iMaging 5.0: Our Newest Radiology Operating System Unleashed

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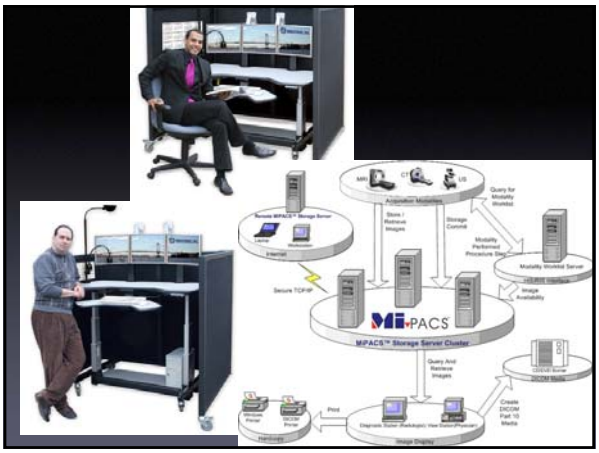
iMaging 5.0: What's New?

- PACS
- Consultants
- Modalities
- Protocols
- HIPAA

PACS

- picture archiving and communication systems
- replaces hard-copy based means of managing medical images
- 'filmless'
- off-site viewing/interpretation
- data storage vs. fileroom



PACS

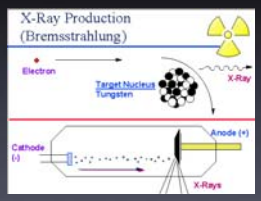
- Workstations in the main department
  - 3MP resolution
  - In OR
- Web-based browsers
  - On PCs throughout hospital/clinics
  - Available on home PC thru VPN
- CDs of studies are available in file room

PACS vs Film

- Advantages/ Disadvantages
  - Storage
  - Access
  - Cost
  - Security

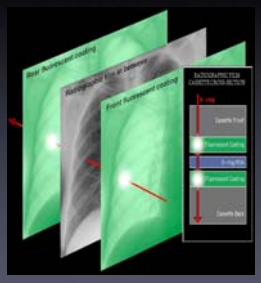
Physics

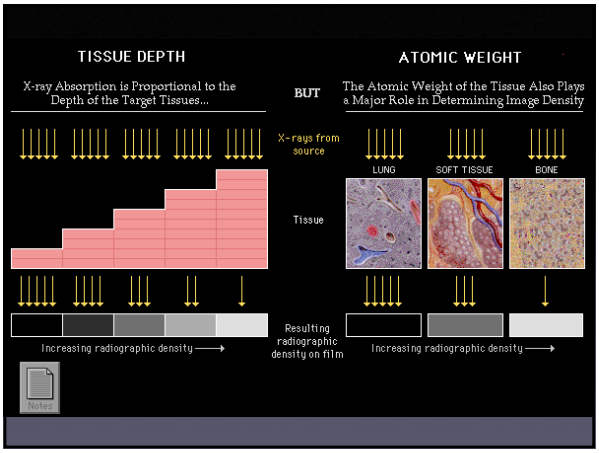
- Xray imaging
- Shoot electrons at tungsten target
- Emit xrays (photons)
- Directed at object/ detector



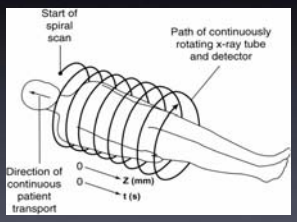
Physics

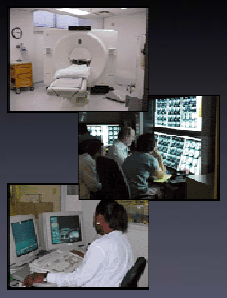
- Some of the photons absorbed by patient
- Photons that penetrate patient strike detector
- Different tissues have different xray absorption - contrast





Helical CT





MR Basics

- Hydrogen proton imaging
- Observe behavior of protons in magnet after application of RF signal
- Unsurpassed contrast resolution, spatial resolution limited
- Time consuming, costly
- Contraindications?

Ultrasound

- 1 to 10 MHz frequency/ 1.5mm wavelength
- speed determined by tissue
- different tissues(impedance)->different speed->reflection
- time for echo to travel back to probe used to calculate depth of tissue interface causing echo

Doppler Ultrasound

$$f = f_0 \frac{v}{v - v_{s,r}}$$

- apparent change in frequency or wavelength of a wave that is perceived by an observer moving relative to the source of the waves
- rbc's move away or towards the transducer
- measuring frequency shift of a particular sample blood volume determines speed and direction

Nuclear Medicine

- uses unsealed radioactive substances in diagnosis and therapy
- differ from most other imaging modalities in that the tests show the function of the system being investigated as opposed to the anatomy
- majority of diagnostic tests involve formation of an image using gamma camera
- Most diagnostic radionuclides emit gamma rays

Nuclear Medicine

- The most commonly used radionuclides are:
  - technetium-99m
  - iodine-123 and 131
  - thallium-201
  - gallium-67
- PET - metabolically active molecule (sugar)

PET

- positron emission tomography
- Oncology: (18F) fluorodeoxyglucose (FDG, FDG-PET) retained by tissues with high metabolic activity
- Neurology: radioactivity associated with brain activity
- Cardiology: "hibernating myocardium"

Interventional Radiology

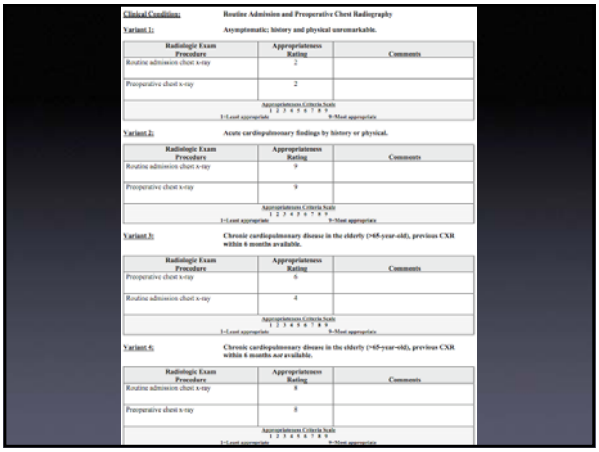
- Vascular Diagnosis
  - Arteriography
  - Venography
  - Lymphangiography
- Vascular Intervention
  - Angioplasty/stents
  - Embolization
  - Filters
  - Chemoembo
- Venous access
- Non Vascular Intervention
  - Regional tumor therapy
  - Biopsy
  - Drainage
  - Biliary
- Urological

