Radiation protection in gastroenterology



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About me



- Medical Physics Ph.D.
- Scientific member of Iran University of medical Sciences
- 20 years experience in Radiation Protection
- Cooperative with AEOI and IAEA in radiation protection Field
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Outline:

- Importance of Radiation Protection in Gastrointestinal procedures

- Basic rules in RP

- Special technique for Radiation protection in Gastroenterology

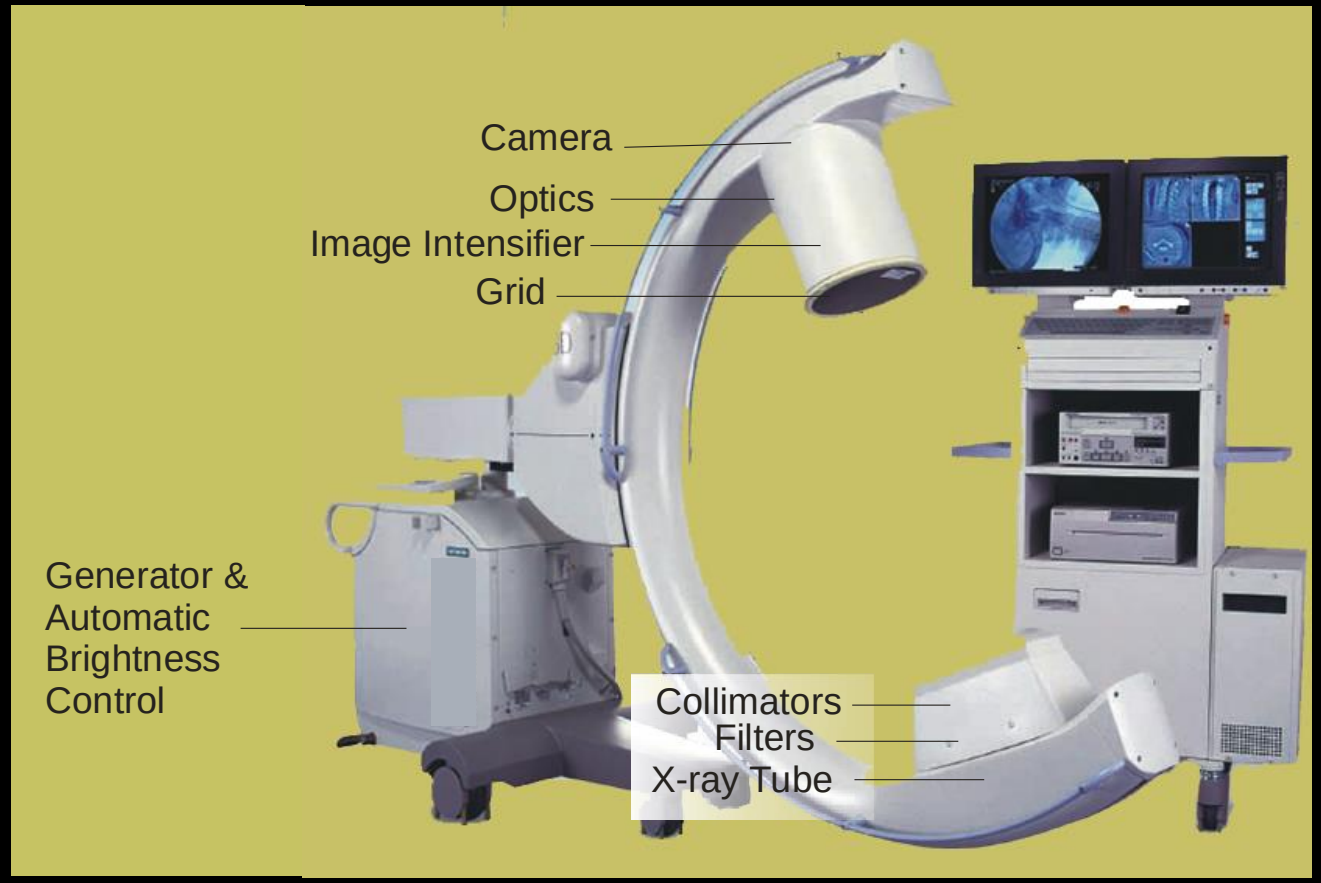
Importance of Radiation Protection in Gastrointestinal procedures

