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Digital Imaging and Communications in Medicine

Practical Guide: Medical Imaging Concepts

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Clinical workflow overview

- Physicians:
  - Elicit a story or complaint from a patient
  - Try to figure out what, if anything, is wrong
  - Figure out a treatment plan
  - Treat the patient
  - If the patient is not improving, go back to beginning

What do radiologists do?

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Image humans (and animals) to:

- Diagnose diseases or anomalies
- Guide and perform procedures
- Help develop treatment plans
- Evaluate progression or regression of disease (response to treatment)
- Assist in forensic investigations

Imaging

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Mechanical energy – Ultrasound

Electromagnetic energy

- RF – MR imaging
- Infrared – thermal
- Visible light – endoscopy, ophthalmology, dermatology, microscopy
- Ultraviolet – fluorescence microscopy
- Gamma – radiographic imaging
- Protons – radiation therapy

Adult liver

A 50 year old man with cirrhosis and worsening LFTs

Abdomen Ultrasound

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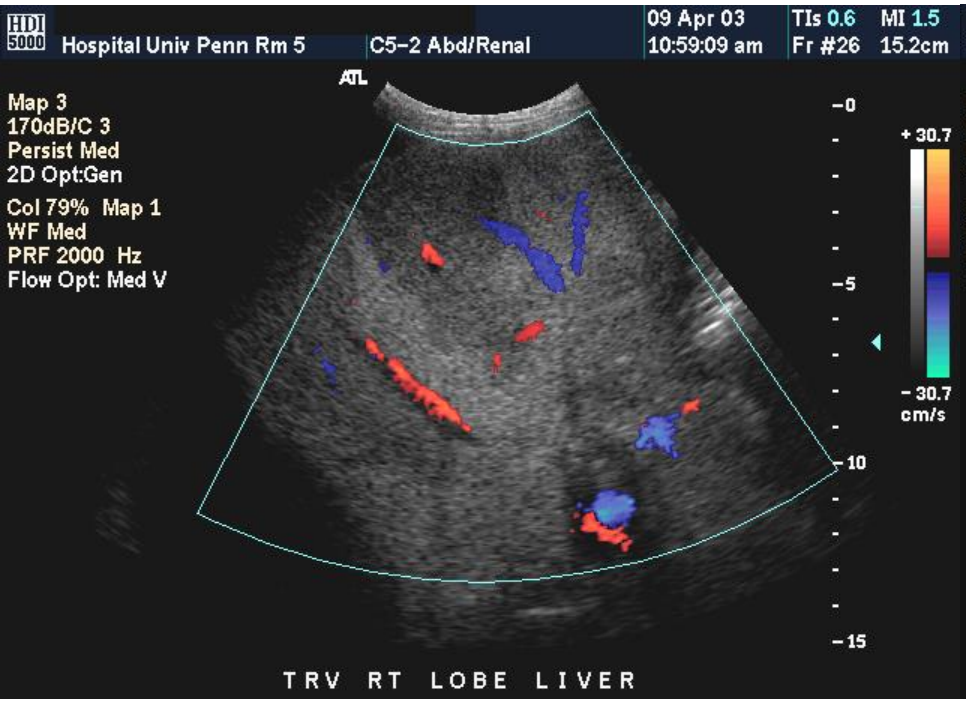
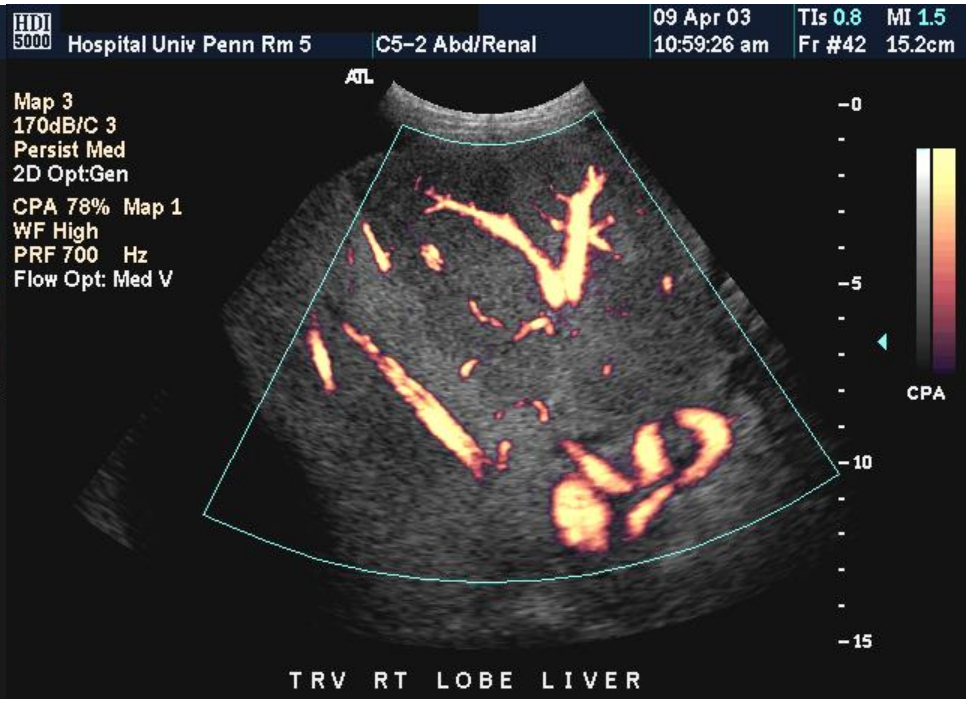
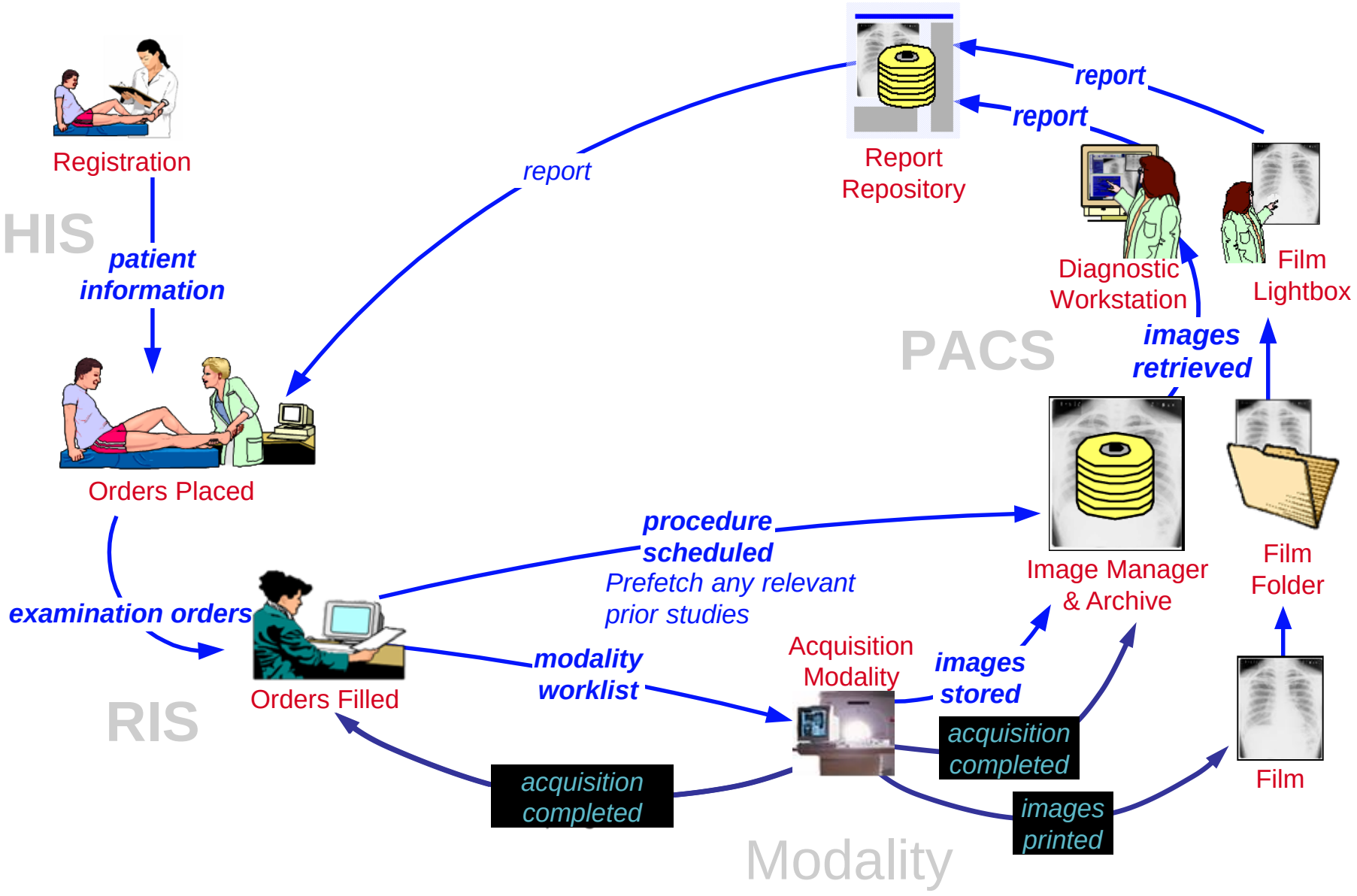
Good news for this patient





