient and radiologic personnel, radiation monitoring requirements, and education in keeping radiation exposure as low as reasonably achievable (ALARA).

#### B. Registered Radiologist Assistant

A registered radiologist assistant is an advanced level radiographer who is certified and registered as a radiologist assistant by the American Registry of Radiologic Technologists (ARRT) after having successfully completed an advanced academic program encompassing an ACR/ASRT (American Society of Radiologic Technologists) radiologist assistant curriculum and a radiologist-directed clinical preceptorship. Under radiologist supervision, the radiologist assistant may perform patient assessment, patient management and selected examinations as delineated in the Joint Policy Statement of the ACR and the ASRT titled "Radiologist Assistant: Roles and Responsibilities" and as allowed by state law. The radiologist assistant transmits to the supervising radiologists those observations that have a bearing on diagnosis. Performance of diagnostic interpretations remains outside the scope of practice of the radiologist assistant. (2006 - ACR Resolution 34)

#### C. Radiologic Technologist

In addition to the qualifications listed under the general radiography guideline the radiologic technologist should have training in performing fluoroscopic examinations<sup>1</sup>

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<sup>1</sup>The American College of Radiology approves of the practice of certified and/or licensed radiologic technologists performing fluoroscopy in a facility or department as a positioning or localizing procedure only, and then only if monitored by a supervising physician who is personally and immediately available\*. There must be a written policy or process for the positioning or localizing procedure that is approved by the

on infants and children. The technologist should be skilled in the performance of upper gastrointestinal contrast examinations, including patient positioning, usual and alternative routes of barium administration, use of gonadal shielding, and methods of applying safe effective physical restraint. Familiarity with the specific equipment is necessary to keep radiation exposure to patient and staff ALARA.

#### IV. SPECIFICATIONS OF THE EXAMINATION

The written or electronic request for a pediatric contrast – upper gastrointestinal examination should provide sufficient information to demonstrate the medical necessity of the examination and allow for its proper performance and interpretation.

Documentation that satisfies medical necessity includes 1) signs and symptoms and/or 2) relevant history (including known diagnoses). Additional information regarding the specific reason for the examination or a provisional diagnosis would be helpful and may at times be needed to allow for the proper performance and interpretation of the examination.

The request for the examination must be originated by a physician or other appropriately licensed health care provider. The accompanying clinical information should be provided by a physician or other appropriately licensed health care provider familiar with the patient's clinical problem or question and consistent with the state scope of practice requirements. (2006 - ACR Resolution 35)

##### A. Patient Selection

The upper gastrointestinal contrast examination should be performed only for an appropriate clinical indication. A qualified imaging physician, as described in Section III.A, who is familiar with the anomalies and diseases of the pediatric gastrointestinal tract should be available to help the clinician decide the most appropriate way to evaluate the child's problem(s).

##### B. Preparation

The child should have nothing by mouth or by tube feeding prior to the examination. The length of time that

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medical director of the facility or department/service and that includes written authority or policies and processes for designating radiologic technologists who may perform such procedures. (1987, 1997, 2007 - ACR Resolution 12-m)

\*For the purposes of this guideline, "personally and immediately available" is defined in manner of the "personal supervision" provision of CMS—a physician must be in attendance in the room during the performance of the procedure. Program Memorandum Carriers, DHHS, HCFA, Transmittal B-01-28, April 19, 2001.

the child should fast depends on the child's age, the examination, and the clinical circumstances: for example, 2 hours for neonates and infants under 3 months, 3 hours for infants 3-12 months, and 4 hours for all other children. For emergent indications (e.g., suspected malrotation or volvulus), fasting may not be required.

##### C. Examination Preliminaries

1. Medical history should be reviewed to determine the appropriate protocol for the individual patient. Children who require medications or monitoring may have the timing or type of examination modified. Concurrent medical conditions should be considered in patient scheduling and study design.
2. If available, pertinent prior studies should be reviewed.
3. Preliminary radiographs are not always necessary but may be performed at the discretion of the physician.