Radiologist as Consultant

- We're not 'technologists'
- Offer advice re:
  - Exam indication
  - Procedures
  - Interpretation
  - Conferences

PROTOCOL

- ACR appropriateness criteria
- Available at acr.org
- Not perfect, but helpful
- Not followed



Clinical Condition: Routine Admission and Preoperative Chest Radiography

Variant 1: Asymptomatic; history and physical unremarkable.

Radiologic Exam Procedure	Appropriateness Rating	Comments
Routine admission chest x-ray	2	
Preoperative chest x-ray	2	

Appropriateness Criteria Scale
1 2 3 4 5 6 7 8 9
1=Least appropriate 9=Most appropriate

Variant 2: Acute cardiopulmonary findings by history or physical.

Radiologic Exam Procedure	Appropriateness Rating	Comments
Routine admission chest x-ray	9	
Preoperative chest x-ray	9	

Appropriateness Criteria Scale
1 2 3 4 5 6 7 8 9
1=Least appropriate 9=Most appropriate

Variant 3: Chronic cardiopulmonary disease in the elderly (>65-year-old), previous CXR within 6 months available.

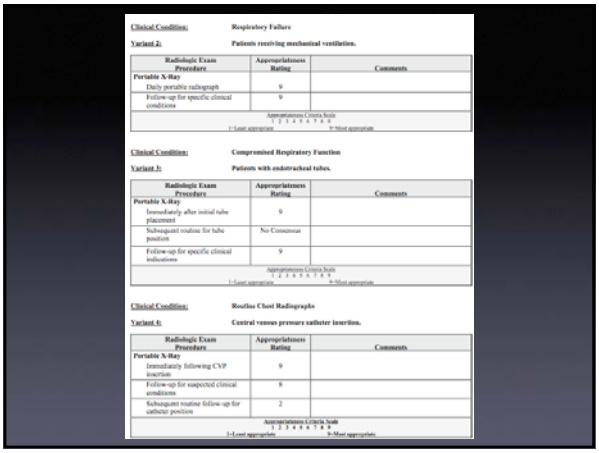
Radiologic Exam Procedure	Appropriateness Rating	Comments
Preoperative chest x-ray	6	
Routine admission chest x-ray	4	

Appropriateness Criteria Scale
1 2 3 4 5 6 7 8 9
1=Least appropriate 9=Most appropriate

Variant 4: Chronic cardiopulmonary disease in the elderly (>65-year-old), previous CXR within 6 months *not* available.

Radiologic Exam Procedure	Appropriateness Rating	Comments
Routine admission chest x-ray	8	
Preoperative chest x-ray	8	

Appropriateness Criteria Scale
1 2 3 4 5 6 7 8 9
1=Least appropriate 9=Most appropriate



Clinical Condition: Respiratory Failure

Variant 2: Patients receiving mechanical ventilation.

Radiologic Exam Procedure	Appropriateness Rating	Comments
Portable X-Ray		
Daily portable radiograph	9	
Follow-up for specific clinical conditions	9	

Appropriateness Criteria Scale
1 2 3 4 5 6 7 8 9
1=Least appropriate 9=Most appropriate

Clinical Condition: Compromised Respiratory Function

Variant 3: Patients with endotracheal tubes.

Radiologic Exam Procedure	Appropriateness Rating	Comments
Portable X-Ray		
Immediately after initial tube placement	9	
Subsequent routine for tube position	No Consensus	
Follow-up for specific clinical indications	9	

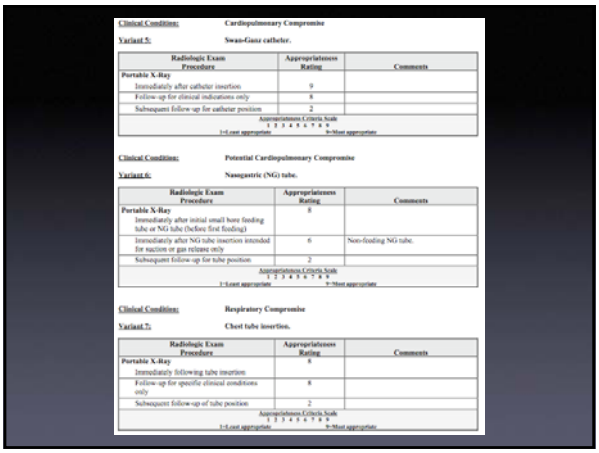
Appropriateness Criteria Scale
1 2 3 4 5 6 7 8 9
1=Least appropriate 9=Most appropriate

Clinical Condition: Routine Chest Radiographs

Variant 4: Central venous pressure catheter insertion.

Radiologic Exam Procedure	Appropriateness Rating	Comments
Portable X-Ray		
Immediately following CVP insertion	9	
Follow-up for suspected clinical conditions	8	
Subsequent routine follow-up for catheter position	2	

Appropriateness Criteria Scale
1 2 3 4 5 6 7 8 9
1=Least appropriate 9=Most appropriate



Clinical Condition: Cardiopulmonary Compromise

Variant 5: Swan-Ganz catheter.

Radiologic Exam Procedure	Appropriateness Rating	Comments
Portable X-Ray		
Immediately after catheter insertion	9	
Follow-up for clinical indications only	8	
Subsequent follow-up for catheter position	2	

Appropriateness Criteria Scale
1 2 3 4 5 6 7 8 9
1=Least appropriate 9=Most appropriate

Clinical Condition: Potential Cardiopulmonary Compromise

Variant 6: Nasogastric (NG) tube.