- Uses of fluoroscopy in GI
  - Endoscopic retrograde cholangiopancreatography (ERCP)
  - Enteroscopy
    - Double/single balloon
  - Luminal stenting
    - Esophagus
    - Small intestine
    - Colon/rectum
  - Luminal stricture dilation
  - Colonoscopy

Anatomy of C-Arm x-ray machine



Digital C-Arm with Flat panel detector

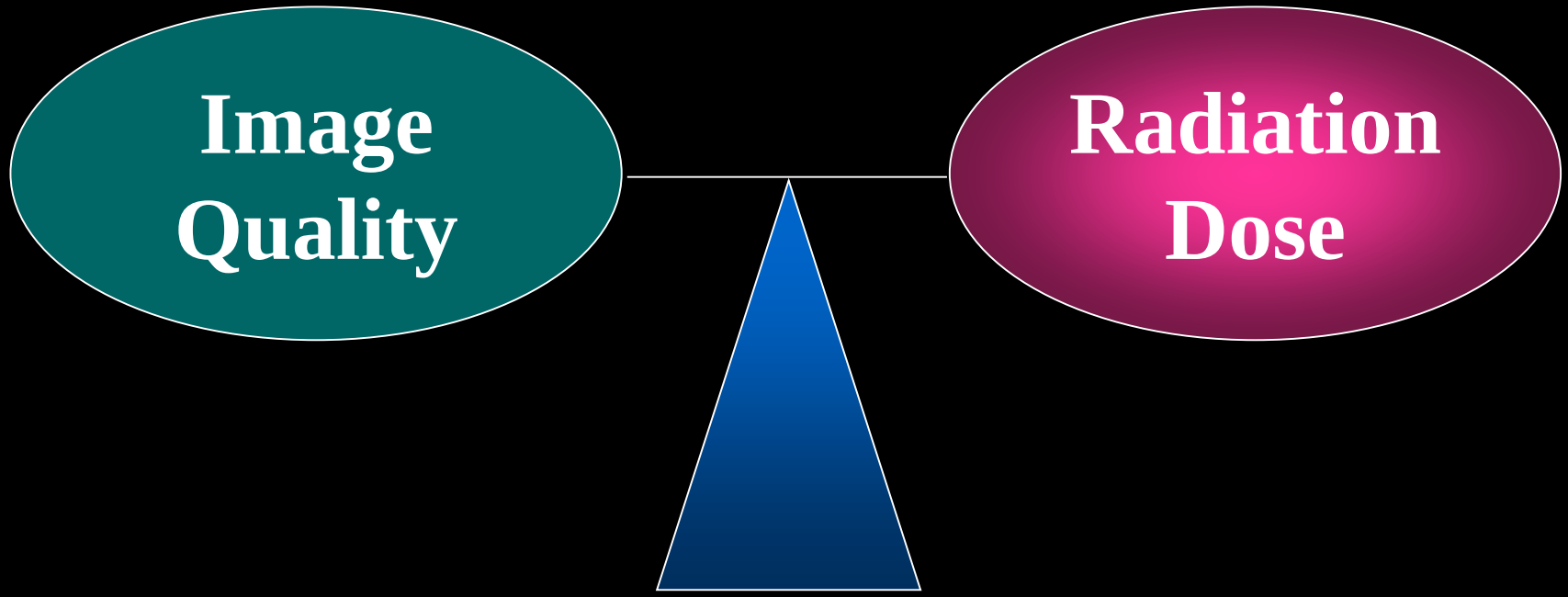


Analogue C-Arm with Image Intensifier

Paradox of Image quality and Dose

Better image quality with higher radiation dose reaching the image receptor.

Tradeoff: higher patient and staff dose!!



