Pediatric Radiology Fellowship at Phoenix Children’s Hospital

The fellowship will be a one year program, organized into 1-4 (2 week blocks) including the following disciplines (described below). The blocks will not follow in the order listed:

1: General Orientation Introduction to Fluoroscopy and Plain Film Radiography. 2 weeks.
2: Pediatric Fluoroscopy, Radiation Safety. 2 (2 week blocks)
3: Plain Film Radiology. 3 (2 week blocks)
4: Neuroradiology. 2 (2 week blocks)
5: Ultrasound. 2 (2 week blocks)
6: CT. 4 (2 week blocks)
7: MRI. 3 (2 week blocks)
8: Nuclear and Molecular Imaging. 2 (2 week blocks)
9: Clinical Research/ Elective. 2 (2 week blocks)
10: Vascular and Interventional Radiology. 1 (2 week blocks)
11: Vacation and meetings 4 weeks

General Philosophy for Pediatric Radiology

Goals: Fellows will develop the professional skills and caring attitude that will enable them to work with referring physicians and with the clinical team to provide timely and appropriate pediatric imaging. During the early blocks the fellow will learn practical skills for functioning in a pediatric radiology department and will focus on technical and conference skills. Talking to pediatric patients at an age-appropriate level and in a caring and respectful manner will be emphasized. Radiation safety in particular, the goal of using as low a dose as is reasonably achievable (ALARA)—will become part of the fellow’s daily routine with emphasis on recent publications by the Society of Pediatric Radiology. This value will be reinforced by the diagnostic radiology staff.

Overview of Fellowship

The fellow will develop increasing independence by using professional and technical skills to provide quality fluoroscopic examinations for pediatric patients. The fellow will develop professional skills in pediatric US. The fellow will develop the professional knowledge, skills needed to provide high-quality CT, MR imaging, radiography, and US of pediatric patients, with an emphasis on neuroradiology but also including vascular MR imaging and exposure to MR spectroscopy. During this year the fellow will become the role interventional radiology plays in pediatric patient management. Even though at this hospital sedation is under the aegis of the Anesthesiology Department, the fellow will learn safe sedation practices. The fellow will develop the professional knowledge and technical skills needed to protocol, perform, and interpret high-quality chest radiography, chest CT, MR imaging of the airway, and chest US for pediatric patients. The fellow will learn the differences between screen-film radiography, computed radiography, and direct radiography and the physics of image capture. The goal of providing cost effective imaging will be emphasized during each subspecialty rotation. It will be based imaging literature and American College of Radiology guidelines.

Educational Strategies

General Objectives for All Rotations

Educational Strategies

1. Training and practice on use of imaging workstations, accessing electronic medical records, and using voice recognition for generating reports.
2. Basic instruction in Citrix and vpn software for communicating with hospital programs from fellow’s home computer and importing electronic images for lectures and rounding with house staff personnel.
3. Learning methods of literature research with the librarian and other resources.
4. Familiarize with location of pediatric crash cart and specific method for calling a pediatric emergency or code with a pediatric radiology nurse.
5. Review all imaging protocol guidelines in consultation with Program Director and attending staff radiologist.
6. Receive orientation from the Program Director in regard to goals, expectations, and responsibilities during fellowship.
7. Participate in basic statistic course offered by hospital or web based.
8. Method of incorporation of cases into electronic teaching files by information system person.
9. Further objectives:
   a. Observe staff interacting with patient and patient’s family in caring, professional manner.
   b. Demonstrate techniques for explaining procedures, technology, terminology, and results to patient and patient’s family.
   c. Demonstrate role as consultant in expediting cost effective and appropriate imaging workup of new patient.
   d. Demonstrate different imaging preferences for different disease processes.
   e. Attendance at interdisciplinary conferences related to subject material of each modality rotation and observing radiologist giving an interdisciplinary conference.
   f. Demonstrate to pediatric radiology nurse the location of the pediatric crash carts in the department and the method of calling a pediatric code.
   g. Demonstrate ability to perform an online literature search on a research topic by showing a printout of sources, collecting appropriate literature on the selected research topic, and initiating the selection of appropriate methodology for the research project.

