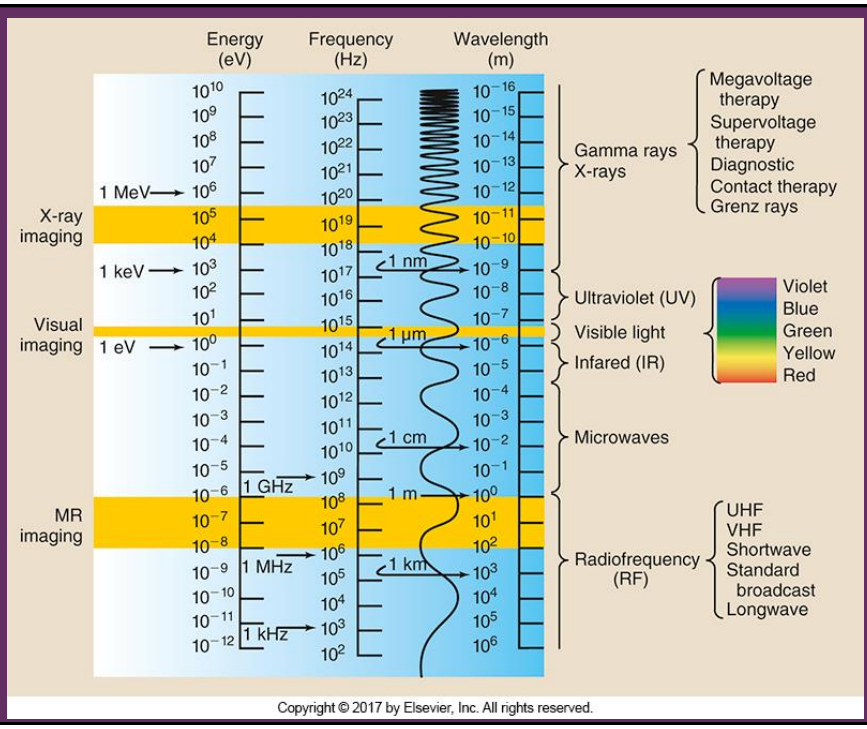
# Introduction to Radiation Safety

Fluoroscopy for Physician Assistants



## Radiation: What is it?

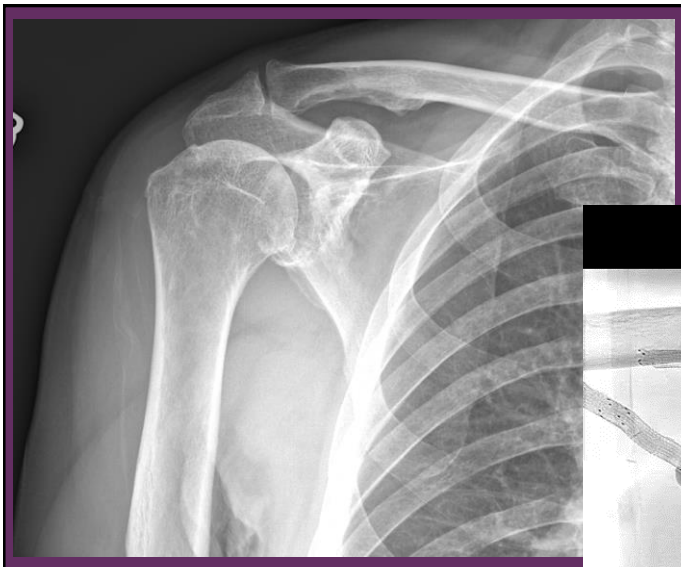
- Radiation, according to the World Nuclear Association, is defined as "…energy traveling through space." (http://www.world-nuclear.org/nuclear-basics/what-is-radiation.aspx)
- Radiation is in our environment
- In the form of electromagnetic radiation such as radio-waves, microwaves, and visible light
  - Naturally occurring
  - Man-made





# Radiation Production

- X-rays are made using an x-ray tube
- X-ray photons exiting the tube interact with patient tissues to form x-ray images
  - The images could be static (still images) or dynamic (moving as in fluoroscopy)
- In either case, x-ray photons can scatter from the patient as much as 6 feet (sometimes more)
- Other people in the room may receive x-ray exposure because of the scattered radiation





