Diagnostic Radiology Residents Physics Curriculum and Updates

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FLORIDA HOSPITAL
The skill to heal. The spirit to care.

UCF

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Florida Hospital's University

FLORIDA STATE UNIVERSITY

Relevant Conflicts of Interest

Chair of the Imaging Physics Curricula Subcommittee

Attendees/trainees should not construe any of the discussion or content of the session as insider information about the American Board of Radiology or its examinations.

- **Imaging Physics Curricula Subcommittee (RRPSR)**
  - **Publish current syllabi of the medical physics curriculum recommended by AAPM for Diagnostic Radiology Residents and Cardiology Fellows**

Diagnostic Radiology Residents Physics Curriculum
AAPM Subcommittee of the Medical Physics Education of Physicians Committee
May 2007

Diagnostic Radiology Residents Physics Curriculum

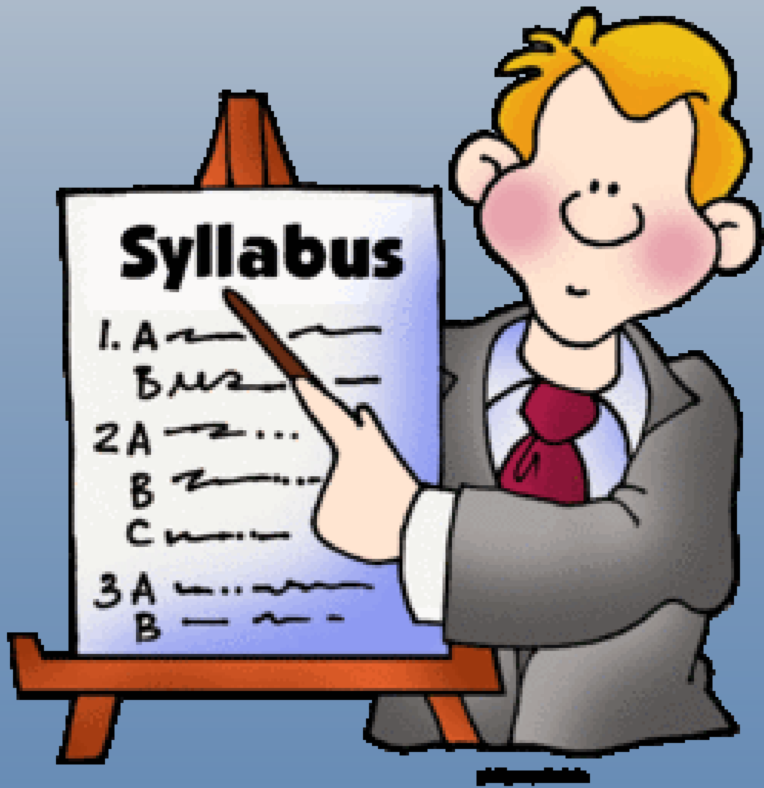
Prepared by

Imaging Physics Curricula Subcommittee
AAPM Subcommittee of the Medical Physics Education of Physicians Committee

UPDATED – DECEMBER 2015

- 2006 AAPM Forum on Physics Education
- 2007 RSNA multi-organizational follow-up
- 2007 Curriculum (Chair: Dr. Phil Heintz)
- 2013 Questions & Answers (Chair: Dr. Kalpana Kanal)
- 2015 Updated Curriculum (Chair: Dr. Kalpana Kanal)
- 2016 Updated Questions and Answers (Chair: Dr. William F. Sensakovic)

- **Principal attributes of a radiologist**
  - **Clinical acumen**
  - **Mastery of technology**
  - **Dedication to safety and quality**



- Includes topics that:
  - Each physician should know to be considered competent
  - Meet regulations
  - Pass specialty boards
- Supplemented with Q&A
- Updated on a 2-3 year cycle

TABLE OF CONTENTS

Module 9: General Radiography

After completing this module, the resident should be able to apply the "Fundamental Knowledge" and "Clinical Applications" learned from the module to example tasks, such as those found in "Clinical Problem-solving."