Radiologic Exam Procedure	Appropriateness Rating	Comments
Portable X-Ray	8	
Immediately after initial small bore feeding tube or NG tube (before first feeding)		
Immediately after NG tube insertion intended for suction or gas release only	6	Non-feeding NG tube.
Subsequent follow-up for tube position	2	

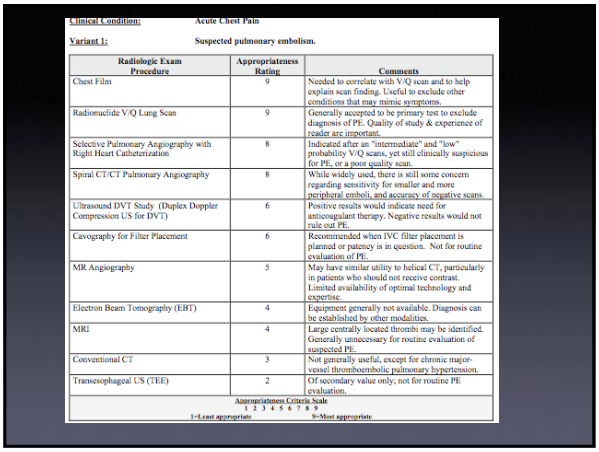
Appropriateness Criteria Scale
1 2 3 4 5 6 7 8 9
1=Least appropriate 9=Most appropriate

Clinical Condition: Respiratory Compromise

Variant 7: Chest tube insertion.

Radiologic Exam Procedure	Appropriateness Rating	Comments
Portable X-Ray	8	
Immediately following tube insertion		
Follow-up for specific clinical conditions only	8	
Subsequent follow-up of tube position	2	

Appropriateness Criteria Scale
1 2 3 4 5 6 7 8 9
1=Least appropriate 9=Most appropriate

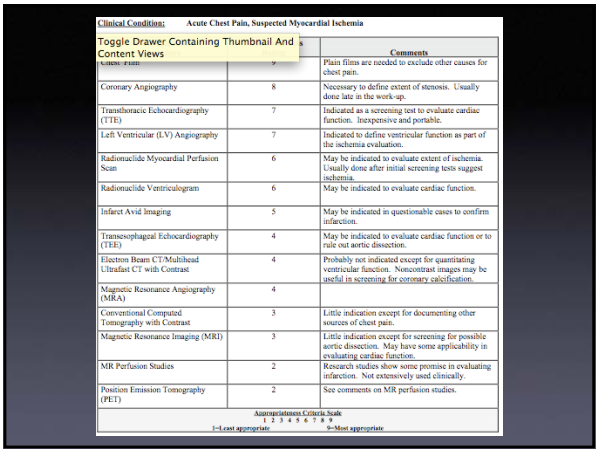


Clinical Condition: Acute Chest Pain

Variant 1: Suspected pulmonary embolism.

Radiologic Exam Procedure	Appropriateness Rating	Comments
Chest Film	9	Needed to correlate with V/Q scan and to help explain scan finding. Useful to exclude other conditions that may mimic symptoms.
Radionuclide V/Q Lung Scan	9	Generally accepted to be primary test to exclude diagnosis of PE. Quality of study & experience of reader are important.
Selective Pulmonary Angiography with Right Heart Catheterization	8	Indicated after an "intermediate" and "low" probability V/Q scans, yet still clinically suspicious for PE, or a poor quality scan.
Spiral CT/CT Pulmonary Angiography	8	While widely used, there is still some concern regarding sensitivity for smaller and more peripheral emboli, and accuracy of negative scans.
Ultrasound DVT Study (Duplex Doppler Compression US for DVT)	6	Positive results would indicate need for anticoagulant therapy. Negative results would not rule out PE.
Cavography for Filter Placement	6	Recommended when IVC filter placement is planned or patency is in question. Not for routine evaluation of PE.
MR Angiography	5	May have similar utility to helical CT, particularly in patients who should not receive contrast. Limited availability of optimal technology and expertise.
Electron Beam Tomography (EBT)	4	Equipment generally not available. Diagnosis can be established by other modalities.
MRI	4	Large centrally located thrombi may be identified. Generally unnecessary for routine evaluation of suspected PE.
Conventional CT	3	Not generally useful, except for chronic major-vessel thromboembolic pulmonary hypertension.
Transesophageal US (TEE)	2	Of secondary value only; not for routine PE evaluation.

Appropriateness Criteria Scale
1 2 3 4 5 6 7 8 9
1=Least appropriate 9=Most appropriate



Clinical Condition: Acute Chest Pain, Suspected Myocardial Ischemia

Toggle Drawer Containing Thumbnail And Content Views

		Comments
Chest Film	9	Plain films are needed to exclude other causes for chest pain.
Coronary Angiography	8	Necessary to define extent of stenosis. Usually done late in the work-up.
Transthoracic Echocardiography (TTE)	7	Indicated as a screening test to evaluate cardiac function. Inexpensive and portable.
Left Ventricular (LV) Angiography	7	Indicated to define ventricular function as part of the ischemia evaluation.
Radionuclide Myocardial Perfusion Scan	6	May be indicated to evaluate extent of ischemia. Usually done after initial screening tests suggest ischemia.
Radionuclide Ventriculogram	6	May be indicated to evaluate cardiac function.
Infarct Avid Imaging	5	May be indicated in questionable cases to confirm infarction.
Transesophageal Echocardiography (TEE)	4	May be indicated to evaluate cardiac function or to rule out aortic dissection.
Electron Beam CT/Multihead Ultrafast CT with Contrast	4	Probably not indicated except for quantitating ventricular function. Noncontrast images may be useful in screening for coronary calcification.
Magnetic Resonance Angiography (MRA)	4	
Conventional Computed Tomography with Contrast	3	Little indication except for documenting other sources of chest pain.
Magnetic Resonance Imaging (MRI)	3	Little indication except for screening for possible aortic dissection. May have some applicability in evaluating cardiac function.
MR Perfusion Studies	2	Research studies show some promise in evaluating infarction. Not extensively used clinically.
Position Emission Tomography (PET)	2	See comments on MR perfusion studies.