# Ionizing Radiation

- Ionizing radiation is potentially dangerous to patients and personnel
- The energy of the x-ray photon is transferred to the outer shell electron of the tissue atom
- That electron is then ejected out of its orbit and the atom is now ionized
- Ionizing radiation in high amounts (high doses) has been shown to cause temporary or permanent effects to the human body

## Ionizing Radiation (cont)

- These effects can include radiation burns, hair loss, cataracts, and cancer
- In the human population there *could* even be genetic effects in future generations
- Mostly, these effects require large amounts of radiation for them to occur
- However, in the long term we don't know (nor can we predict) what happens with smaller doses of diagnostic radiation



## Ionizing Radiation (cont)

- We have all heard about radiation disasters that took place in such cities like Hiroshima, Chernobyl, and Fukushima
- Populations in these areas were exposed to massive amounts of ionizing radiation
- This radiation destroyed tissue, immune systems, and in many cases people died from their injuries due to the exposure
- The unit of measure for the EfD in humans is the rem or the Sv

# Exposure to Patients & Personnel

- Keep in mind the patient is always receiving the highest amount of radiation
- While the patient is undergoing a fluoroscopic procedure ***personnel are still exposed to radiation***
- Personnel exposure is primarily due to scatter radiation from the patient



# Exposure to Patients & Personnel

- Radiation dose from scattered x-ray photons is about 1/1000 of what the patient receives
- While these doses are very small, there is still the potential of a long-term effect
  - A long-term effect is one that appears many years after someone has been exposed
  - Examples of long term effects are cataracts and cancer

# ALARA

- Stands for “As Low As Reasonably Achievable”
- This is the basis of the principle of radiation safety and radiation protection
- Radiation protection to patients and personnel is crucial as we must protect against all levels of radiation exposure
- Like repeated exposure to the sun, exposure to radiation is cumulative



# ALARA (cont)

- In certain situations, patients may suffer skin burns or hair loss with diagnostic or interventional procedures
- The primary radiation safety factors
  - Time
  - Distance
  - Shielding
- X-ray field size also has an impact on exposure

# ALARA (cont)

- What are some things we can do?
  - Ensure you state “X-ray!” prior to exposure
  - We use the smallest x-ray field possible
    - Production of scatter radiation is diminished
  - We provide gonadal shielding for the patient
    - We can also use shielding for sensitive tissues
  - We use leaded protective apparel any time we use fluoroscopy
    - Protective aprons, thyroid shields, leaded eye-wear, etc.



# Radiation Protection

- Radiation protection practices must be in place at all times
- We must ensure those who are in the room during the fluoroscopic procedure are not exposed to unnecessary radiation
- Our job and duty as the operator to use the least amount of radiation possible to get the information needed

## Radiation Protection (cont)

- In addition to abiding by ALARA, those of us using mobile equipment (this includes mini c-arms and full-size c-arms) must be monitored
- If we have the potential of receiving 1/10 of the annual Effective Dose Limit for occupationally exposed individuals, we must be monitored
- Radiation monitoring is the law so we must be wearing a radiation dosimeter



## Radiation Protection (cont)

- Radiation dosimeters are issued by your department
- Dosimeters are designed to estimate any radiation exposure you receive in the course of your job
- The dosimeters are changed out monthly and reports are generated
- The dosimetry reports are reviewed by a Radiation Safety officer at your facility

## Radiation Protection (cont)

- In addition to radiation dosimetry, protective apparel and gonadal shielding are evaluated once per year and tracked
  - Usually performed by the Imaging Department
- Protective apparel and gonadal shielding are x-rayed to check for integrity of the lead
- Proper lead care is critical to maintain
  - Do NOT fold aprons or shields – ***DO lay them flat or hang on a specially made rack***



## In Conclusion

- Diagnostic amounts of radiation have the *potential* of causing tissue damage
- Generally speaking, we cannot see any immediate damage when performing routine x-rays or general fluoroscopy
- Our duty as fluoroscopy operators is to limit the amount of radiation used
- We must protect our patients and ourselves from unnecessary amounts of radiation

There is an online quiz associated with this module that must be passed prior to conducting any fluoroscopic procedure.
E-mail me for the password.