Fundamental Knowledge:

1. Describe the components of a radiographic imaging system.
2. List and describe the factors affecting radiographic image quality.
3. Explain how the geometric features of a general radiographic system affect the resulting image.
4. Describe the different types of acquisition systems used in general radiography.
5. Distinguish among the basic imaging requirements for specific body part or views acquired in general radiography.
6. Define entrance skin exposure and how it relates to patient dose.

Clinical Application:

1. Develop appropriate technique factors used in common radiographic procedures.
2. Analyze the radiation dose from a medical procedure, and communicate the benefits and risks to the referring physician.

Clinical Problem-solving:

1. Why is image quality frequently compromised in mobile radiography?
2. What are the geometric requirements for image acquisition that affect image quality?
3. What system components affect patient radiation dose? How do they reduce patient dose?
4. How can collimation impact image processing?
5. Which factors determine the appropriate grid to use for different radiographic exams?

Curriculum:

9. General Radiography
    - 9.1. System Components
        - 9.1.1. Tube
        - 9.1.2. Filtration
        - 9.1.3. Collimator
        - 9.1.4. Automatic Exposure Control (AEC)
        - 9.1.5. Grid and Bucky Factor
        - 9.1.6. Compensation Filters
    - 9.2. Geometrical Requirements
        - 9.2.1. Focal Spot Size
        - 9.2.2. Collimation
        - 9.2.3. Heel Effect
    - 9.3. Acquisition Systems
        - 9.3.1. Dual-Energy
        - 9.3.2. Tomosynthesis
    - 9.4. Image Characteristics
        - 9.4.1. Spatial Resolution
        - 9.4.2. Contrast Sensitivity
        - 9.4.3. Noise
        - 9.4.4. Temporal Resolution
        - 9.4.5. Artifacts

        - 9.4.6. Image Processing
        - 9.4.7. Computer-Aided Detection (CAD)
    - 9.5. Applications
        - 9.5.1. Head/Neck
        - 9.5.2. Chest
        - 9.5.3. Abdomen/Pelvis
        - 9.5.4. Spine
        - 9.5.5. Extremities
        - 9.5.6. Pediatrics and Neonatal
        - 9.5.7. Portable/Mobile
    - 9.6. Dosimetry
        - 9.6.1. Entrance Skin Air Kerma
        - 9.6.2. Effective Dose
        - 9.6.3. Organ Dose
        - 9.6.4. Reference Levels
    - 9.7. Factors Affecting Patient Dose
        - 9.7.1. Technique Optimization (e.g. kVp, mA, Time, etc.)
        - 9.7.2. Imaging Geometry
        - 9.7.3. Beam Filtration
        - 9.7.4. Grid
        - 9.7.5. Field Size
        - 9.7.6. Receptor Speed
    - 9.8. Quality Assurance and Quality Control

Example Q&A:

Q1. What is responsible for the heart appearing enlarged on an AP chest image as compared to a PA chest image?

A. The focal spot size
B. The use of focused grids
C. Greater scatter from objects closer to the x-ray tube
D. The outward divergence of the x-ray beam from the focal spot
E. Increased parallax from x-ray tubes with both large and small focal spots

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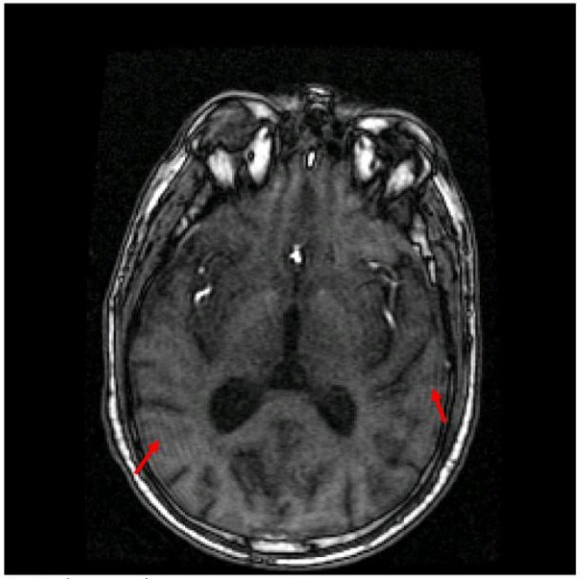
Detail level does ***not*** equate to importance

Example Q&A:

Q1. What artifact is present in this MR image?



