



Emergency Radiology Fellowship Curriculum

This document outlines a model 12-month fellowship curriculum for training in emergency radiology (ER). This is intended as an ideal curriculum to produce comprehensively trained emergency radiologists for academic and private practice with a breadth of training exposure to become expert diagnosticians and thought-leaders in the field. If a specific fellowship does not offer certain components, it is possible and suggested to draw on external educational resources to augment expertise in deficient areas.

I. Institutional setting and infrastructure

a. Institution

- i. Level 1-trauma center strongly recommended
- ii. Emergency Department (ED) volume and breadth:
 1. Consider a minimum of 50,000 annual ED patient visits per fellow, and a minimum of 12,000 annual imaging examinations.
 2. Age range: pediatric to geriatric
- iii. Availability of core modalities: computed tomography (CT), radiography (XR), ultrasound (US), nuclear medicine, and magnetic resonance imaging (MRI)
- iv. Faculty resources and supervision
 1. 2:1 faculty-to-fellow ratio (or higher)
 2. Faculty supervision throughout 24-hour cycle

b. Infrastructure

- i. Dedicated ER division with clinical, research, and educational missions
- ii. Attending-level supervision available at least through some, and preferably all, off-hours times

c. Clinical fellow schedule

- i. Clinical duty during a variety of shifts, including day, evening and overnight shifts, including weekend shifts
- ii. Consider dedicated elective time to improve breadth of skill set (e.g., if dedicated ER division has limited neuro-MRI, consider dedicated neuroradiology elective time).

II. Non-clinical educational offerings

a. *Didactic ER lectures*: minimum of four dedicated fellowship-level didactic lectures per month on topics of interest

b. Scholarship

- i. Opportunity to become involved in research or other scholarly activity, if desired
- ii. If appropriate, dedicated academic time off-duty up to 1 day per week for fellows with academic/scholarly interests and initiative; alternatively, a dedicated research rotation can serve this purpose.
- iii. Scientific journal reviewer/publishing mentorship

c. *Interdisciplinary conferences*



- i. Attendance and participation in trauma surgery morbidity and mortality (M&M) conference
- ii. Attendance and participation in emergency medicine M&M conference
- d. *Participation at national/international radiology and clinical meetings*
 - a. American Society of Emergency Radiology annual meeting (requires pre-start planning)
 - b. Other subspecialty society meetings, e.g., RSNA, ARRS, ACR
- e. *Department-wide conferences* (e.g., grand rounds)
- f. Teaching of residents, medical students, technologists, non-radiology clinicians, nurses and paramedical personnel

III. Knowledge of relevant anatomy: Fellowship training should serve to augment any deficient areas of head-to-toe anatomy from residency.

IV. Traumatic and non-traumatic pathology and pathophysiology

- a. Traumatic
 - i. Neuroradiology
 - 1. Intracranial injury, calvarial, midface and skull base fractures
 - 2. Spine trauma, with familiarity with classification systems (e.g., SLIC, TLICS, AO Spine, flexion-teardrop)
 - 3. Blunt and penetrating cerebrovascular injury
 - 4. Spinal cord injury
 - ii. Thoracic
 - 1. Pulmonary - contusion/laceration
 - 2. Pleural - Pneumothorax, hemothorax
 - 3. Cardiac and pericardial injury
 - 4. Diaphragmatic injury
 - 5. Blunt and penetrating injury to the airway and esophagus
 - iii. Abdominal
 - 1. Solid organ trauma: hepatic, splenic, pancreatic, renal and other organs, with familiarity with the American Association of Surgeons of Trauma (AAST) and CT-based classification system.
 - 2. Hemoperitoneum, pneumoperitoneum
 - 3. Traumatic bowel and mesenteric injury
 - 4. Bladder, urinary collecting system, and ureteral injury
 - 5. Traumatic abdominal wall hernias
 - iv. Musculoskeletal
 - 1. Fractures and dislocations: focus on subtle or missed emergent fractures (e.g., Lisfranc, Segond fractures) and supplemental radiographic views or other imaging
 - 2. Familiarity with classification systems where clinically appropriate
 - v. Vascular
 - 1. Aortic injury
 - 2. Peripheral vascular injury