Medical Knowledge

1. Understand the appropriate use of each imaging modality in the evaluation of infant, childhood, and adolescent disease in the context of routine and emergent imaging.
2. Be able to interpret all imaging studies and to dictate in a timely manor: Dictations should have key elements of the clinical history, past relevant history, current study, and interpretation. Learn the method of performing pre-set dictations.
3. In each modality be familiar with the equipment, the standard views, imaging sequences, and radiation doses.
4. Understand the uses and limitations of each modality in childhood and adolescent diseases.
5. Learn to utilize online resources from SPR and other sources.
   a. Cleveland Clinic’s Pediatric Radiology core concepts
   b. Cincinnati Children’s online learning modules
   c. Children’s Memorial Hospital Digital Teaching File
   d. Brain myelination atlas
   e. Lieberman’s e-radiology
7. Learn approach and differential diagnoses to different disease processes.
8. Understand low dose techniques and philosophies of “Image Gently” from SPR.
9. Enter at least two cases into teaching file during each modality rotation.

Patient Care

1. Involvement in patient care provided during both outpatient and inpatient children.
2. Evaluate appropriateness of requested examinations by familiarizing oneself with the reasons for studies in each modality.
3. Provide safe environment by following standard procedures according to the Procedures and Policy Statements.
4. Follow recommendations for safe contact with patients by washing of hands prior and after each encounter.
5. Dictations in appropriate timely manor with the use of standard format and appropriate language.
6. Recheck the correct sidedness of patient.
7. Be physically present in the modality except for designated conferences during rotation.
Interpersonal and Communication Skills

1. Work professionally and effectively with technologists.
2. Communicate findings effectively with referring physicians.
4. Direct phone service to physician or service for emergent studies, critical values, and documentation of communication.
5. Demonstrate respect, compassion, and integrity in interactions with patients, technologists and physicians.
6. Inquire about special needs of patients.
7. Respectful for ethnic, economic, religious, and language diversity of families.
8. Avoid negative comments concerning other health care providers or institutions.
9. Do not discuss histories and care of patients in public places.
10. Observe HIPAA regulations.
11. Employ PowerPoint software for lecture presentations and learn how to use audio-visual technology for lectures

System Based Practice

1. Understand how each modality lends itself into the caring for patient, making correct diagnosis and helping improve outcomes.
2. Understand appropriateness of imaging guidelines from department’s standard protocols and ACR guidelines.
3. Understand best practices to exhibit and promote positive attitudes and behaviors that enhance patient care.
4. Try to create safe environment and endorse the JCAHO, institution guidelines for a safe environment.
5. Report errors for peer review and improvement in performance.
6. Work to improve systems not only within radiology but with the referring physicians or patients.
7. Cognoscente of prevalence of unnecessary imaging studies.
8. Understands balance between cost effectiveness and quality.
9. Empathetic to the obstacles and shortcomings of the health care system.
10. Understands how radiology relates to other health care professionals.

Practice Based Learning

1. Improvement in patient care through cognitive knowledge, observational skills, procedural skills and feedback.
2. Applies principles of evidence based medicine.
3. Critically reviews radiological literature.
4. Participates in QC and QA.
5. Effectively promotes learning with students, residents, and other health care professionals.

Professionalism

1. Demonstrates responsible work, attendance, work assignments
2. Demonstrates sensitivity to patient’s age, culture, gender, disability
3. Demonstrates acceptable personal demeanor and hygiene
4. Demonstrates respect, compassion, integrity, ethics, confidentiality

Expectations of Performance

1. Expectation of timely arrival at work and contact faculty member if there is delay.
2. Daily review of schedule of each modality.
3. Connect with other fellows or faculty members about ongoing studies.
4. Daily interactions with residents and medical students for their education.

Documentation: The achievement of the above objectives and the objectives in each rotation will be documented by monthly pediatric radiology checklist with individualized items pertinent to that rotation.
Rotations in Pediatric Radiology Fellowship (specific objectives for each rotation)

Goals and objectives will be discussed at the beginning of each rotation.

