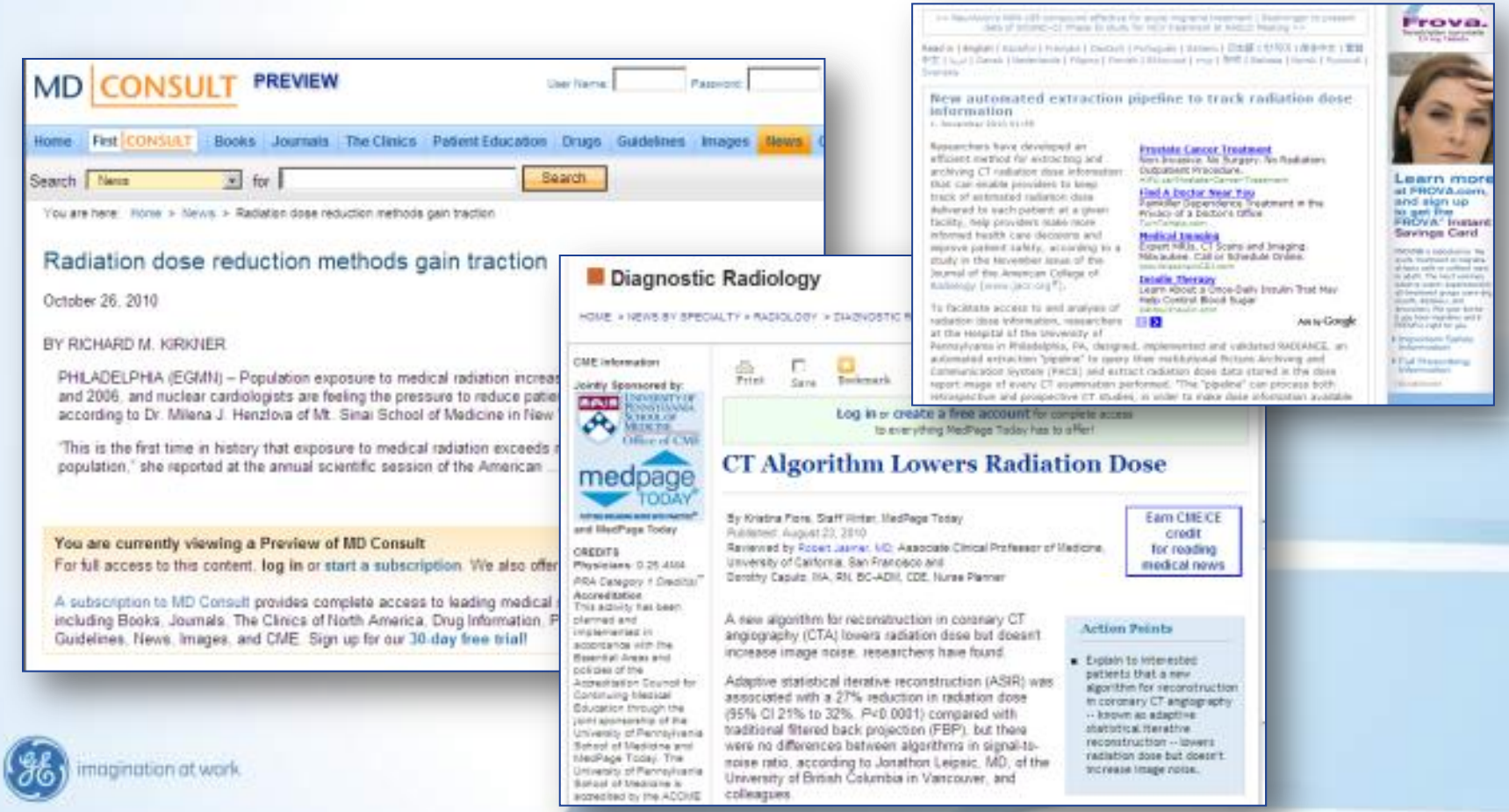
Radiation Safety for the Spine Interventionalist

imagination at work

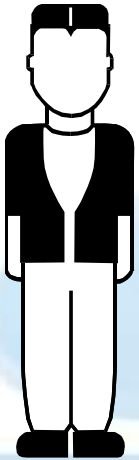
Dose makes headlines



What is radiation?

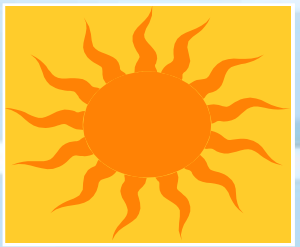
Radiation is invisible energy that travels in the form of waves or high speed particles.

Also known as **ionizing radiation**, this has enough energy to break chemical bonds in molecules or remove tightly bound electrons from Atoms, thus creating charged molecules OR ATOMS (IONS).



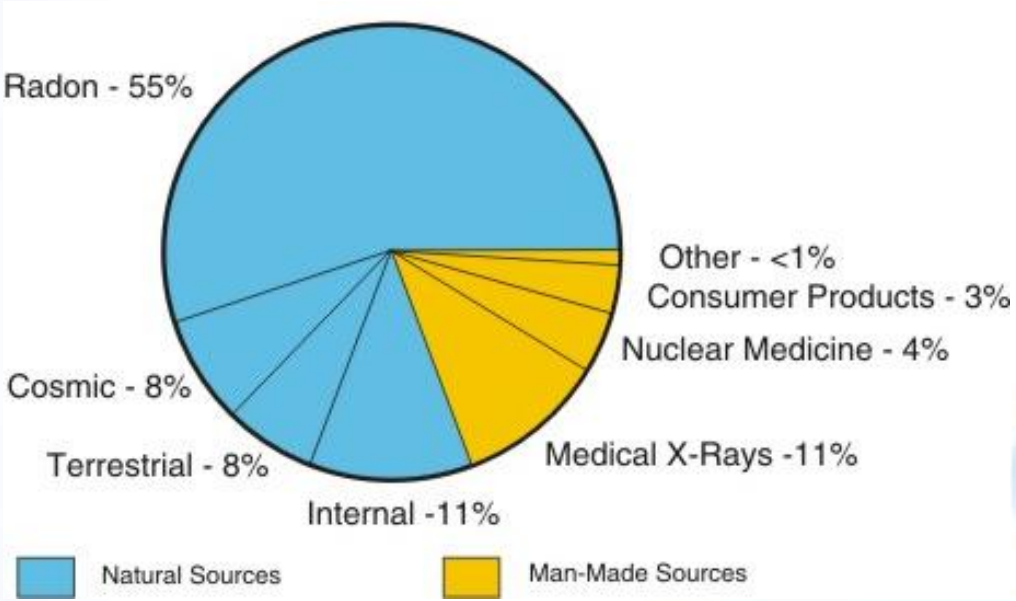
38-75 mRem/year

200-400 mRem/year



15-20 mRem/year

Sources of Radiation Exposure



As
Low
As
Reasonably
Achievable

Delivering the proper amount of radiation is critical to producing superb image quality

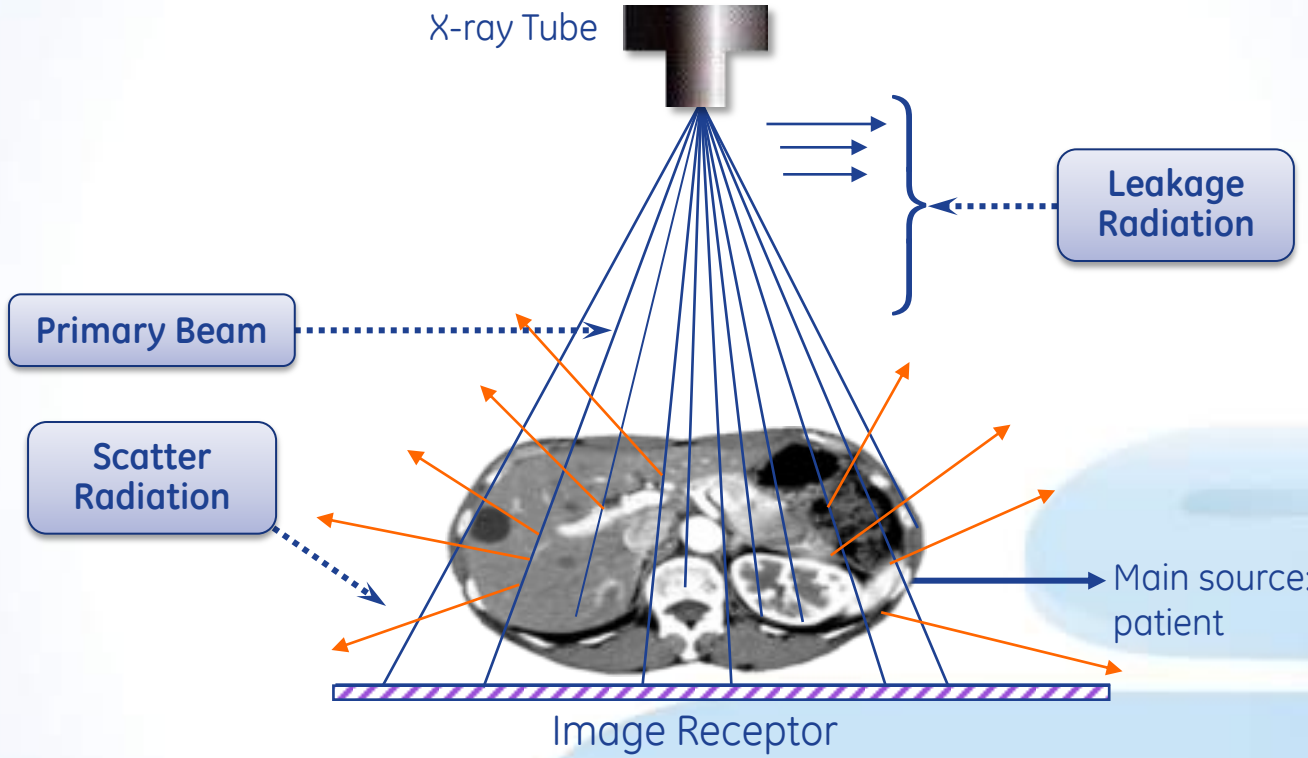
Why should we care about dose?

- Physicians need fluoroscopy to perform Minimally Invasive Surgery (MIS)
- They want the best I.Q. at lowest possible dose
- Radiation dose is cumulative
- High doses of radiation can be harmful to the body
- Physicians and techs are in a radiation environment every day

Imaging challenges in the OR or procedures room

- Equipment & instrument crowding
- Exposure to patient, surgeons and staff
- Patient draping
- Limited options for patient positioning

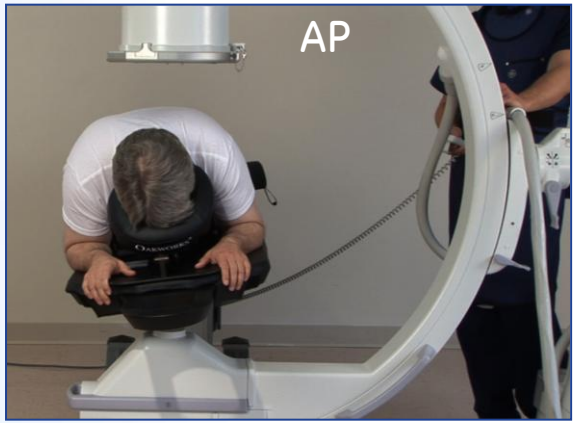
The Right Image at the Right Dose



Patient receives primary radiation

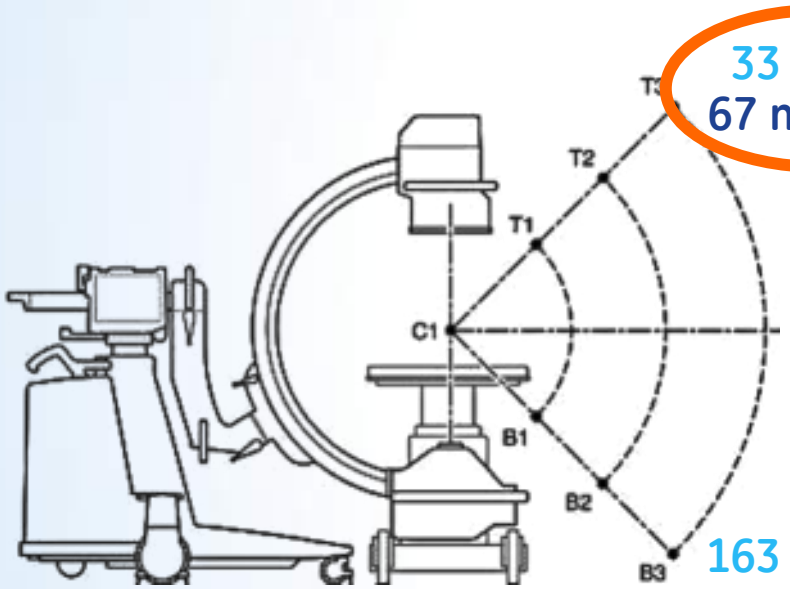
Surgeon and staff normally receive scatter radiation

Positioning & Set-up for Pain



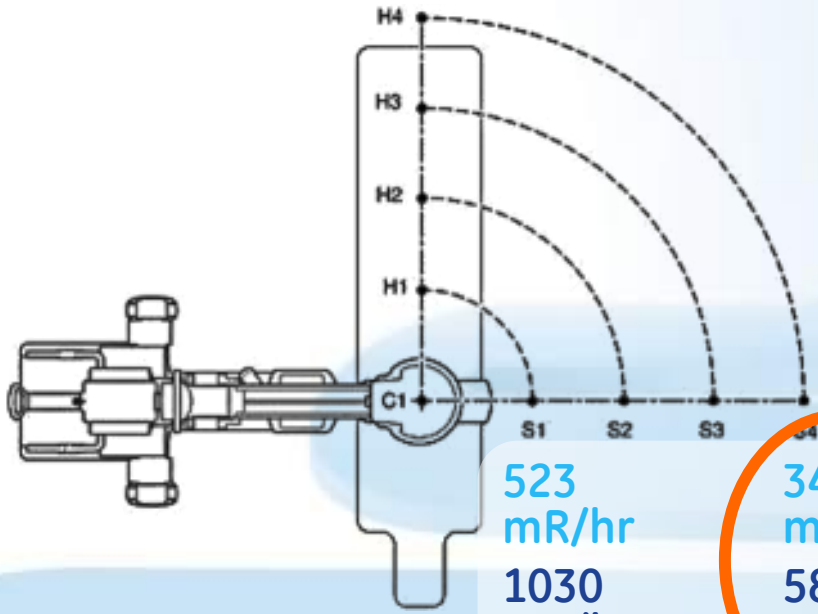
Air Kerma Scatter Rates

9 Inch Image Intensifier
12 Inch Image Intensifier



33 mR/hr
67 mR/hr

163 mR/hr
248 mR/hr



523 mR/hr
1030 mR/hr

34 mR/hr
58 mR/hr

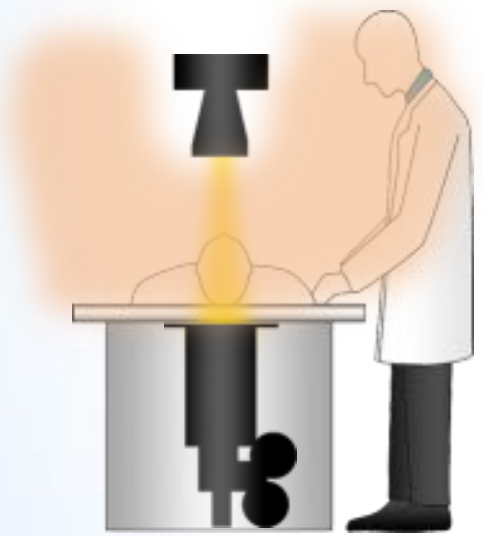
Technique: Fluoroscopic 73kVp @ 2.4 ma
Phantom: ANSI Abdomen Phantom

imagination at work

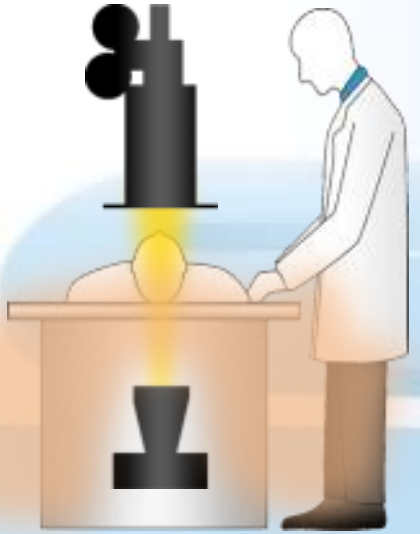
Inverse Square Principle – Distance reduces dose

Scatter radiation

Scatter radiation with X-ray tube on top



Scatter radiation with I.I. on top



Good radiation protection practices

Dose = Exposure Rate x Time

What impacts dose?	How can we reduce it?
Exposure time	Minimize exposure time
Exposure amount	Minimize exposure amount

Take precautions!

Maximum dosimeter readings

MONTHLY	420 mrems
QUARTERLY	1250 mrems
YEARLY	5000 mrems
LIFETIME	5 rems x (n-18) where “n” is your age

These levels are the standards set by the federal government for radiation exposure to occupational personnel

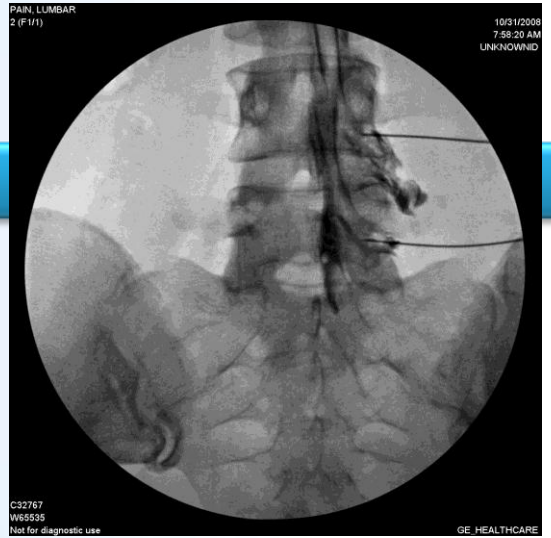
Dose = *Amount of radiation received -* ***mrem***
Dose Rate = *How fast you receive the dose -* ***mrem/hr.***

Annual radiation exposure limits

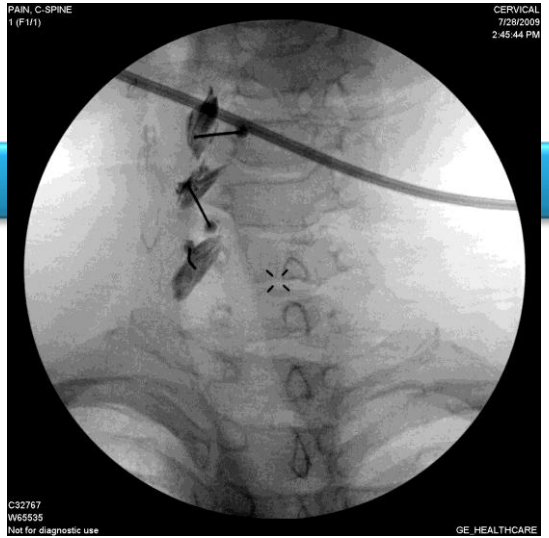
Whole body (organs & gonads)	5,000 mrem/yr
Lens of eyes	15,000 mrem/yr
Extremities & skin	50,000 mrem/yr
Fetal	500 mrem/gestation period

Minimize exposure time.

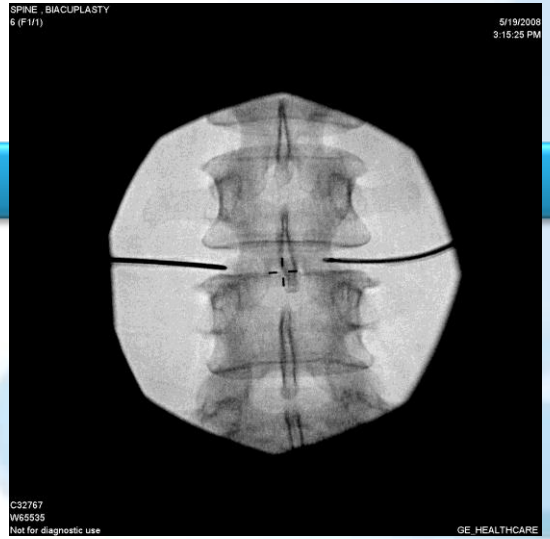
Better image quality means less exposure time



Lumbar



Cervical



Biacuplasty

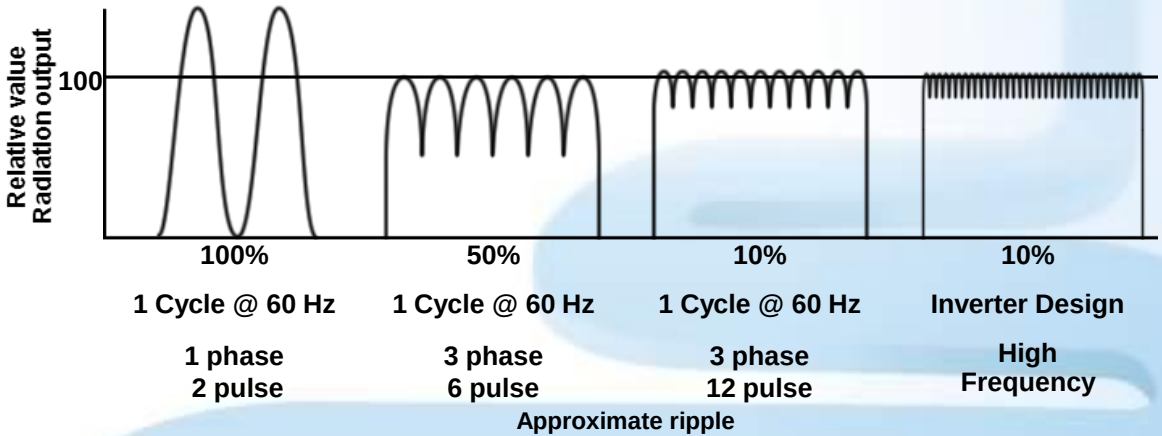
Power efficiency is a balancing act

Providing a superb image with each exposure can reduce exposure time.

If you can't see, you tend to fluoro longer.

Choose power so you have it when you need it

15 kW high frequency, generator delivers constant peak power



High Penetrating Power to Image Large Patients and do more applications

Rotating anode drives high I.Q.

Allows for a higher peak power capacity

Offers smaller focal spot for better resolution

Anode target rotates 3,560 RPM

Larger target area gives higher heat dissipation making it capable of high power pulse mode

- 300,000 H.U. Heat Storage
- 85,000 H.U./min. Heat Dissipation rate
- Small Focal spots – 0.3mm/0.6mm

Auto features make dose optimization easy

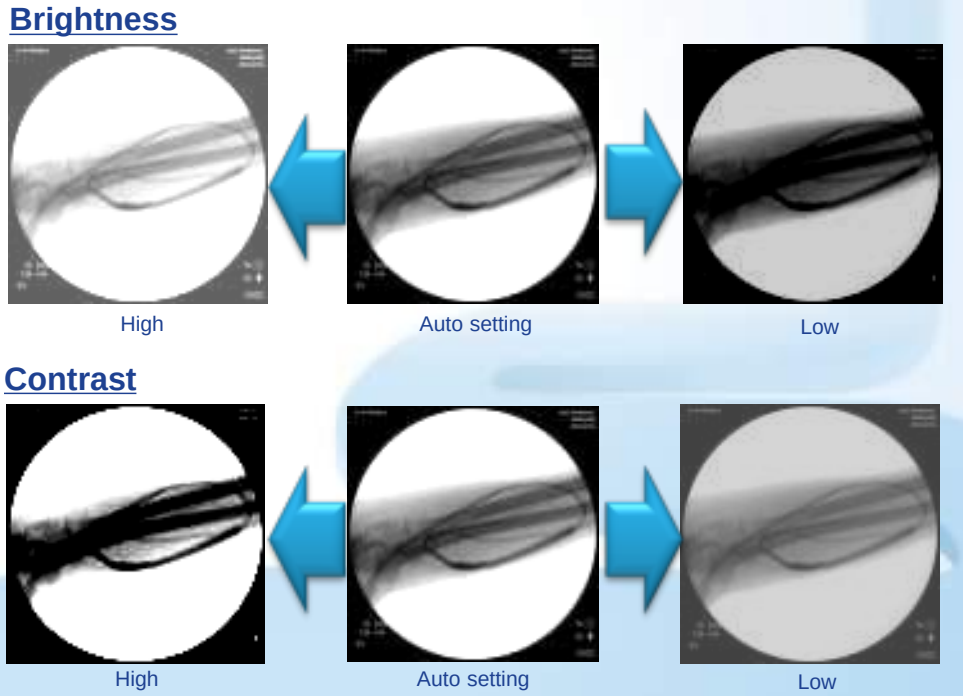
Automatic brightness & contrast features optimize imaging

Point & shoot capability reduces errors and unnecessary dose

Auto features can optimize technique factors for anatomical density:

- KVp
- mA
- Camera gain

Auto metal detection features prevent blooming or burnout and prevent retakes



Fewer shots required with laser aimer

- Removable targeting device pinpoints anatomy of interest
- Crosshairs on the image help ensure alignment
- Fewer shots, less dose

Minimize exposure amount.

Reduce dose by up to 90%

Low Dose Mode
One half the milliamperage
Up to 50% dose reduction

Pulse Fluoro Mode
1, 2, 4, 8 PPS
75-90% reduction in dose vs. standard fluoro

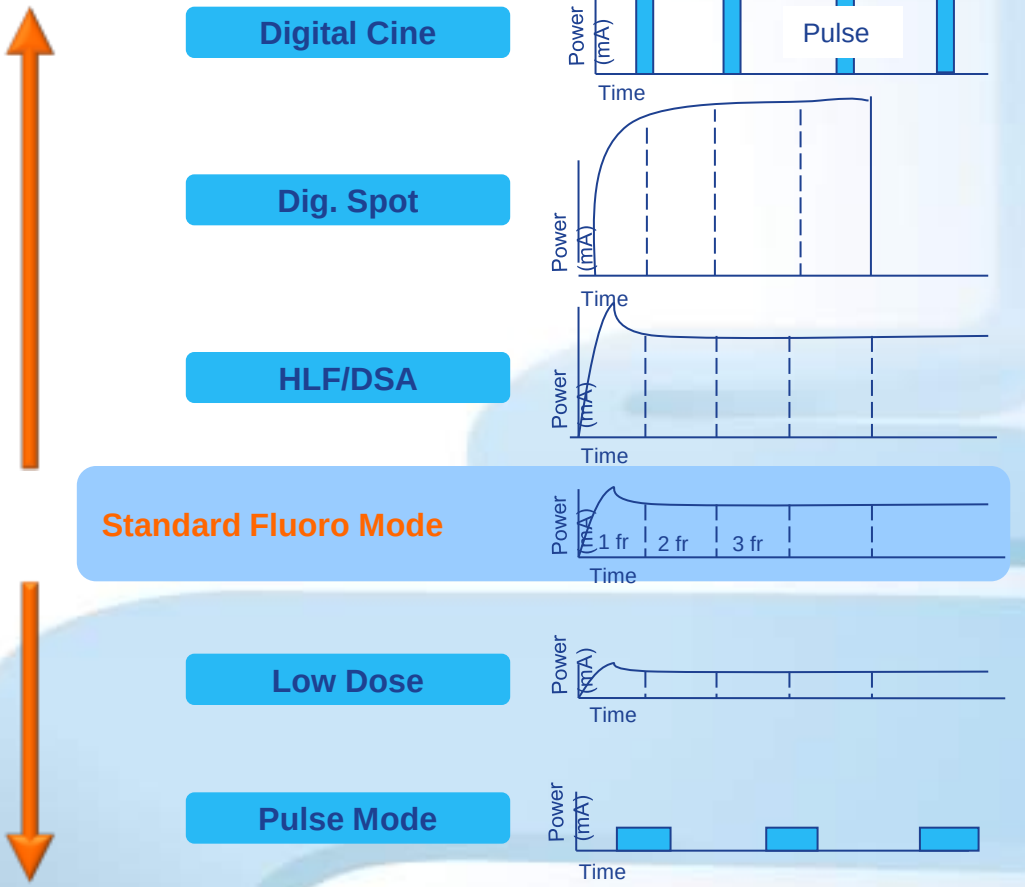
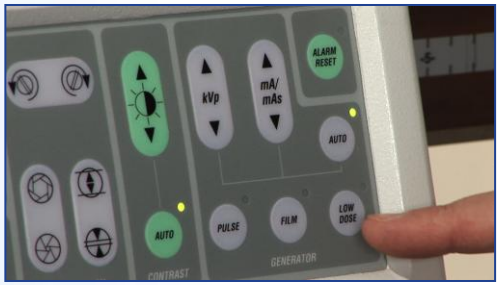
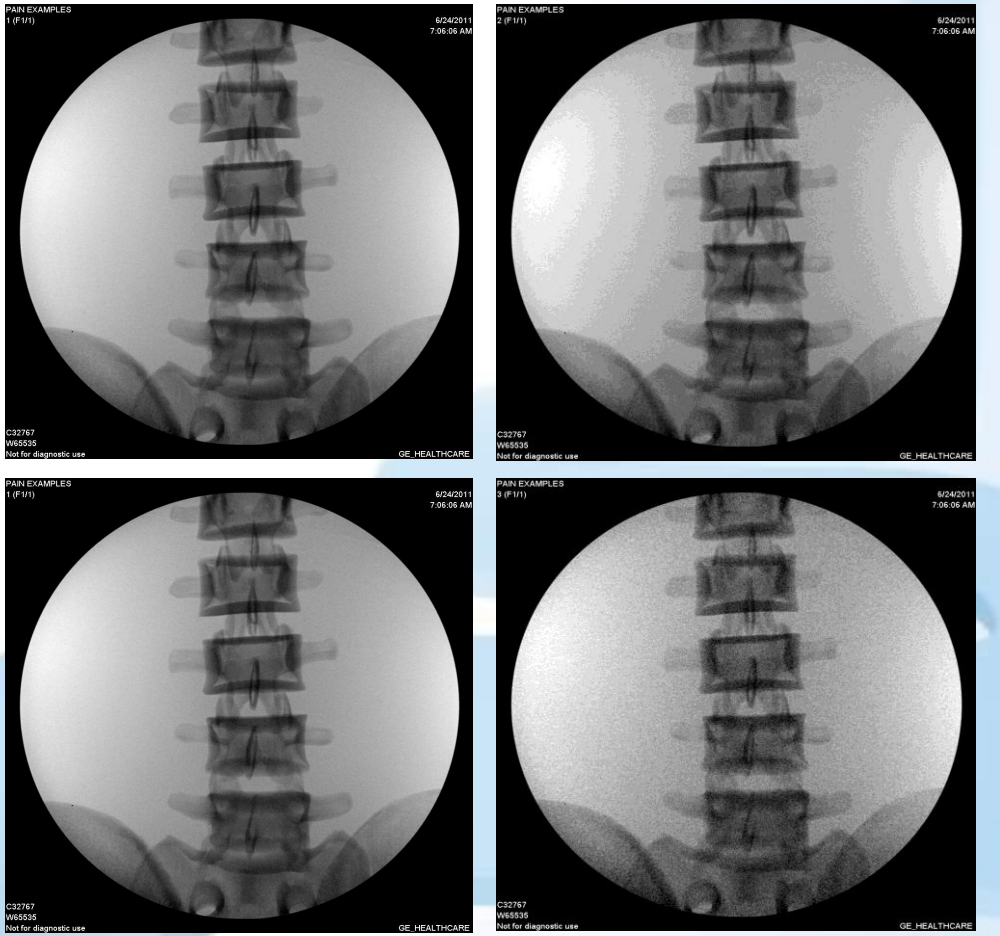


Image quality versus dose reduction

Low dose example on average size patient



Pulse fluoro example on average size patient



On-screen collimation limits exposure

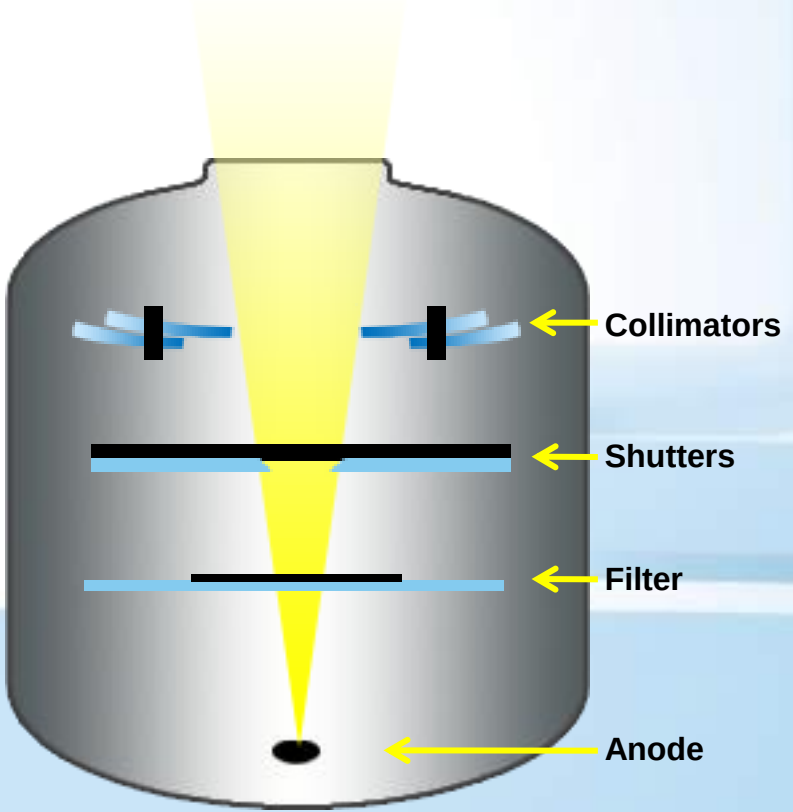
- Limit radiation with iris, dual leaf, and curved collimator
- Collimators shield exposure using lead and tungsten shutters
- Collimate & rotate from last image for fewer shots
- Improved I.Q. through smaller focus area

Beam filtration reduces patient skin dose

Beam filters absorb low-energy photons that would be absorbed by the patient

Filtering the X-ray removes harmful and unnecessary radiation at lower energy and lower frequency levels

Hardens the beam for better I.Q.



Know your field of view

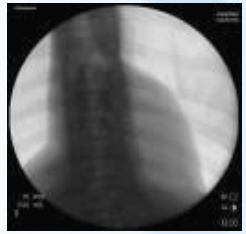
Size counts when it comes to dose

Larger field of view, more scatter radiation, but lower primary dose

Each magnification increases technique by 50%
- - higher technique, higher dose

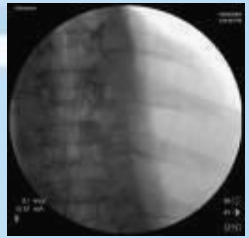
Magnification is a trade-off between image quality and dose levels

Normal
- Largest Coverage
- Lowest Dose

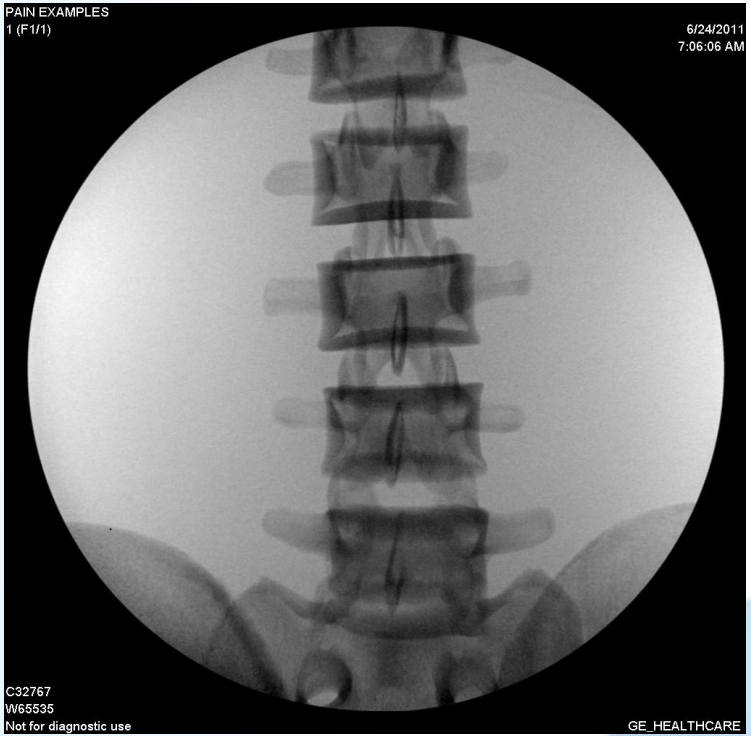


Mag.1
- Zoomed image
- Higher-res.
- Higher dose

Mag.2
- Largest display
- Highest Res.
- Highest Dose



Magnification means higher dose



Protecting personnel

Distance: Stand as far from the radiation source as possible and use leaded shielding

Shielding: Lead aprons, screens, thyroid shields minimize exposure

0.5 mm of lead or its equivalent

Monitoring: Should be worn by all personnel who are in the room anytime fluoroscopy is taking place.

Radiation monitoring

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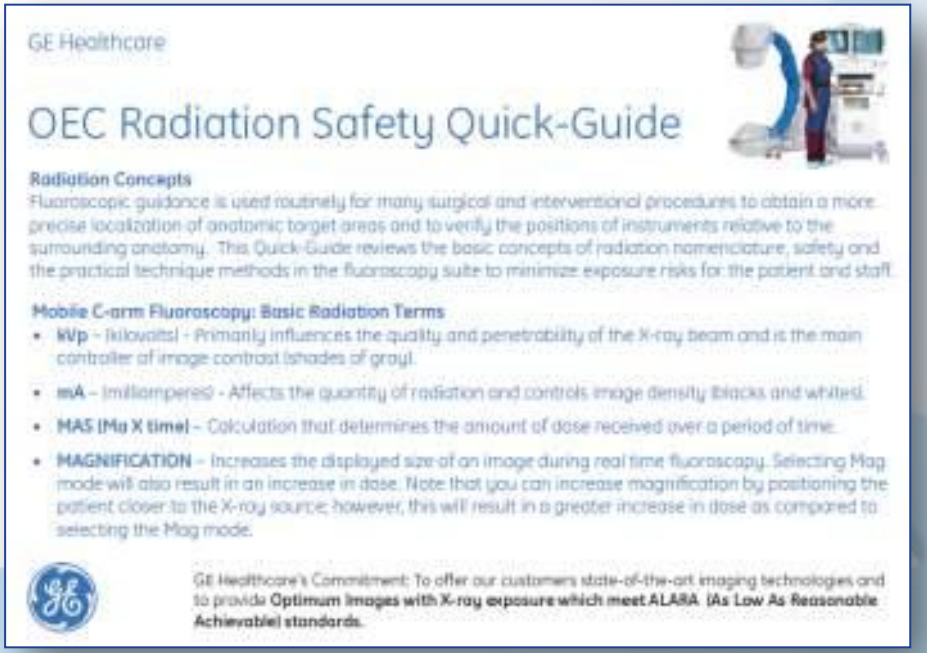

GE Healthcare

OEC Radiation Safety Quick-Guide

Radiation Concepts

Fluoroscopic guidance is used routinely for many surgical and interventional procedures to obtain a more precise localization of anatomic target areas and to verify the positions of instruments relative to the surrounding anatomy. This Quick-Guide reviews the basic concepts of radiation nomenclature, safety and the practical technique methods in the fluoroscopy suite to minimize exposure risks for the patient and staff.

Mobile C-arm Fluoroscopy: Basic Radiation Terms

- **kVp** – (kilovolts) - Primarily influences the quality and penetrability of the X-ray beam and is the main controller of image contrast (shades of gray).
- **mA** – (milliampere) - Affects the quantity of radiation and controls image density (blacks and whites).
- **MAS (Ma X time)** – Calculation that determines the amount of dose received over a period of time.
- **MAGNIFICATION** – Increases the displayed size of an image during real time fluoroscopy. Selecting Mag mode will also result in an increase in dose. Note that you can increase magnification by positioning the patient closer to the X-ray source; however, this will result in a greater increase in dose as compared to selecting the Mag mode.

GE Healthcare's Commitment: To offer our customers state-of-the-art imaging technologies and to provide **Optimum Images with X-ray exposure which meet ALARA (As Low As Reasonable Achievable) standards.**

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