Appropriateness Criteria Scale
1 2 3 4 5 6 7 8 9
1=Least appropriate 9=Most appropriate

Clinical Condition: **Pulsatile Abdominal Mass**

Radiologic Exam Procedure	Appropriateness Rating	Comments
Computed Tomography Angiography (CTA)	8	
Aortic Ultrasound (US)	8	The definitive screening modality but only measures aortic diameter accurately.
Computed Tomography (CT) with Contrast	8	Accurately defines aortic size and useful in defining extent. Relatively quick with acceptable cost.
Aortography	8	Most accurately defines extent and branch involvement but less accurate in defining diameter. Expensive.
Computed Tomography (CT) without Contrast	7	Useful even when contrast injection contraindicated. Screening helical CT is very rapid and accurate.
Abdominal Plain Films	5	Easily performed and inexpensive, but not accurate in estimating diameter of the aorta. Lateral is more accurate than the frontal plain film in estimating aortic diameter.
Magnetic Resonance Imaging (MRI)	6	Better than CT in defining extent but more expensive and time consuming. Can diagnose an inflammatory aneurysm.
Magnetic Resonance Angiography (MRA)	5	Can define branch involvement with reasonable accuracy but is time consuming and expensive.
Peripheral Runoff Angiography	5	Important if there are signs or symptoms of peripheral vascular disease.
Abdominal Ultrasound (US)	4	May miss small aneurysm. Useful if aorta found normal on aortic US.
Aortic Duplex Ultrasound (US)	3	Useful only if signs or symptoms of peripheral vascular disease are present and angiography not planned.
Visceral Angiography	3	Rarely indicated. Risky in patients with large aneurysms.
Intravenous Pyelogram (IVP)	2	Only indicated if additional information needed about the urinary tract.

Appropriateness Criteria Scale
1 2 3 4 5 6 7 8 9
1=Least appropriate 9=Most appropriate

Clinical Condition: **Acute Right Upper Quadrant Pain**

Variant 1: **Fever, elevated WBC, positive Murphy sign.**

Radiologic Exam Procedure	Appropriateness Rating	Comments
Ultrasound	8	
Cholescintigraphy	6	May use either nuclear medicine exam or ultrasound exam.
Plain x-ray	4	
Computed tomography exam	4	
Contrast Studies		
Upper GI	4	
Barium enema	4	

Appropriateness Criteria Scale
1 2 3 4 5 6 7 8 9
1=Least appropriate 9=Most appropriate

Variant 2: **Fever, elevated WBC, positive Murphy sign, normal gallbladder ultrasound.**

Radiologic Exam Procedure	Appropriateness Rating	Comments
Cholescintigraphy	8	
Computed tomography	6	
Plain x-ray	6	
Contrast Studies		
Upper GI	6	
Barium enema	3	
Ultrasound		
Repeat ultrasound within 24 hours	4	

Appropriateness Criteria Scale
1 2 3 4 5 6 7 8 9
1=Least appropriate 9=Most appropriate

Clinical Condition: **Acute Right Upper Quadrant Pain**

Variant 3: **No fever, normal WBC.**

Radiologic Exam Procedure	Appropriateness Rating	Comments
Ultrasound	8	
Computed tomography exam	7	
Cholescintigraphy	6	
Contrast Studies		
Upper GI	6	
Barium enema	4	
Plain x-ray	4	

Appropriateness Criteria Scale
1 2 3 4 5 6 7 8 9
1=Least appropriate 9=Most appropriate

Variant 4: **No fever, normal WBC, ultrasound shows only gallstones.**

Radiologic Exam Procedure	Appropriateness Rating	Comments
Cholescintigraphy	8	
Computed tomography exam	6	
Contrast Studies		
Upper GI	6	
Barium enema	4	
Plain x-ray	4	

Appropriateness Criteria Scale
1 2 3 4 5 6 7 8 9
1=Least appropriate 9=Most appropriate

Clinical Condition: Acute Right Lower Quadrant Pain

Variant 1: Fever, leukocytosis, and classic presentation clinically for appendicitis.

Radiologic Exam Procedure	Appropriateness Rating	Comments
Plain X-ray Chest	4	
AP and upright abdomen	4	
Ultrasound RLQ graded compression	4	Imaging is rarely needed in this setting. If some contraindication exists for surgery or other potential complications or if there is anything atypical in the presentation, and imaging is needed, ultrasound or CT could be used for confirmation. Color Doppler can often be helpful in the ultrasound evaluation.
Pelvic/endovaginal	3	
Computed Tomography Contrast enhanced CT	4	
Non-contrast (No oral or IV contrast)	2	
Nuclear Medicine WBC scanning	2	
Gallium	2	
Magnetic Resonance Imaging Abdomen with or without enhancement	2	
Barium Fluoroscopy Procedure Air-contrast barium enema	2	
Conventional small-bowel series	2	
Enteroclysis of the small bowel	2	
Single-contrast barium enema	No Consensus	

Appropriateness Criteria Scale
1 2 3 4 5 6 7 8 9
1=Least appropriate 9=Most appropriate

Clinical Condition: Suspected Abdominal Abscess

Variant 1: Postoperative patient with fever.

Radiologic Exam Procedure	Appropriateness Rating	Comments
Computed Tomography CT with IV contrast	8	
CT without IV contrast	6	IV contrast is preferred. However, if it is contraindicated, the study may still be of value.
Ultrasound	6	
Radiography Plain films	6	
UGI-small bowel follow	4	Appropriate if concern for anastomotic leak—should use water-soluble agent.
Contrast enema	4	Appropriate if concern for anastomotic leak—should use water-soluble agent.
Nuclear Medicine Gallium	4	
WBC (Tc or In)	4	
Magnetic Resonance MRI without contrast	2	
MRI with contrast	2	
Interventional Angiography	2	

Appropriateness Criteria Scale
1 2 3 4 5 6 7 8 9
1=Least appropriate 9=Most appropriate

Clinical Condition: Suspected Small Bowel Obstruction

Variant 1: No prior history of malignancy.

