Scatter Radiation & Interactions (LMRT Detailed Guide)

What is Scatter Radiation?

Scatter radiation is secondary radiation produced when the primary x-ray beam interacts with the patient and is deflected from its original path.

- Travels in random directions
- Has less energy than the primary beam
- Main cause: Compton interaction

Types of X-ray Interactions

Compton Interaction (MAIN SOURCE OF SCATTER)

What Happens:

- X-ray photon hits a loosely bound outer-shell electron
- Electron is ejected (ionization)
- Photon is deflected with lower energy → becomes scatter

Key Points:

- Occurs in soft tissue
- Produces scatter radiation
- Major cause of image fog
- Increases occupational exposure

Most important interaction in diagnostic radiography

Photoelectric Effect (NO SCATTER)

What Happens:

- X-ray photon hits an inner-shell electron
- Electron is ejected
- Photon is completely absorbed

Key Points:

- No scatter produced
- Creates image contrast
- More likely at lower kVp
- Occurs in bone and dense tissues

Important for image quality (contrast)

Characteristic Radiation (INSIDE THE TUBE)

What Happens:

- Inner-shell electron is removed
- Outer-shell electron fills the vacancy
- Energy released as an x-ray photon

Key Points:

- Occurs in the x-ray tube target (anode)
- Produces useful x-rays, not scatter
- Energy depends on target material (tungsten)

NOT a source of scatter radiation in the patient

Comparison of Interactions

Interaction	Scatter Produced?	Image Effect	Where Occurs
Compton	✅ YES	↓ Contrast (fog)	Soft tissue
Photoelectric	❌ NO	↑ Contrast	Bone
Characteristic	❌ NO (in patient)	Produces useful beam	X-ray tube

Effects of Scatter Radiation

On Image Quality:

- Causes fog
- Reduces contrast
- Makes image appear gray

On Radiation Safety:

- Increases patient dose
- Main source of technologist exposure

Factors That Increase Scatter

High kVp

- More photon energy → more Compton interactions
  ↑ Scatter

Large Field Size

- More tissue exposed
  ↑ Scatter

Increased Patient Thickness

- More interactions occur
  ↑ Scatter

Scatter Radiation Control Methods

Collimation (MOST IMPORTANT)

Restricting the size of the x-ray beam

Reduces:

- Scatter production
- Patient dose

Improves:

- Image contrast

#1 method to control scatter

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2. Grids

Purpose:

- Absorb scatter before it reaches the image receptor

How it Works:

- Lead strips block scatter
- Primary beam passes through

Grid Ratio:

- Higher ratio = better scatter cleanup
- BUT → requires higher exposure (↑ dose)

Air Gap Technique

- Increase distance between patient and detector

Scatter spreads out and misses IR
Improves contrast

Optimal kVp Selection

- Avoid unnecessarily high kVp

Lower kVp:

- Less scatter
- Better contrast

Must balance to avoid underexposure

Patient Shielding

- Lead aprons, gonadal shields

Protect from scatter exposure

Compression

- Reduces tissue thickness

Less tissue = fewer interactions
Less scatter produced

Distance (Inverse Square Law)

- Increasing distance reduces exposure

For technologists:

- Stand back
- Use protective barriers

Quick Summary Table

Control Method	Effect
Collimation	↓ Scatter production
Grid	↓ Scatter reaching IR
Air gap	↓ Scatter reaching IR
Lower kVp	↓ Scatter
Compression	↓ Scatter
Distance	↓ Exposure

(VERY IMPORTANT)

- Compton = Scatter + ↓ Contrast
- Photoelectric = Absorption + ↑ Contrast
- Characteristic = Produced in tube (NOT scatter)
- #1 scatter control = Collimation
- Scatter increases with kVp, field size, and thickness
- Grids improve contrast but increase patient dose