##### D. Examination Technique

(See the [ACR Practice Guideline for the Performance of Esophagrams and Upper Gastrointestinal Examination in Adults](#).)

Digital pulsed and last image hold features of fluoroscopy reduce radiation dose and should be used when available.

Barium or other contrast media should be administered in a manner that is appropriate for the child's age. Flavoring agents may be added. A nasogastric tube may be needed for some studies. The amount of contrast administered is determined by the child's age and the portion(s) of the gastrointestinal tract to be studied.

Whenever the integrity of a specific portion of the gastrointestinal tract is in question, the upper gastrointestinal examination may be performed with water-soluble contrast (ionic or nonionic). Care should be taken in using hyperosmolar water-soluble contrast in newborns and particularly in premature infants. It should also be avoided or minimized in patients in whom there is a significant risk of aspiration.

Double-contrast examinations of the upper gastrointestinal tract are performed for the same reason as in adults: when there is need to see the mucosal surfaces in detail. Because of the need for patient cooperation (swallowing the gas-producing granules, keeping the air within the gastrointestinal tract), double-contrast studies are less commonly performed in pediatric patients.

Contrast examinations of the swallowing mechanism, by their very nature, have more variation in how the contrast is given. Thick or thin fluids may be given by bottle through a variety of nipples. Barium or pureed products may be given with a spoon, through a syringe, or with a cup. Solid (barium-coated) food may also be administered. Contrast examinations of the swallowing mechanism, whenever possible, should be performed with videofluoroscopy or rapid-sequence recording.

Positioning varies with the type of study and with the child's age. When performing an upper gastrointestinal examination, fluoroscopy images identifying the location of the duodenal-jejunal junction should be obtained. Contrast examinations of the swallowing mechanism are usually done with the child seated upright and lateral to the incident beam. Chairs that support the child's head and allow proper positioning of the neck may be used. Older children may undergo contrast examinations of the swallowing mechanism while seated in a wheelchair or standing.

Infants and young children are frequently immobilized during barium studies. Fluoroscopic imaging may be supplemented with large format images as needed. When performing fluoroscopic examinations on pediatric patients, radiation exposure should be kept ALARA while preserving diagnostic image quality. Fluoroscopic time should be minimized and recorded.

#### E. Radiographic Quality Control

Correlation of radiologic, endoscopic, and pathologic findings, where available, is suggested for a quality control program.

### V. DOCUMENTATION

An official interpretation (final report) of the examination should be included in the patient's medical record.

Reporting should be in accordance with the [ACR Practice Guideline for Communication of Diagnostic Imaging Findings](#).

### VI. EQUIPMENT SPECIFICATIONS

Examinations should be performed with fluoroscopic image intensification and radiographic equipment meeting all applicable federal and state radiation standards. The equipment should provide diagnostic fluoroscopic image quality and recording (radiographs, video, or digital) capability. The equipment should be capable of producing kilovoltage greater than 100 kVp. Equipment necessary to compress and isolate accessible regions of the stomach and duodenum should be readily available.

Facilities should have the ability to deliver supplemental oxygen, to suction the oral cavity and upper respiratory tract, and to respond to life-threatening emergencies that may accompany aspiration, allergic reaction to contrast agents, or reflux.

### VII. RADIATION SAFETY IN IMAGING

Radiologists, medical physicists, radiologic technologists, and all supervising physicians have a responsibility to minimize radiation dose to individual patients, to staff, and to society as a whole, while maintaining the necessary diagnostic image quality. This is the concept "As Low As Reasonably Achievable (ALARA)".

Facilities, in consultation with the medical physicist, should have in place and should adhere to policies and procedures, in accordance with ALARA, to vary examination protocols to take into account patient body habitus, such as height and/or weight, body mass index or lateral width. The dose reduction devices that are available on imaging equipment should be active or manual techniques should be used to moderate the exposure while maintaining the necessary diagnostic image quality. Patient radiation doses should be periodically measured by a medical physicist in accordance with the appropriate ACR Technical Standard. (2006 - ACR Resolution 17)

### VIII. QUALITY CONTROL AND IMPROVEMENT, SAFETY, INFECTION CONTROL, AND PATIENT EDUCATION CONCERNS

Policies and procedures related to quality, patient education, infection control, and safety should be developed and implemented in accordance with the ACR Policy on Quality Control and Improvement, Safety, Infection Control, and Patient Education Concerns appearing elsewhere in the ACR Practice Guidelines and Technical Standards book.