3. Contained (pseudoaneurysm and AV fistula) and uncontained (active bleeding) vascular injury

b. Non-traumatic

i. Neuroradiology

1. Cerebrovascular ischemia
2. Intracranial hemorrhage
3. Intracranial neoplasm
4. Intracranial herniation patterns
5. Intracranial infections
6. Spinal cord emergencies (e.g., cord compression, cauda equina syndrome, diskitis, osteomyelitis)
7. Emergent airway conditions (e.g., Ludwig angina, retropharyngeal abscess)

ii. Thoracic

1. Pulmonary infection and inflammation, including diseases of the airways, parenchyma, and pleura
2. Pulmonary edema
3. Thoracic vascular emergencies (e.g., aortic aneurysm, pulmonary embolism)
4. Primary and metastatic thoracic malignancy; familiarity with thoracic oncologic emergencies

iii. Abdominal

1. Gastrointestinal inflammation and infection
2. Gastric, midgut, and colonic volvulus
3. Bowel obstruction
4. Bowel ischemia (etiologies and patterns of disease)
5. Pancreatitis, with use of standard classification terminology
6. Gallbladder and biliary emergencies
7. Urologic infection and calculous disease
8. Abdominal wall hernias
9. Acute and chronic liver parenchymal and vascular disease
10. Abdominopelvic malignancies
11. Obstetric and non-obstetric female pelvic emergencies
12. Male pelvic emergencies

iv. Musculoskeletal

1. Bone and joint infection
2. Bone and joint prosthetic and peri-prosthetic complications
3. Cellulitis and necrotizing fasciitis
4. Soft-tissue abscess
5. Acute presentation of musculoskeletal malignancies

v. Vascular

1. Deep venous thrombosis



2. Thrombophlebitis

3. Peripheral arterial emergencies (e.g., thrombosis)

V. Advanced imaging interpretive skills: (*) indicates elective, depending on institutional resources

- a. Trauma
 - i. Understanding of mechanisms of blunt trauma
 - ii. Penetrating injuries, including ballistic and stab injuries (e.g., ballistic pressure wave theory)
 - iii. Specific features of blast injury
 - iv. Optimal exam protocoling for polytrauma
 - v. CT cystography (trauma): indications and technical factors
 - vi. Extremity CT angiography (CTA)
- b. Head and neck CTA*
- c. Brain MRI*
 - i. Ischemia
 - ii. Malignancy
- d. Spine MRI*
 - i. Trauma
 - ii. Non-traumatic
- e. Emergent nuclear medicine* (basic interpretive knowledge)
 - i. Ventilation and perfusion scintigraphy
 - ii. Hepatobiliary scintigraphy
 - iii. Tagged-RBC gastrointestinal scintigraphy
 - iv. Osteomyelitis imaging
- f. Coronary CTA*: patient preparation and image interpretation
- g. Musculoskeletal MRI*:
 - i. Osteomyelitis or soft-tissue infection
 - ii. Radiographically occult fracture

VI. Non-interpretive subspecialty skills:

- a. *Disaster preparedness*: understanding of institutional and radiology planning for disaster preparedness
- b. *Interpretive triage*: awareness of and ability to triage imaging appropriately in times of high volume
- c. *Emergency medicine imaging workflow*: emergency radiologists are often called upon to help optimizing workflow in the ED, and ER fellows should be exposed to basics of workflow processes.

VII. Image acquisition and patient preparation knowledge and skills

- a. Ultrasonography
 - i. Technique: probe selection, setting adjustment (depth, gain)



- ii. Image acquisition for problem-solving: hepatobiliary, renal, pleura, ascites, focused assessment with sonography in trauma (FAST), foreign body
- b. Radiography: familiarity with standard and advanced projections for XR in evaluation of the acute patient, including appropriateness
 - i. Nasal and facial bone radiographs; weight-bearing shoulder radiographs; weight-bearing foot radiographs; ulnar deviation wrist radiographs, inspiratory-expiratory chest radiographs; flexion and extension cervical spine radiographs
- c. CT
 - i. Scanning parameters (pitch, dose)
 - ii. Optimal protocoling
 - iii. Optimizing contrast examinations
- d. MRI sequences and protocoling
- e. Dual-energy CT (DECT), if available
- f. Appropriate imaging selection; optimizing imaging resource utilization in the ED

VIII. Quality and safety

- a. IV contrast reaction management
- b. IV infiltration management
- c. Radiation dose optimization, ALARA, Image Gently, Image Wisely
- d. MRI safety
- e. Managing imaging of the pregnant and pediatric patient in the ED

IX. Professionalism and career development

- a. Communication skills
 - i. Verbal (e.g., interactions with support staff and non-radiology clinicians)
 - ii. Written (e.g., report creation, manuscript preparation)
- b. Fellow evaluation
 - i. Program director should meet with the fellows routinely to allow two-way feedback.
 - ii. Fellows should have an anonymous or protected method of providing feedback on individual faculty.
- c. Program evaluation
 - i. Fellows need to have an anonymous or protected method of providing feedback on the fellowship program.
- d. Graduated assumption of independent image interpretation: although a minimum of 6 months of the fellowship should occur with direct faculty supervision and sign-off, fellows should graduate to independent signing in preparation for practice at some point during the fellowship.
- e. Curriculum vitae preparation and optimization
- f. Assistance and advice with employment search