This is color flow and power Doppler: it shows that the blood vessels in the liver are not distorted by any “mass”.

Obstetrical Ultrasound


Registration
HIS
patient information
Orders Placed
examination orders
Orders Filled
RIS
report
Report Repository
report
report
Diagnostic Workstation
Film Lightbox
PACS
images retrieved
Image Manager & Archive
Film Folder
procedure scheduled
Prefetch any relevant prior studies
modality worklist
Acquisition Modality
images stored
acquisition completed
acquisition completed
images printed
Film
Modality

Why are healthcare workflows so complex?

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- Legacy procedures and systems
- We are “idiosyncratic”
- Interactions between departments
- Many personnel, each with particular tasks to perform and information needed

Complex Workflow: Intraoperative Ultrasound

We provide ultrasound in the operating room to assist the surgeons in locating structures and planning surgical approaches

About 20% of the time, the ultrasound changes the surgical plan

Intraoperative ultrasound

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With permisson: Susan Rowling, MD, Frank Spitz, MD

The radiologist's view

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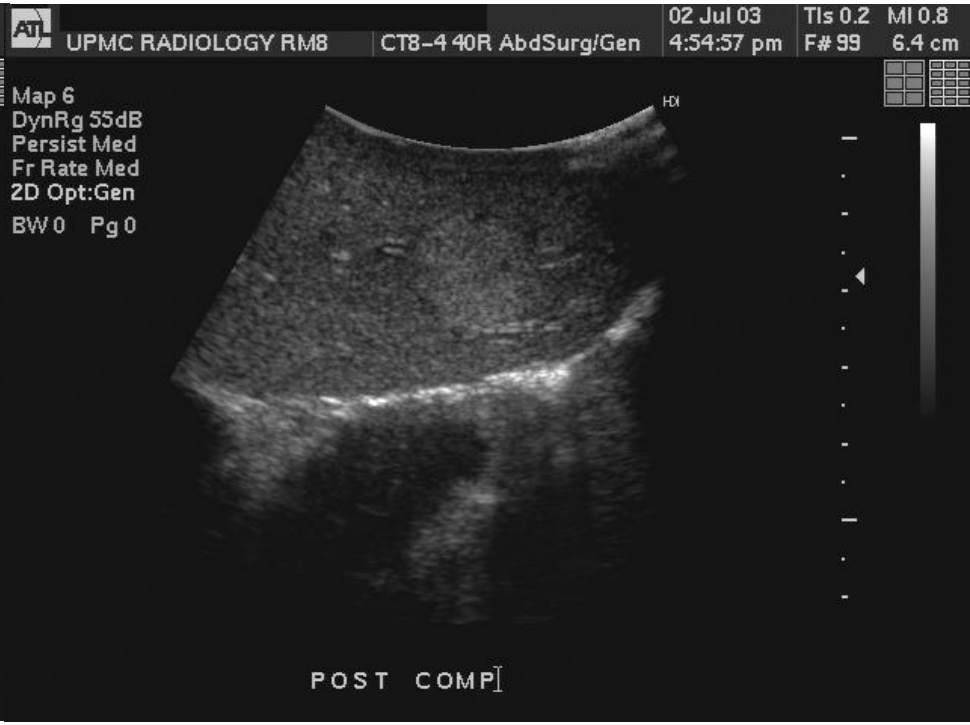
Intraoperative ultrasound