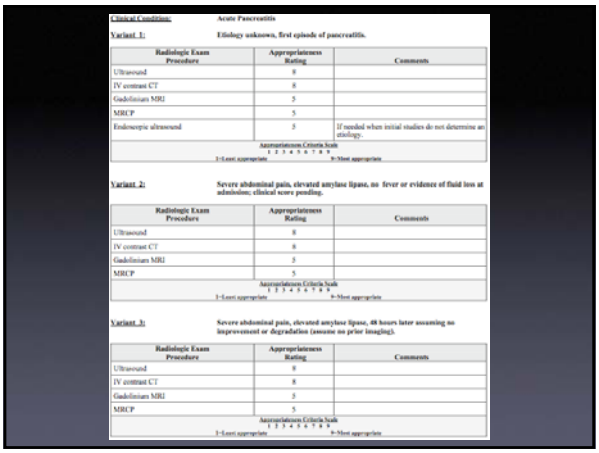
Radiologic Exam Procedure	Appropriateness Rating	Comments
Computed Tomography Abdomen & pelvis	8	
Plain X-ray Supine & upright abdomen	8	
Small bowel follow-through	6	
Small bowel enteroclysis	6	
Ultrasound Abdomen sonogram	3	For experienced sonologists, may be an acceptable alternative means of diagnosis.
Magnetic Resonance Imaging Abdomen evaluation	2	

Appropriateness Criteria Scale
1 2 3 4 5 6 7 8 9
1=Least appropriate 9=Most appropriate

Variant 2: Prior history of malignancy.

Radiologic Exam Procedure	Appropriateness Rating	Comments
Computed Tomography Abdomen & pelvis	8	
Plain X-ray Supine & upright abdomen	8	
Small bowel follow-through	6	
Small bowel enteroclysis	6	
Ultrasound Abdomen sonogram	4	
Magnetic Resonance Imaging Abdomen evaluation	2	

Appropriateness Criteria Scale
1 2 3 4 5 6 7 8 9
1=Least appropriate 9=Most appropriate



Clinical Condition: Acute Pancreatitis

Variant 1: Etiology unknown, first episode of pancreatitis.

Radiologic Exam Procedure	Appropriateness Rating	Comments
Ultrasound	8	
IV contrast CT	8	
Gadolinium MRI	5	
MRCP	5	
Endoscopic ultrasound	5	If needed when initial studies do not determine an etiology.

Appropriateness Criteria Scale
1 2 3 4 5 6 7 8 9
1=Least appropriate 9=Most appropriate

Variant 2: Severe abdominal pain, elevated amylase lipase, no fever or evidence of fluid loss at admission; clinical score pending.

Radiologic Exam Procedure	Appropriateness Rating	Comments
Ultrasound	8	
IV contrast CT	8	
Gadolinium MRI	5	
MRCP	5	

Appropriateness Criteria Scale
1 2 3 4 5 6 7 8 9
1=Least appropriate 9=Most appropriate

Variant 3: Severe abdominal pain, elevated amylase lipase, 48 hours later assuming no improvement or degradation (assume no prior imaging).

Radiologic Exam Procedure	Appropriateness Rating	Comments
Ultrasound	8	
IV contrast CT	8	
Gadolinium MRI	5	
MRCP	5	

Appropriateness Criteria Scale
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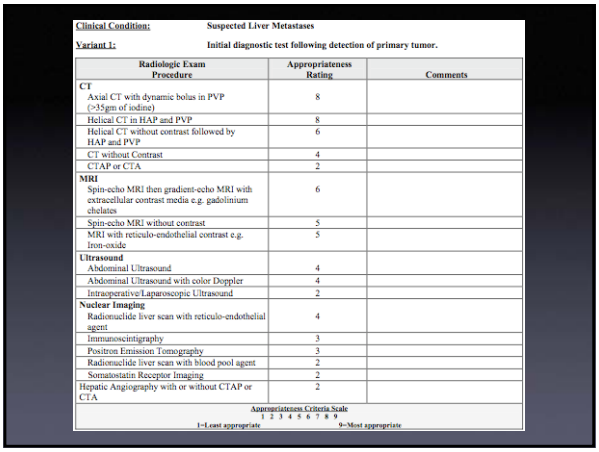

Clinical Condition: Suspected Liver Metastases

Variant 1: Initial diagnostic test following detection of primary tumor.

Radiologic Exam Procedure	Appropriateness Rating	Comments
CT		
Axial CT with dynamic bolus in PVP (>35gm of iodine)	8	
Helical CT in HAP and PVP	8	
Helical CT without contrast followed by HAP and PVP	6	
CT without Contrast	4	
CTAP or CTA	2	
MRI		
Spin-echo MRI then gradient-echo MRI with extracellular contrast media e.g. gadolinium chelates	6	
Spin-echo MRI without contrast	5	
MRI with reticulo-endothelial contrast e.g. Iron-oxide	5	
Ultrasound		
Abdominal Ultrasound	4	
Abdominal Ultrasound with color Doppler	4	
Intraoperative/Laparoscopic Ultrasound	2	
Nuclear Imaging		
Radionuclide liver scan with reticulo-endothelial agent	4	
Immunoscintigraphy	3	
Positron Emission Tomography	3	
Radionuclide liver scan with blood pool agent	2	
Somatostatin Receptor Imaging	2	
Hepatic Angiography with or without CTAP or CTA	2	

Appropriateness Criteria Scale
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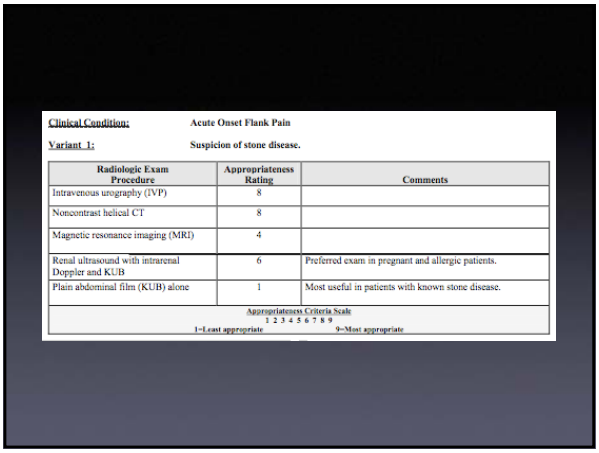
1=Least appropriate 9=Most appropriate



Clinical Condition: Acute Onset Flank Pain

Variant 1: Suspicion of stone disease.