Rotation 1: General Orientation, Radiography and Fluoroscopy,

Description: At the conclusion of the rotation, the fellow will know how to access and use imaging workstations, electronic medical records, voice recognition dictation stations, pagers, and e-mail; be familiarized with the operation of the fluoroscopic device with its low dose radiation settings, review all pediatric protocols for fluoroscopy and learn components of conventional digital radiography in examination of the chest, abdomen, skeletal surveys for suspected nonaccidental trauma, metabolic disease or skeletal dysplasias, bone age determinations, extremities, skull, scoliosis, foreign body survey, and shunt analysis. Learn the location of the emergency cart and how to call a pediatric code; discuss an overview of the fellowship with the program director; begin formulating a research project; and learn how to incorporate cases into electronic teaching files.

Educational Strategies
1. Learn common plain film exams and pathology.
2. Gain familiarity with pediatric fluoroscopy (UGI, VCUG, MBS).
3. Recognizes and describes relevant radiologic abnormalities.
4. Synthesize radiologic and clinical information and form an impression.
5. Utilize information technology to investigate clinical questions and for continuous self-learning.

Medical Knowledge
1. Learn protocols for plain film procedures.
2. Indications for fluoroscopic imaging studies.
3. Learn differential diagnoses for different common disease processes.
4. Learn procedure for bone age determination.
5. Learn general fluoroscopic procedures and usage of fluoroscopic equipment.

Patient Care
See general objectives.

Interpersonal/communication skills:
See general objectives.

Practice-based learning and improvement:
See general objectives:

Professionalism:
See general objectives:

System-based practice:
See general objectives.

Rotation 2: Pediatric Fluoroscopy, Radiation Safety,

Description. At the conclusion of the rotation, the fellow will develop increasing independence by using professional and technical skills to provide quality fluoroscopic examinations for pediatric patients. The fellow will effectively perform pediatric fluoroscopic procedures according to the protocols of the department, communicate with and educate families of pediatric patients regarding radiation concerns, various diagnoses, and communicate in a respectful and professional manner with patients. Talking to pediatric patients at an age-appropriate level and in a caring and respectful manner, the fellow will become adept at performing barium enema examinations in different age brackets, the pneumatic reduction of intussusception, the demonstration of gastroesophageal reflex, accurately defining malrotation, performing voiding cystography for demonstration of vesicoureteral...
reflux and demonstration of male urethral abnormalities, defining aspiration and laryngeal penetration, demonstration of the components of small bowel evaluation for inflammatory bowel disease.

Radiation safety in particular, the goal of using as low a dose as is reasonably achievable (ALARA) and "Image Gently" will become part of the fellow's daily routine with emphasis on recent publications by the Society of Pediatric Radiology. This value will be reinforced by radiation safety officer.

Objectives of this rotation

Educational strategies
1. Procedures for upper gastrointestinal studies, small bowel studies, barium enemas, speech evaluations, and cystograms.
2. Usage of the Octastop for fluoroscopic studies.
3. Learn methods for enema tip insertions, air reductions, tracheo-esophageal studies, and ostomies, and shunt valve adjustments

Medical Knowledge
1. Fluoroscopic recognition of gastroesophageal reflux, gastric outlet obstruction, malrotation, and volvulus.
2. Fluoroscopic recognition of inflammatory bowel disease
4. Fluoroscopic recognition of laryngeal penetration and aspiration.
5. Fluoroscopic recognition of vesicoureteral reflux and male urethral abnormalities.
6. Understand and learn to apply principles of radiation safety

Patient Care
See general objectives.

Interpersonal/communication skills:
See general objectives.

Practice-based learning and improvement:
See general objectives:

Professionalism:
See general objectives:

System-based practice:
See general objectives.

ROTATION 3: Plain Film Radiology

Description. The fellow will gain an understanding of the spectrum of normal and pathologic process frequently encountered in pediatric patients of all ages as seen on plain film examination. In addition to working on diagnostic skills and mastering the subtleties of plain film interpretation, there will be emphasis on when to recommend advanced imaging and how to be an effective imaging consultant. Plain film interpretation skills and consultation will be strengthened through the course of the year by regular participation in call and conferences.