A. Patient motion
B. Aliasing
C. Truncation
D. Flow artifacts

Answer: C – Truncation

Explanation: Truncation artifacts are also known as Gibbs-ringing artifacts. They typically present as multiple parallel lines adjacent to high-contrast interfaces. Those artifacts come from using a finite number of sampling points in the frequency or phase-encoding direction in the image acquisition. The Fourier transform of a signal will result in overshoot and undershoot oscillations (ringing) when a sharp border is encountered in the image. The ringing could happen in both the frequency and phase directions. However, it is commonly seen in the phase direction since phase step usually is reduced to save scan time. The solution for this artifact is to increase the imaging matrix, which usually will increase scan time and reduce SNR.

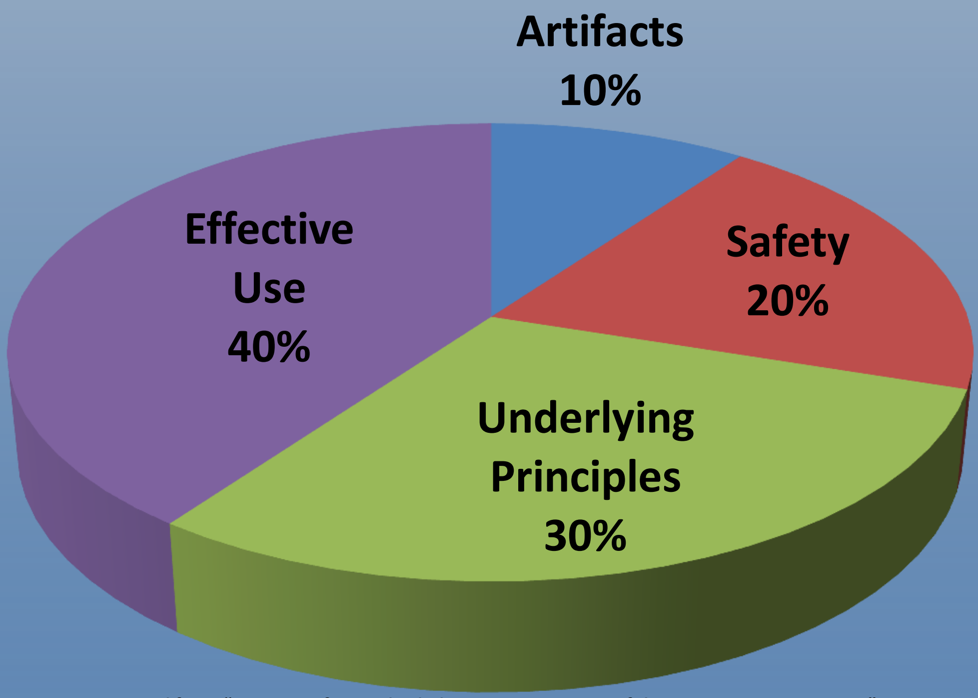
References:

1. Zhuo J. and Gullapalli RP. *AAPM/RSNA Physics Tutorial for Residents, MR Artifacts, Safety and Quality Control,* RadioGraphics 2006: 26:275-297. http://pubs.rsna.org/doi/full/10.1148/rg.261055134
2. Elster, A.D. and J.H. Burdette. *Questions and Answers in Magnetic Resonance Imaging*, 2nd ed. St. Louis: Mosby, 2001.
3. Edelman, R.R, J.R. Hesselink, M.B. Zlatkin, and J.V. Crues, eds. *Clinical Magnetic Resonance Imaging*, 3rd ed., v1. Philadelphia: Saunders Elsevier, 2006.

Recent Updates

- Included
  - Dual energy
  - Tomosynthesis
- Removed
  - Film
- Style
  - Streamlined
  - Clinically based
  - Image questions

- **Future directions**
  - **Modality module structure**
  - **Rules of thumb**



Derived from "Preparing for Medical Physics Components of the ABR Core Examination"

THANK YOU!

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Curriculum can be accessed from the AAPM website

https://www.aapm.org/education/ERG/DIARAD/