41-year-old woman with colon carcinoma for resection of a solitary liver mass

After compression

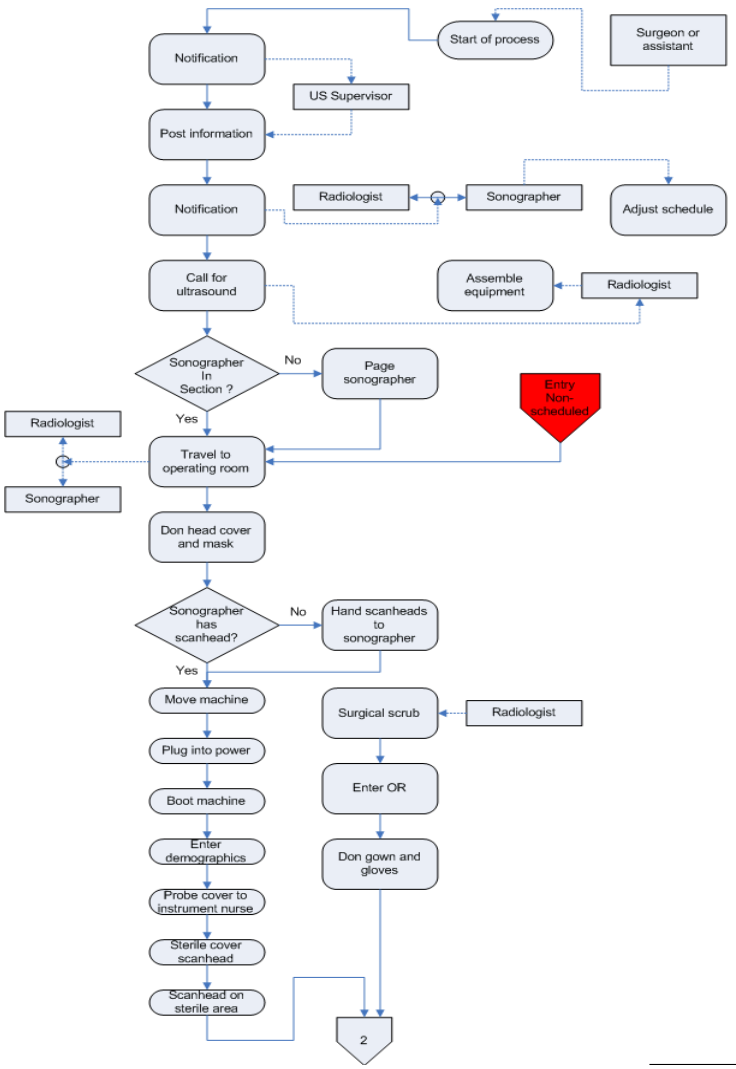


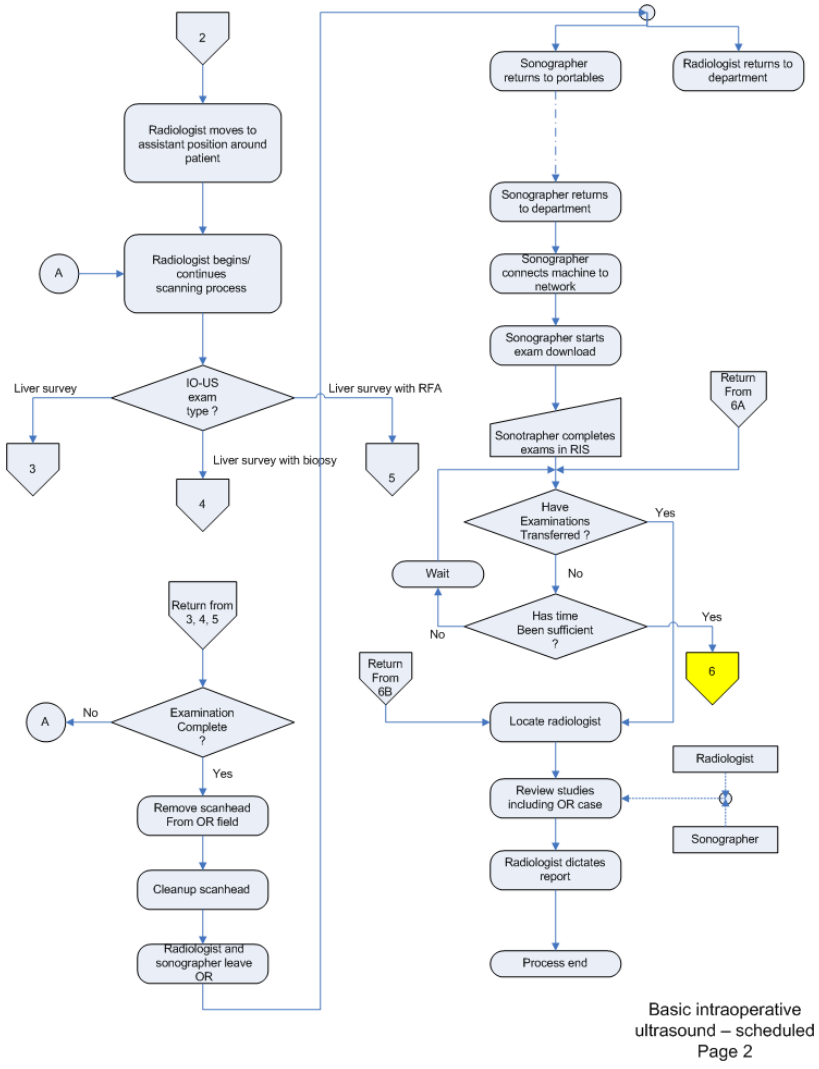
This is NOT another metastasis!
It is a cavernous hemangioma – a benign liver lesion.

Intraoperative ultrasound

- Often resulted in delays for both surgery and radiology
- Surgeons had to wait for 20 minutes or more for us to arrive with our equipment
- For radiology, it added to patient waiting time (took a radiologist and sonographer out of the Department)

Basic workflow: Intraoperative liver





Basic intraoperative ultrasound – scheduled
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Delays

- We noted that some intraoperative ultrasound studies were subject to much greater delays than others
- We thought that one difference was whether or not the study was scheduled in advance
- We looked at the difference in workflow

Non-scheduled workflow

- Included more steps
- Each step involved time
- Once we showed how many more steps were involved, we discussed this with the surgeons and explained that scheduling ahead of time would result in shorter delays
- They now routinely schedule their studies

Intraoperative ultrasound

- An already complex workflow in radiology
- Made more complex with interaction with another department's workflow
- Does not include the workflow steps done by surgery

Intraoperative ultrasound

- Also shows the need for standardization in the OR (hence the DICOM in Surgery WG)
- There are vendor-based standards, but they are usually proprietary
- There are standards (HDMI for video) that permit display on different devices, but not integration + interoperation

Why is workflow important?

- Much of radiology workflow grew out of the film, paper, and pencil age
- This includes not only processes, but organization
- Radiology had been largely radiology-centric
  - This in a time when “patient centered” has become a goal

Opportunities

- Our workflow tends to be supported by thick client, customized software
- Difficult transitions for legacy information systems

- Agile and adaptable
- Support changes in healthcare practice and payment

Emphasis

- Rapid data mining
- Increased patient involvement
- Improved communication between healthcare providers
- Demonstrating improvements in outcome
- Proving increased efficiency

With thanks to . . .

- Steven C. Horii, MD, FACR, FSIIM
- American College of Radiology