Objectives of this rotation

Educational strategies
2. Learn age related normal anatomy and normal variants.
3. Learn common and classic appearance of pediatric pathology on plain film exam.
4. Recognizes and describes relevant radiologic abnormalities.
5. Synthesize radiologic and clinical information and form an impression.
6. Utilize information technology to investigate clinical questions and for continuous self-learning.
Medical Knowledge
1. Diagnose neonatal lung diseases such as HMD, neonatal lung infection, and bronchopulmonary dysplasia.
2. Diagnosis of bowel obstruction and development of an age appropriate differential.
3. Diagnose VP Shunt abnormalities
4. Know classification of Salter fractures and develop ability to identify common fractures and subluxations.
5. Differentiate disease processes on portable chest examinations such as pulmonary edema, pulmonary hemorrhage, pneumothorax, and cardiomegaly.
6. Able to identify and categorize congenital cardiac disease by systematic review of heart size and configuration, pulmonary vascularity, and ancillary findings such as abdominal situs, etc.
7. Familiarize with common bone dysplasias.

Patient Care
See general objectives.

Interpersonal/communication skills:
See general objectives.

Practice-based learning and improvement:
See general objectives:

Professionalism:
See general objectives:

System-based practice:
See general objectives.

ROTATION 4: Ultrasound Imaging.

Description. The fellow will develop the professional skills and caring attitude that will enable him or her to provide timely and appropriate pediatric US examinations, with emphasis on the genitourinary tract and evaluation of urinary infection. The fellow will learn how to prepare and give conferences, with an emphasis on organizational, communication, and teaching skills. Hand on skills in performing ultrasound examinations will be emphasized in demonstration of intussusception, pyloric stenosis, pleural effusion, kidneys and bladder, appendicitis, and gall bladder disease. The fellow will be comfortable in the performance of many different ultrasound procedures.

Objectives of this rotation

Educational Strategies:
1. Ability to operate ultrasound devices.
2. Performance of ultrasound procedures with emphasis on:
   a. Intussusception
   b. Pyloric stenosis
   c. Pleural effusion.
   d. Kidneys and bladder.
   e. Appendicitis.
   f. Liver disease.
   g. Gall bladder disease.
   h. Testicular abnormalities.
   i. Ovarian torsion.
4. Familiarize with ultrasound recording procedures.
5. Complications of ultrasound guided biopsies.

**Medical Knowledge:**
1. Ultrasound findings in pyloric stenosis.
2. Ultrasound findings in appendicitis.
3. Ultrasound differentiation of various liver diseases.
5. Ultrasound identification of gall stones and gall bladder wall thickening.
6. Ultrasound differentiation of ovarian cyst and ovarian torsion.
7. Ultrasound differentiation of testicular torsion and epididimitis.
8. Aware of indications for ultrasound imaging studies.

**Patient Care**
See general objectives.

**Interpersonal/communication skills:**
See general objectives.

**Practice-based learning and improvement:**
See general objectives:

**Professionalism:**
See general objectives.

**System-based practice:**
See general objectives.

**ROTATION 5: Neuroradiology.**

*Description.* The fellow will understand the appropriate use and limitations of various imaging studies in the neuroradiologic workup of children of all ages; able to perform pediatric head and spine ultrasound examinations, know the components and sequences of CT and MR imaging examinations as outlined in protocol guidelines. He will understand common findings on pediatric neuroradiologic examinations, including normal development of the infant brain, metabolic and destructive brain disorders, congenital malformations of the brain and spine, phakomatoses, brain and spine disorders, hydrocephalus, infections of the nervous system, and anomalies of cerebral vasculature.

**Objectives of this rotation**

**Educational strategies:**
1. Able to perform and interpret pediatric head and spine ultrasound.
2. Able to protocol and interpret pediatric head and spine CT examinations.
3. Able to protocol and interpret pediatric head and spine MR examinations.

**Medical Knowledge:**
1. Understand use and limitations of various neuroradiologic modalities.
2. Radiologic findings in normal development of infant brain.
3. Radiologic findings in metabolic and destructive brain disorders.
4. Radiologic findings in congenital malformations of the CNS.
5. Radiologic findings in phakomatoses and CNS tumors.
6. Radiologic findings in CNS vascular abnormalities.
7. Radiologic findings in CNS infections.

**Patient Care**

See general objectives.

**Interpersonal/communication skills:**

See general objectives.