Radiologic Exam Procedure	Appropriateness Rating	Comments
Intravenous urography (IVP)	8	
Noncontrast helical CT	8	
Magnetic resonance imaging (MRI)	4	
Renal ultrasound with intrarenal Doppler and KUB	6	Preferred exam in pregnant and allergic patients.
Plain abdominal film (KUB) alone	1	Most useful in patients with known stone disease.

Appropriateness Criteria Scale
1 2 3 4 5 6 7 8 9
1=Least appropriate 9=Most appropriate

Clinical Condition: Cerebrovascular Disease*

Variant 6: New focal neurologic defect, fixed or worsening. Less than 6 hours.

Radiologic Exam Procedure	Appropriateness Rating	Comments
Intra-arterial angiography	8	
Ultrasound	6	
Magnetic resonance		
MR plain (SE, GE, FLAIR, and/or diffusion)	8	
MR angiography	8	
MR with contrast	6	
fMRI (BOLD, spectroscopy, and/or perfusion)	5	
Computed tomography		
CT plain	8	
CT angiography	6	
CT perfusion (xenon, iodine)	5	
CT with contrast	4	
Nuclear medicine		
SPECT	5	
PET	2	

Appropriateness Criteria Scale
1 2 3 4 5 6 7 8 9
1=Least appropriate 9=Most appropriate

Clinical Condition: Headache

Variant 1: Worsened chronic headache. History of headache.

Radiologic Exam Procedure	Appropriateness Rating	Comments
Computed tomography		
CT	4	
CT + contrast	4	
CT angiography	2	
Magnetic resonance		
MRI	4	
MRI + contrast	4	
MRA	2	
Catheter angiography	2	
Nuclear medicine		
SPECT	2	

Appropriateness Criteria Scale
1 2 3 4 5 6 7 8 9
1=Least appropriate 9=Most appropriate

Variant 2: Sudden onset of severe headache ("Worst headache of one's life, thunderclap headache").

Radiologic Exam Procedure	Appropriateness Rating	Comments
Computed tomography		
CT	9	
CT angiography	4	
Magnetic resonance		
MRI	6	
MRA	6	
Catheter angiography	6	
Ultrasound	2	
Nuclear medicine		
SPECT	2	

Appropriateness Criteria Scale
1 2 3 4 5 6 7 8 9
1=Least appropriate 9=Most appropriate

Clinical Condition: Patient Without Known Disease Presenting With a Progressive Neurological Deficit (PND)

Variant 3: PND in an adult >40.

Radiologic Exam Procedure	Appropriateness Rating	Comments
Magnetic resonance		
Unenhanced MR	8	
Enhanced MR (pre- and postcontrast)	8	
Double- triple-dose enhanced MR	2	
fMRI	No Consensus	Rapidly developing technologies that may prove useful for clinical problem solving.
MR spectroscopy	No Consensus	Rapidly developing technologies that may prove useful for clinical problem solving.
Computed tomography		
Unenhanced CT	6	If MR is not available.
Enhanced CT (pre- and postcontrast)	6	
Double-dose-delayed enhanced CT	2	
Vascular imaging		
MR angiography	4	
CT angiography	3	Relatively new modality with promising clinical utility.
Catheter Angiogram	2	
Ultrasound	3	
Nuclear Medicine		
PET	2	
SPECT	No Consensus	

Appropriateness Criteria Scale
1 2 3 4 5 6 7 8 9
1=Least appropriate 9=Most appropriate

Clinical Condition: Acute Low Back Pain

Variant 3: Suspicion CA, infection.

Radiologic Exam Procedure	Appropriateness Rating	Comments
Plain MRI	8	
MRI + Gadolinium	7	
Plain Lumbar X-Rays	7	
Isotope Bone Scan	5	
CT	4	
Myelogram	2	
Myelogram/CT	2	

Appropriateness Criteria Scale
1 2 3 4 5 6 7 8 9
1=Least appropriate 9=Most appropriate

Variant 4: Radiculopathy.

Radiologic Exam Procedure	Appropriateness Rating	Comments
Plain MRI	8	
Myelogram/CT	5	
CT	5	
MRI + Gadolinium	4	
Plain Lumbar X-Rays	4	
Isotope Bone Scan	2	
Myelogram	2	

Appropriateness Criteria Scale
1 2 3 4 5 6 7 8 9
1=Least appropriate 9=Most appropriate

Clinical Condition: Closed Head Injury

Variant 3: Moderate or severe acute closed head injury, stable.

Radiologic Exam Procedure	Appropriateness Rating	Comments
CT	9	
C-spine plain film radiographs	8	
MR	6	
Skull plain film radiographs	4	
CT with contrast	2	
MR with gadolinium	2	
MR with MRA	2	
Cerebral angiography	2	
SPECT	2	
PET	2	
Xenon-enhanced CT	2	
Transcranial Doppler	2	

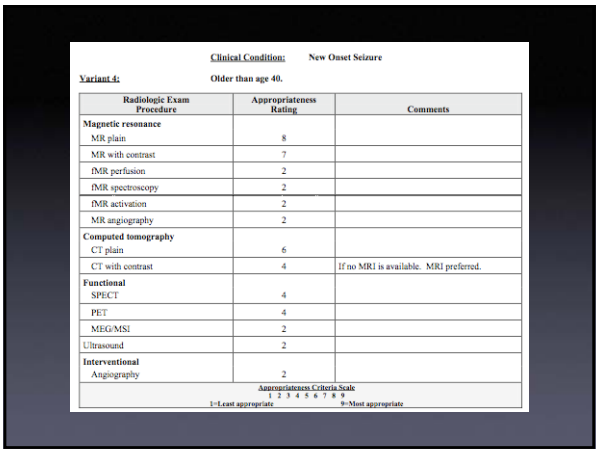
Appropriateness Criteria Scale
1 2 3 4 5 6 7 8 9
1=Least appropriate 9=Most appropriate

Clinical Condition: Head injury with fracture

Variant 12: Depressed skull fracture.