The lowest possible radiation dose consistent with acceptable diagnostic image quality should be used particularly in pediatric examinations. Radiation doses should be determined periodically based on a reasonable sample of pediatric examinations. Technical factors should be appropriate for the size and the age of the child and should be determined with consideration of parameters such as characteristics of the imaging system, organs in the radiation field, lead shielding, etc. Guidelines concerning effective pediatric technical factors are published in the radiologic literature.

Equipment performance monitoring should be in accordance with the [ACR Technical Standard for Diagnostic Medical Physics Performance Monitoring of Radiologic and Fluoroscopic Equipment](#).

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Principal Reviewers: Kimberly E. Applegate, MD, MS  
Peter J. Strouse, MD

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## REFERENCES

1. Brown PH, Silberberg PJ, Thomas RD, et al. A multihospital survey of radiation exposure and image quality in pediatric fluoroscopy. *Pediatr Radiol* 2000; 30:236-242.
2. Brown PH, Thomas RD, Silberberg PJ, et al. Optimization of a fluoroscope to reduce radiation exposure in pediatric imaging. *Pediatr Radiol* 2000;30:229-235.
3. Cohen MD, Towbin R, Baker S, et al. Comparison of iohexol with barium in gastrointestinal studies of infants and children. *AJR* 1991;156:345-350.
4. Coussement AM. Improving acceptance of barium in children by using milk for dilution. *Radiology* 1992;184:578.
5. Feczko PJ. Increased frequency of reactions to contrast material during gastrointestinal studies. *Radiology* 1990;174:367-368.
6. Gore RM, Levin MS. *Textbook of Gastrointestinal Radiology* (2-volume set). 2nd edition. Philadelphia, Pa: W.B. Saunders; 2000.
7. Hernandez RJ, Goodsitt MM. Reduction of radiation dose in pediatric patients using pulsed fluoroscopy. *AJR* 1996;167:1247-1253.
8. Kirks DR, ed. *Practical Pediatric Imaging: Diagnostic Radiology of Infants and Children*. 3rd edition. Boston, Mass: Little, Brown and Company; 1998.
9. McAlister WH, Askin FB. The effect of some contrast agents in the lung: an experimental study in the rat and dog. *AJR* 1983;140:245-251.
10. Newman LA, Cleveland RH, Blickman JG, et al. Videofluoroscopic analysis of the infant swallow. *Invest Radiology* 1991;26:870-873.
11. Simanovsky N, Buonomo C, Nurko S. The infant with chronic vomiting: the value of the upper GI series. *Pediatr Radiol* 2002;32:549-550.
12. Stringer DA, Babyn PS. *Pediatric Gastrointestinal Imaging and Intervention*. 2nd edition. Philadelphia, Pa: BC Decker; 2000.
13. Stringer D, Hassall E, Ferguson AC, et al. Hypersensitivity reaction to single contrast barium meal studies in children. *Pediatr Radiol* 1993;23:587-588.
14. Strouse PJ. Disorders of intestinal rotation and fixation ("malrotation"). *Pediatr Radiol* 2004;34:837-851.
15. Willis CE, Slovis TL. The ALARA concept in pediatric CR and DR: dose reduction in pediatric radiographic exams: a white paper conference. *AJR* 2005; 184:373-374.
16. Zerilli KS, Stefans VA, DiPietro MA. Protocol for the use of videofluoroscopy in pediatric swallowing dysfunction. *Am J Occup Ther* 1990;44:441-446.
17. Zerlin JM. Contrast studies of the gastrointestinal tract in the neonate. *Semin Pediatr Surg* 1992;1:284-295.