**Practice-based learning and improvement:**

See general objectives:

**Professionalism:**

See general objectives:

**System-based practice:**

See general objectives.

---

**ROTATION 6: Nuclear Medicine and Molecular Imaging**

*Description.* The fellow will develop the professional and technical skills necessary to provide quality nuclear medicine examinations for pediatric patients. Specific procedures to be learned include nuclear cystography, lymphoscintigraphy, bone scanning, renal scanning (diuretic, cortical), F-18 scanning, pulmonary perfusion scanning, and scanning for gastric emptying or reflux disorders, and for thyroid function. Radiation safety as it pertains to nuclear medicine will be reviewed. The fellow also will learn the proper dosage schedules for radiopharmaceuticals. The fellow will be able to discuss several unique considerations of radiation exposure from radiopharmaceuticals used in children, safely and effectively perform pediatric nuclear medicine procedures according to the protocols of the department.

**Objectives of this rotation.**

**Educational Strategies:**

1. Understand the components of nuclear imaging techniques.
2. Understand the advanced PET-CT imaging techniques.
3. Have knowledge of techniques of evaluation of tumors.
4. Have knowledge of techniques for evaluation of infection.
5. Have knowledge of techniques of evaluating urinary tract abnormalities.
6. Have knowledge of techniques of evaluating imaging traumatic lesions.

**Medical Knowledge:**

1. Nuclear radiology knowledge of differentiation of osteoid osteoma and fracture.
2. Nuclear radiology knowledge of different levels of urinary obstruction.
3. Nuclear radiology knowledge of differentiation of bleeding associated with Meckel’s diverticulum and other sites.
4. Nuclear radiology knowledge of dumping versus slow gastric emptying.
5. Nuclear radiology knowledge of gall bladder disease versus biliary obstruction.
6. Nuclear radiology knowledge of physiology of brown fat.
7. Nuclear radiology knowledge of glucose uptake and differentiation of benign and malignant processes.
8. Nuclear radiology knowledge of differentiation of infarct from osteomyelitis in sickle cell disease.

**Patient Care:**

See general objectives.
Interpersonal/communication skills:
See general objectives.

Practice-based learning and improvement:
See general objectives.

Professionalism:
See general objectives.

System-based practice:
See general objectives.

ROTATION 7: BODY CT

Description: The fellow gain familiarity with the CT equipment, CT dose reduction techniques and Body CT protocols in the chest including cardiac CTA, abdomen including abdominal CTA, musculoskeletal, and extremity CTA. The role of CT in trauma, congenital, inflammatory processes, infection, mass and tumor assessment and follow will be emphasized throughout this rotation and this year. The strengths and weakness of this technique as well as the complementary role of other modalities such as ultrasound, MRI, and Nuclear Medicine will be learned in daily practice, as a consultant, in conference, and in didactic format.

Educational Strategies:
1. Gain familiarity of standard as well as less commonly used Body CT protocols.
2. Learn how to report CT dose and determine appropriate ways to adjust technique based on CT study ordered, patients age, weight and indication of exam. Be aware of potential alternative imaging exams.
3. Learn appropriate indications for CTA exams.
4. Gain knowledge of when it is appropriate to do a CT with or without IV contrast.
5. Gain knowledge of when oral contrast is indicated and whether positive or negative oral contrast is more likely to be beneficial.
6. Learn a systematic approach to CT review and reporting.
7. Learn how to effectively present CT findings to clinicians informally and in the conference setting.

Medical Knowledge:
1. Gain familiarity with CT equipment, CT dose reduction techniques, and Body CT protocols.
2. Become aware of indications for CT imaging studies and potential alternative exams.
3. Gain knowledge of normal and pathologic CT findings of commonly performed CTA exams.
4. Gain knowledge of normal and pathologic CT findings of chest and Cardiac.
5. Gain knowledge of normal and pathologic CT findings of gastrointestinal and genitourinary systems.
6. Gain knowledge of normal and pathologic CT findings of Pelvis.
7. Gain knowledge of normal and pathologic CT findings of musculoskeletal system.
8. Recognizes and describes relevant radiologic abnormalities and form an impression

Patient Care:
See general objectives.

Interpersonal/communication skills:
See general objectives.