Radiologic Exam Procedure	Appropriateness Rating	Comments
CT	9	
Skull plain film radiographs	8	
C-spine plain film radiographs	6	
MR	6	
MR with gadolinium	2	
MR with MRA	2	
CT with contrast	2	
Cerebral angiography	2	
SPECT	2	
PET	2	
Xenon-enhanced CT	2	
Transcranial Doppler	2	

Appropriateness Criteria Scale
1 2 3 4 5 6 7 8 9
1=Least appropriate 9=Most appropriate

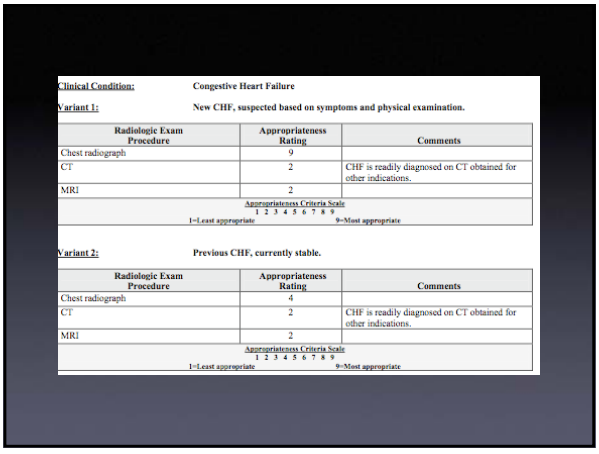


Clinical Condition: New Onset Seizure

Variant 4: Older than age 40.

Radiologic Exam Procedure	Appropriateness Rating	Comments
Magnetic resonance		
MR plain	8	
MR with contrast	7	
fMR perfusion	2	
fMR spectroscopy	2	
fMR activation	2	
MR angiography	2	
Computed tomography		
CT plain	6	
CT with contrast	4	If no MR1 is available. MRI preferred.
Functional		
SPECT	4	
PET	4	
MEG/MSI	2	
Ultrasound	2	
Interventional		
Angiography	2	

Appropriateness Criteria Scale
1 2 3 4 5 6 7 8 9
1=Least appropriate 9=Most appropriate



Clinical Condition: Congestive Heart Failure

Variant 1: New CHF, suspected based on symptoms and physical examination.

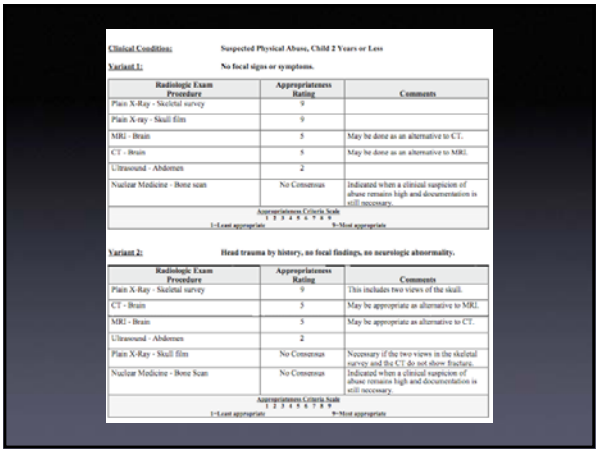
Radiologic Exam Procedure	Appropriateness Rating	Comments
Chest radiograph	9	
CT	2	CHF is readily diagnosed on CT obtained for other indications.
MRI	2	

Appropriateness Criteria Scale
1 2 3 4 5 6 7 8 9
1=Least appropriate 9=Most appropriate

Variant 2: Previous CHF, currently stable.

Radiologic Exam Procedure	Appropriateness Rating	Comments
Chest radiograph	4	
CT	2	CHF is readily diagnosed on CT obtained for other indications.
MRI	2	

Appropriateness Criteria Scale
1 2 3 4 5 6 7 8 9
1=Least appropriate 9=Most appropriate



Clinical Condition: Suspected Physical Abuse, Child 2 Years or Less

Variant 1: No focal signs or symptoms.

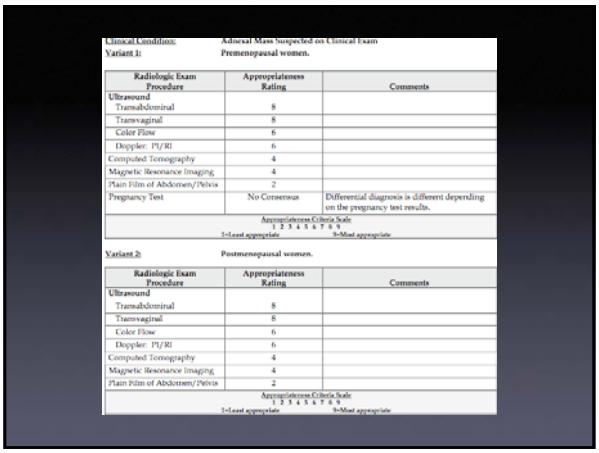
Radiologic Exam Procedure	Appropriateness Rating	Comments
Plain X-Ray - Skeletal survey	9	
Plain X-ray - Skull film	9	
MRI - Brain	5	May be done as an alternative to CT.
CT - Brain	5	May be done as an alternative to MRI.
Ultrasound - Abdomen	2	
Nuclear Medicine - Bone scan	No Consensus	Indicated when a clinical suspicion of abuse remains high and documentation is still necessary.

Appropriateness Criteria Scale
1 2 3 4 5 6 7 8 9
1=Least appropriate 9=Most appropriate

Variant 2: Head trauma by history, no focal findings, no neurologic abnormality.

Radiologic Exam Procedure	Appropriateness Rating	Comments
Plain X-Ray - Skeletal survey	9	This includes two views of the skull.
CT - Brain	5	May be appropriate as alternative to MRI.
MRI - Brain	5	May be appropriate as alternative to CT.
Ultrasound - Abdomen	2	
Plain X-Ray - Skull film	No Consensus	Necessary if the two views in the skeletal survey and the CT do not show fracture.
Nuclear Medicine - Bone Scan	No Consensus	Indicated when a clinical suspicion of abuse remains high and documentation is still necessary.

Appropriateness Criteria Scale
1 2 3 4 5 6 7 8 9
1=Least appropriate 9=Most appropriate



Clinical Condition: Adnexal Mass Suspected on Clinical Exam
Variant 1: Premenopausal women.

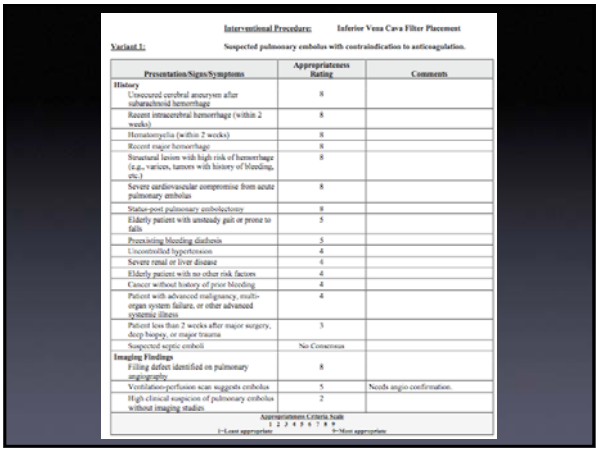
Radiologic Exam Procedure	Appropriateness Rating	Comments
Ultrasound		
Transabdominal	8	
Transvaginal	8	
Color Flow	6	
Doppler: PI/RI	6	
Computed Tomography	4	
Magnetic Resonance Imaging	4	
Plain Film of Abdomen/Pelvis	2	
Pregnancy Test	No Consensus	Differential diagnosis is different depending on the pregnancy test results.

Appropriateness Criteria Scale
1 2 3 4 5 6 7 8 9
1=Least appropriate 9=Most appropriate

Variant 2: Postmenopausal women.

Radiologic Exam Procedure	Appropriateness Rating	Comments
Ultrasound		
Transabdominal	8	
Transvaginal	8	
Color Flow	6	
Doppler: PI/RI	6	
Computed Tomography	4	
Magnetic Resonance Imaging	4	
Plain Film of Abdomen/Pelvis	2	

Appropriateness Criteria Scale
1 2 3 4 5 6 7 8 9
1=Least appropriate 9=Most appropriate



Interventional Procedure: Inferior Vena Cava Filter Placement
Variant 1: Suspected pulmonary embolus with contraindication to anticoagulation.

Presentation/Signs/Symptoms	Appropriateness Rating	Comments
History		
Unrecured cerebral aneurysm after subarachnoid hemorrhage	8	
Recent intracerebral hemorrhage (within 2 weeks)	8	
Hematomyelia (within 2 weeks)	8	
Recent major hemorrhage	8	
Structural lesion with high risk of hemorrhage (e.g., varices, tumors with history of bleeding, etc.)	8	
Severe cardiovascular compromise from acute pulmonary embolus	8	
Status-post pulmonary embolectomy	8	
Elderly patient with unsteady gait or prone to falls	5	
Preexisting bleeding diathesis	5	
Uncontrolled hypertension	4	
Severe renal or liver disease	4	
Elderly patient with no other risk factors	4	
Cancer without history of prior bleeding	4	
Patient with advanced malignancy, multi-organ system failure, or other advanced systemic illness	4	
Patient less than 2 weeks after major surgery, deep biopsy, or major trauma	3	
Suspected septic emboli	No Consensus	
Imaging Findings		
Filling defect identified on pulmonary angiography	8	
Ventilation-perfusion scan suggests embolus	5	Needs angio confirmation.
High clinical suspicion of pulmonary embolus without imaging studies	2	

Appropriateness Criteria Scale
1 2 3 4 5 6 7 8 9
1=Least appropriate 9=Most appropriate

Risk Management

- Radiation safety
- Allergic reactions
- Medical emergencies and treatment issues
- Diagnostic issues
- Competency

HIPAA

- Health Insurance Portability and Accountability Act
- communications networks that link radiology information systems, billing software, and image transmission technology (PACS/teleradiology). hospital demographic downloads, electronic claims submission and remittance, and remote referring physician (reports and images) or patient access (billing records) to information via a web site.

Contrast Reaction

- not caused by iodine
- not related to shellfish
- not true allergy (no drug-antibody)
- mechanism remains unknown
- unpredictable
- dose independent
- prevalence 1-2% (0.04 - 0.22% severe)
- fatal 1 in 75,000

Contrast Reaction - Premedication

- Prednisone 50 mg P.O, 13 hours before test
- Prednisone 50mg P.O, 7 hours before test
- Prednisone 50mg P.O, 1 hour before test plus Benadryl 50 mg P.O, 1 hour before test.

Renal Toxicity

- serum creatinine up more than 25% or > 0.5 mg%
- Risk Factors
  - 5 - 10 fold increase with pre-existing renal insufficiency (increased creatinine)
  - Dehydration
  - CHF
  - Age > 70
  - nephrotoxic drugs

Renal Toxicity

- direct relationship between serum creatinine and likelihood nephrotoxicity
- Hydrate 100 ml/hr Normal saline 4 hrs prior to procedure, continue for 24 hours
- Those on hemodialysis do not need extra seesions or dialysis immediately following contrast administration

Renal Toxicity

- Metformin (Glucophage)
  - oral diabetic agent
  - patients with renal insufficiency may develop lactic acidosis
  - withhold drug for 48 hrs after contrast administration in all patients taking this drug - restart if Cr back to baseline

iMaging 5.0

- Ready for primetime
- Easily accessible
- Integrates well with clinical work
- Free iPod for every 3rd year student
  - See Dr Gruener after this lecture