ALARA

As Low As Reasonably Achievable

No known safe limit of magnitude of radiation exposure!

Patients

Physicians

Professional staff

Limits on Doses for worker and public

	Annual Dose Limit (mSv)
Effective dose, worker	**20**
Equivalent dose to lens of eye	**20**
Equivalent dose to skin	**500**
Equivalent dose to hands and feet	**500**
Effective dose to embryo or fetus	**1**
Effective dose, public	**1**





- No dose limit for patient!. But DRL should be stablished.

Why is it necessary to consider patients protection?

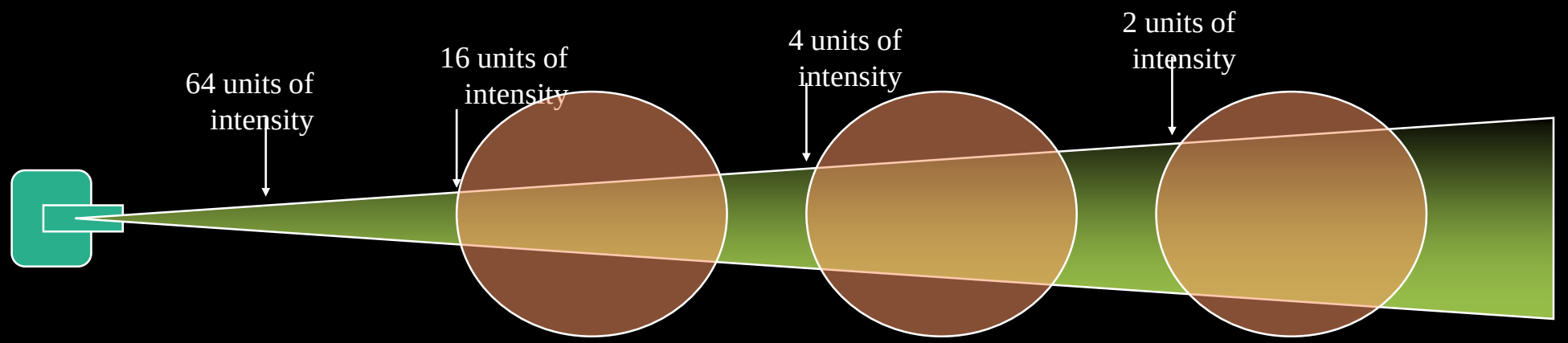
- Patient is irradiated by the direct beam
- Medical personnel is irradiated by the scatter radiation
- Patients may undergo repeated radiation procedures
- A patient may receive in one procedure a dose equivalent to dose the staff may receive in one year

Room setup factors

- Type of fluoroscopy unit – Digital vs. conventional
- Position of X ray tube “overcouch” vs. “Undercouch”
- Height - Distance between the patient and the X ray tube
- Distance between the X ray tube and staff

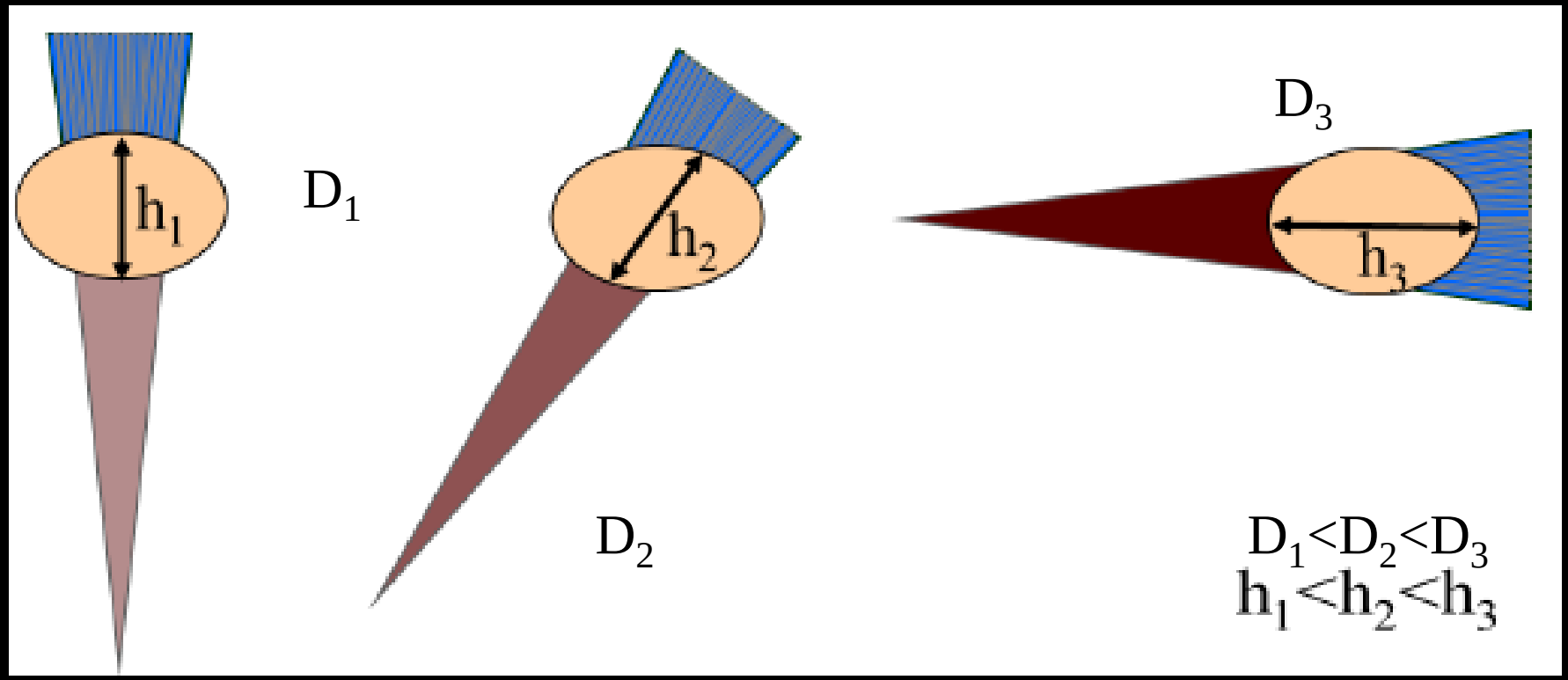
Inverse Square Law

- All other conditions unchanged, moving patient toward or away from the X ray tube can significantly affect dose rate to the skin.
- Increasing the distance by a factor of 2 will decrease the dose by a factor of 4.



Lesson: Keep the X ray tube at the practicable maximum distance from the patient.

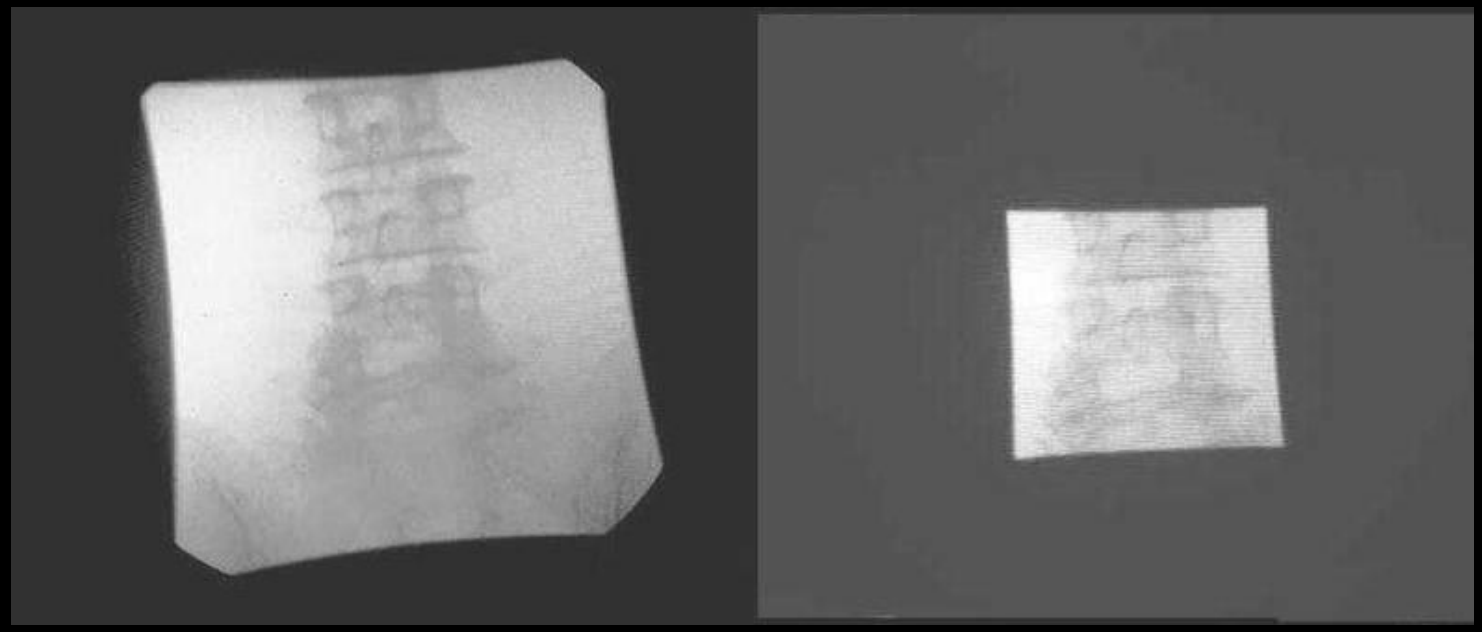
Beam angulation



Be aware of tube angulations. More oblique beams give higher dose rates.

What does collimation do?

Collimation confines the X ray beam to an area of the user's choice.



Collimation

Why is narrowing the field-of-view beneficial?

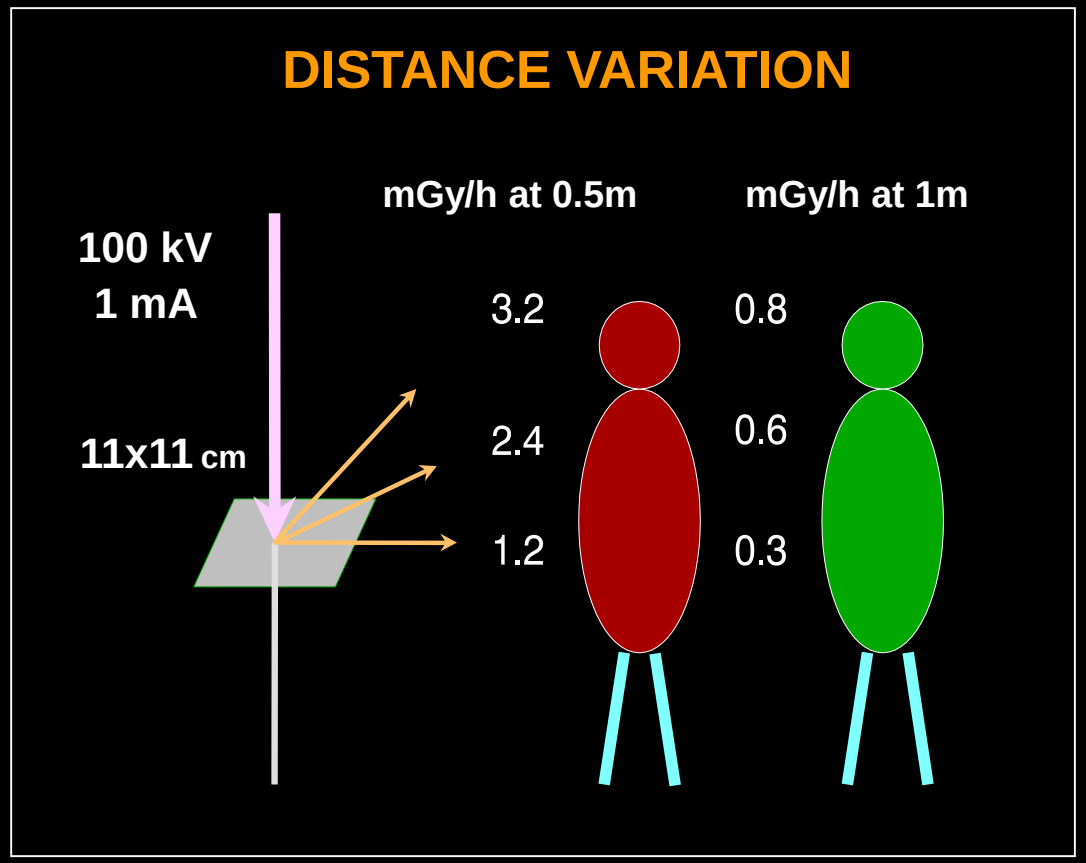
- Reduces stochastic risk to patient by reducing volume of tissue at risk
- Reduces scatter radiation at image receptor to improve image contrast
- Reduces scatter radiation to in-room personnel
- Reduces potential overlap of fields when beam is reoriented

Factors affecting staff doses

- The main source of radiation for the staff in a fluoroscopy room is the patient (scattered radiation).
- The scattered radiation is not uniform around the patient.
- The level of dose rate around the patient is a complex function of a great number of factors.



Staff Distance



Scattered dose rate is lower when distance from patient increases

Decrease Fluoroscopy Time

- Limit the “beam-on” time to the shortest necessary to effectively complete the procedure.
- The dose relation with time in linear .

- Time ↓



Dose ↓

Interventions to Reduce Dose

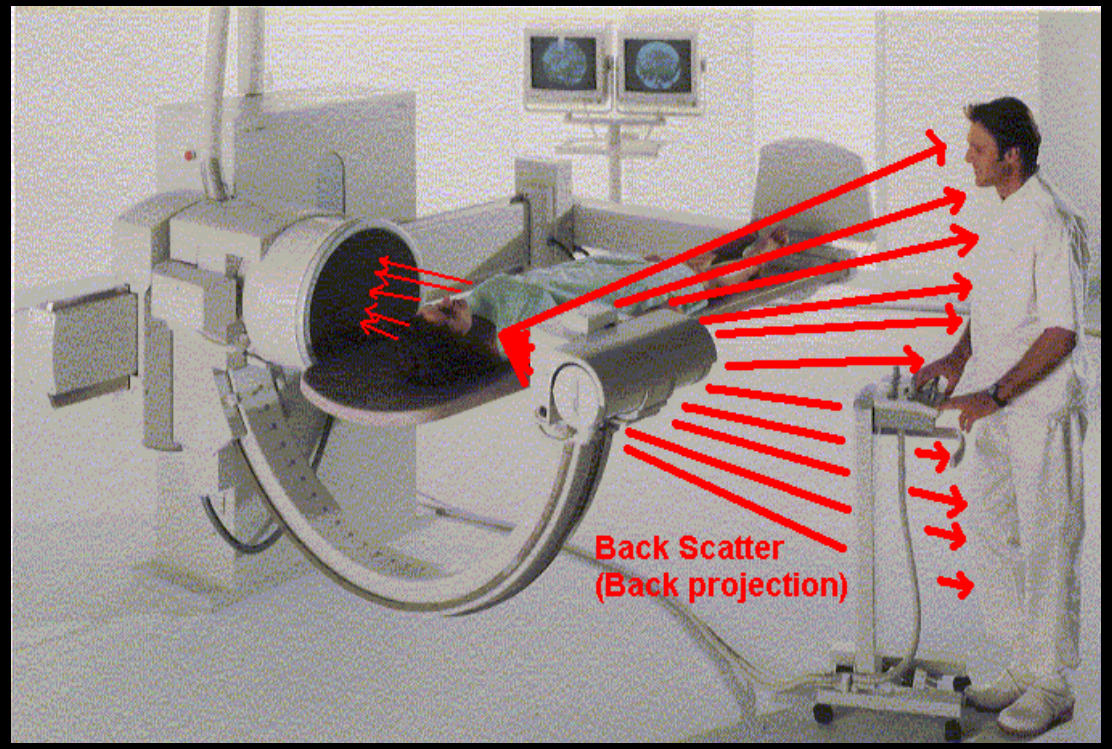
- Personal Protection
  - Lead Apron with lead equivalence of 0.25-0.5 mm (>90% protection from scattered radiation)
  - Eyewear
  - Thyroid
  - Gloves





Positioning

Operator should stand on Image Intensifier side if possible



High scatter to operator!
AVOID THIS POSITION IF POSSIBLE

Entrance Dose to Patient vs. Imaging Geometry

(GOOD Practice) **(BAD Practice)**

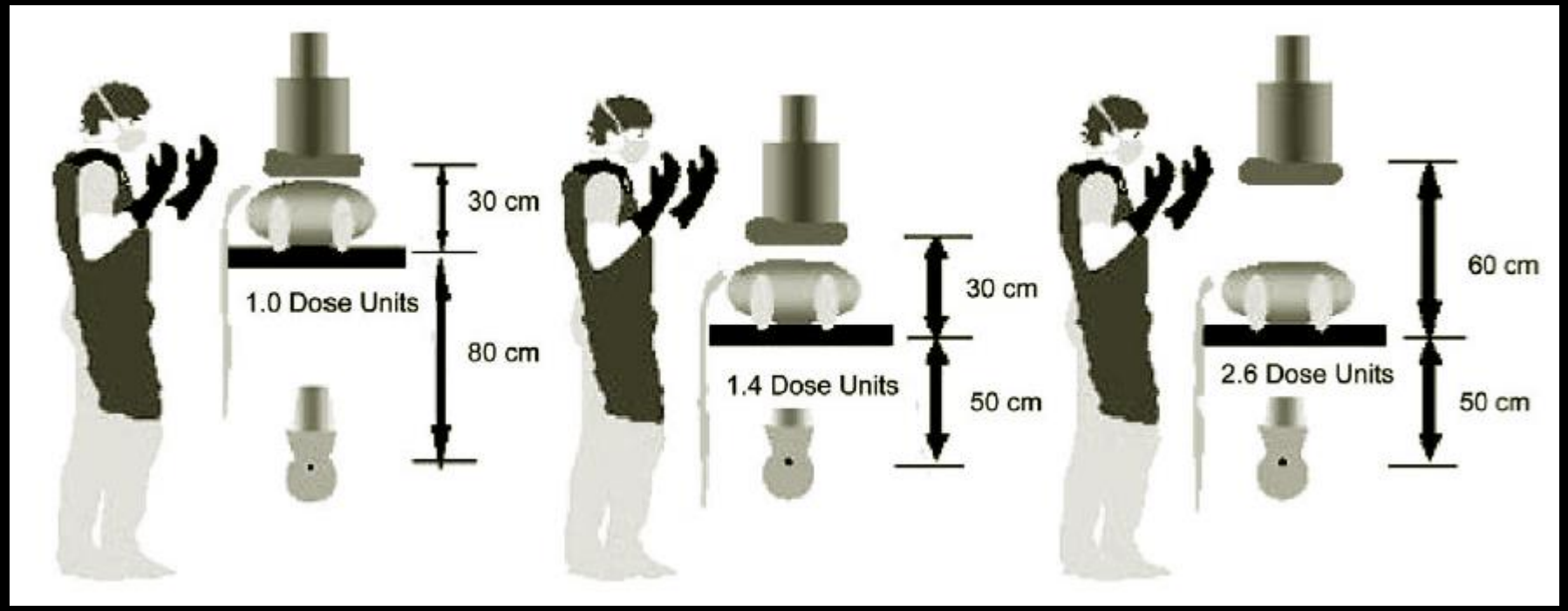


Image Intensifier close to patient, X ray tube far from patient

Image intensifier far from patient, X ray tube close to patient

Thanks for your kind attention