Practice-based learning and improvement:
See general objectives.
**ROTATION 8: BODY MRI**

**Description:** The fellow will learn standard protocols, parameters that suggest intravenous, intra-articular, or oral contrast maybe helpful in performance of an MRI exam. Basic understanding of MRI sequence, utility and limitation of these sequences will be emphasized. The complementary role of MR as well as cost effective utilization of this tool will be reinforced in daily practice. In the age of “Image Gently” MRI’s potential value in diagnosis as a substitute or replacement for CT and Nuclear Medicine studies will also be emphasized as they continue to learn to become an effective imaging consultant.

**Educational Strategies:**
1. Gain familiarity with MRI equipment and Body MRI protocols.
2. Become aware of indications for MR imaging studies and potential alternative or complementary imaging exams.
3. Learn appropriate indications for MRA exams.
4. Gain knowledge of when it is appropriate to do a MRI with IV Gadolinium contrast.
5. Gain knowledge of when oral contrast is indicated and likely to be beneficial.
6. Learn a systematic approach to MRI review and reporting.
7. Learn how to effectively present MRI findings to clinicians informally and in the conference setting.

**Medical Knowledge:**
1. Gain knowledge of normal and pathologic MRI findings of commonly performed vascular exams.
2. Gain knowledge of normal and pathologic MRI findings of Chest and Cardiac.
3. Gain knowledge of normal and pathologic MRI findings of gastrointestinal and genitourinary systems.
4. Gain knowledge of normal and pathologic MRI findings of Pelvis.
5. Gain knowledge of normal and pathologic MRI findings of musculoskeletal system.
6. Recognizes and describes relevant MRI abnormalities and form an impression

**Patient Care:**
See general objectives.

**Interpersonal/communication skills:**
See general objectives.

**Practice-based learning and improvement:**
See general objectives.

**Professionalism:**
See general objectives.

**System-based practice:**
See general objectives
ROTATION 9: Vascular and Interventional Radiology

Description. The fellow will understand the appropriate use and limitations of CT, fluoroscopy, and ultrasound in performing interventional procedures in children; be familiar with common interventional procedures as outlined in the protocol guidelines and with their indications and contraindications; know the laboratory tests and guidelines necessary before any vascular interventional procedure may be performed; know how to perform nephrostomy tube placement, feeding tube placement, gastrostomy tube insertion, abscess drainage, and percutaneous biopsy; and know the difference between the US and MR imaging appearance of hemangiomas and vascular malformations.

Objectives of this rotation

Educational strategies:
1. Perform vascular access.
2. Perform nephrostomy tube placement.
4. Perform abscess drainage.
5. Perform percutaneous biopsy.

Medical Knowledge:
1. Understand use and limitations of interventional procedures.
2. Know the pre-procedure laboratory tests and guidelines necessary.
3. Distinguish between hemangiomas and vascular malformations.

Patient Care:
See general objectives.

Interpersonal/communication skills:
See general objectives.

Practice-based learning and improvement:
See general objectives.

Professionalism:
See general objectives.

System-based practice:
See general objectives.

ROTATION 10: Clinical Research

Description. Each fellow is expected to undertake a clinical research project early in the year under the mentorship of a member of the radiology teaching faculty. The desired outcome of research is that it will result in a scientific presentation and/or publication. If need the Fellow have up to a month scheduled as research based on the merit of a proposed project presented to the faculty, that is being mentored by a faculty member.

Educational Strategies:
1. Understand approach to selecting a research project.
2. Familiarization with IRB and Scientific Review Committee submissions.
3. Understand the data tabulation.
4. Understanding methodology of literature search.

Medical Knowledge:
1. Principles and use of biostatistics in research.
2. Principles of epidemiology and clinical research design.
3. Applying research to clinical Practice.
5. Ethics in research.

Patient Care:
See general objectives.

Interpersonal/communication skills:
See general objectives.

Practice-based learning and improvement:
See general objectives.

Professionalism:
See general objectives.

System-based practice:
See general objectives.

ROTATION 11: Elective

Description. Each fellow has the option of taking a month of elective time in any area of their choosing that can be accommodated at PCH. This is only available if they were able to do their research during the year without a specific month taken for clinical research.

ROTATION 12: Vacation/Meetings: