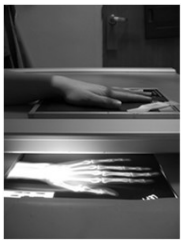
MI123: Clinical Seminar I
Lecture #1

1

How Do X-Rays Work?

- X-rays are produced within the x-ray tube
- X-rays exit the tube through the air and come into contact with the body
  - Pass through soft tissue, skin, organs (darker shades)
  - Become absorbed within dense materials such as bone (whiter shades)
- *Plain Film* VS *Fluoroscopy*
  - Plain film – anatomical, still imaging
  - Fluoroscopy – functional, live imaging



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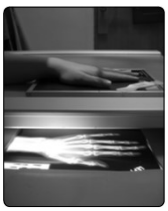
How Do X-Rays Work?



4 requirements for production of x-rays:

- Vacuum (tube housing)
- Source of electrons (filament)
- Method to accelerate the electrons (voltage) rapidly
- Method to stop the electrons (target)

- Primary Radiation
- Remnant Radiation
- Scatter Radiation

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X-Ray Tube/Console Terminology

- mA (milliamperage)
  - Measurement of x-ray tube current or the number of electrons crossing the tube from cathode, this is a unit selected on the operating console
- mAs (milliampere seconds)
  - mA X seconds= mAs
  - Controls the amount of radiation produced by the x-ray tube
  - Affects quantity of x-rays
- kVp (kilovoltage peak)
  - Maximum possible energy of a photon that exits the x-ray tube, this is a unit selected on the operating console
  - Affects quantity and quality of the x-ray
- AEC (Automatic exposure control)
  - The cells that are selected on the operating console that will automatically select the mAs according to cell selection and body part

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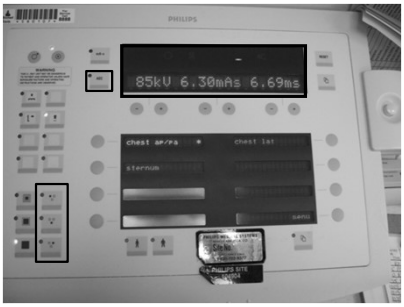

- kVp (kilovoltage peak)
- mA (milliamperage)
- mAs (milliampere seconds)
- AEC (Automatic exposure control)

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Image Receptor (IR)

- Device that receives the energy of the x-ray beam and forms the image of the body part
  - *Film-Screen*
  - *Digital Cassette Systems* (CR)
  - *Solid State Digital Detector* (DR)
  - *Fluoroscopy Screen*

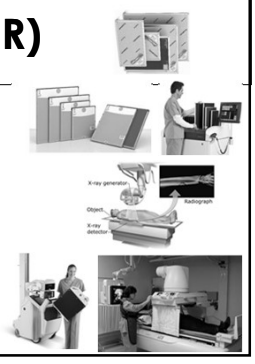

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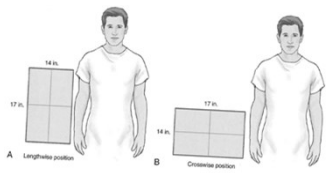
Image Receptor Orientation & Size



Portrait Landscape

- Orientation – arranged to the patient's anatomy
  - Portrait (Lengthwise)
  - Landscape (Crosswise)
- Cassette Sizes
  - 14 x 17
  - 10 x 12
  - 8 x 10

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Table

- Motor Driven/Manual/Floating
- Characteristics of a table:
  - Must allow X-rays to pass through
  - Easily Cleaned
  - Hard to Scratch
  - Without Crevices
- Fixed or Tilting
  - 90-90, 90-45, +90/-20

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Tube Supports/Terminology

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Upright Units

- Upright image receptor
- Ancillary piece of equipment

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Overhead Tube Suspension

- Also known as **ceiling suspension**
  - Most flexible
  - Most costly

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Floor-to-Ceiling

- Rails on floor and ceiling
- Longitudinal positioning

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Floor Suspension

- Tube support column mounted on floor
- May have railing for longitudinal positioning

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C-Arm Equipment

- Tube and image receptor are aligned in a "C" shape
- Operating Room and at Exeter Imaging Center

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Portable Equipment

- Used to perform mobile imaging for patients that are too sick to come to the department

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Specialized Diagnostic Equipment

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Mammography

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Tomography

Tube and image receptor move during the exposure to blur out the surrounding areas

Focuses on anatomy of interest

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Head Units

Used to perform Erect headwork procedures

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Panoramic Dental & Facial Units

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Computed Tomography (CT)

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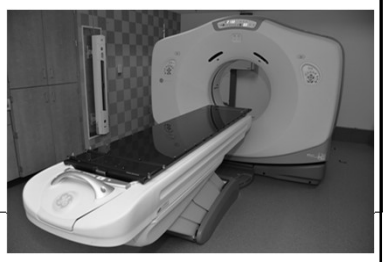
Radiation Therapy Simulators



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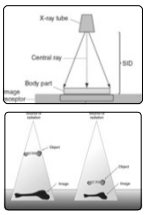
Additional Terminology



- *SID (Source to Image Distance)*
  - Distance from the x-ray tube to the image receptor
    - Affects magnification, detail, density, dose to the patient
    - Larger the SID the less magnified the image
- *OID (Object to Image Distance)*
  - How far the body part is away from the image receptor
    - Farther away the body part from the image receptor the more magnified the anatomy

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Radiation Protection

- ALARA
  - Cardinal Principles
    - Time
    - Distance
    - Shielding
  - Radiation Monitoring

* *Policy*: Minimizing Patient Dose during X-ray Imaging Procedures
https://tth.ellucid.com/documents/view/12708

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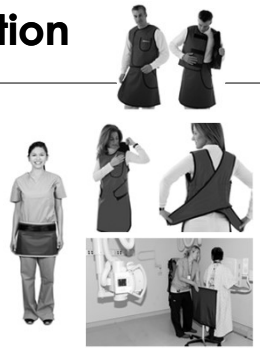
Radiation Protection

- Shields
  - Self/others
  - Patients
    - Placement considerations



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Contrast Media

- Utilized to visualize anatomy that could not otherwise be seen on x-ray

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Emergency Equipment

Equipment in x-ray rooms
- Blood pressure cuff
- Stethoscope
- Oxygen
- Suction
- Buttons in rooms

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Emergency Malfunctions

- Breakers
- Report:
  - To Supervising Technologist and Manager of the area
  - To your Clinical Faculty

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Standard Precautions

Precautions to prevent the transmission of disease by body fluids and substance

- Specific with items such as exposure to:
  - Blood
  - All body fluids
  - Secretions and Excretions (except sweat)
  - Non-intact skin
  - Mucous membranes

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Handwashing

Assessment 6/14/21

Single most important means of prevention of spread of infection

- Handwashing performed before and after patient interactions
- Nails (Fingernails, polish and enhancements) *Policy**

https://tth.ellucid.com/documents/view/6239

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Personal Protective Equipment (PPE)

Equipment provided to the health care worker to provide a barrier between the patient and the health care provider to prevent exposure to the skin and mucous membranes.

- Gloves
- Gowns
- Masks
- Eye wear

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Donning/Removal Sequence

Donning

- Gown
- Mask
- Goggles
- Gloves

Removal

- Gloves
- Goggles
- Gown
- Mask

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Transmission-Based precautions

- Airborne
- Droplet
- Contact
- RH has Additional Hand and Environmental Contact Precautions
- *Enhanced Precautions (COVID-19)

- Applied when a patient is infected with a pathogenic organism or a communicable disease

OR

- When patient is at risk of becoming infected, such as immunosuppressed

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Contact Isolation

Need **gloves** and **gown & hand hygiene**

- For the following:
  - Methicillin Resistant Staphylococcus Aureus (MRSA)
  - Vancomycin Resistant Enterococci (VRE)
  - Lice
  - Scabies
  - Respiratory Syncytial Virus (RSV) (for pediatric patients)
  - Multi-Drug Resistant Organism (MDRO)
  - Impetigo
  - Varicella

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Droplet Isolation

Need a **regular mask & hand hygiene**

- For the following:
  - Influenza
  - Meningitis
  - RSV
  - Meninococcal meningitis
  - Mumps
  - Adenovirus

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Airborne Isolation

Need an **N95 mask & hand hygiene**

- For the following:
  - TB
  - Rubella (Measles)
  - Varicella (Chickenpox)
  - Fever with a rash of unknown origin
  - Disseminated shingles

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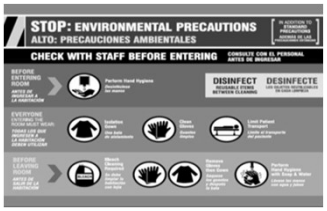
Additional Isolation Precautions

Need a **gown** and **gloves and hand hygiene**

- For the following:
  - Clostridium Difficile (C-Diff)
  - NoroVirus
  - Diarrhea of unknown origin



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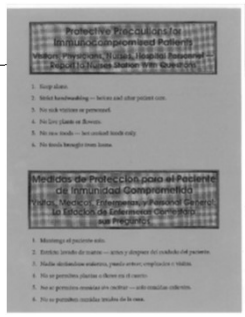
Reverse Isolation

Immunocompromised patients

- Need at minimum **handwashing** before and after leaving the room and mask
  - **Meet the needs of the patient***
  - OR **gloves, gown, mask**
- *Examples* of weakened immune system
  - AIDS
  - Transplant
  - Cancer



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Enhanced Precautions

COVID – 19

Need a **gown, mask, gloves, eye protection and hand hygiene**

- Airborne
- Contact
- Eye Protection

*N-95 Mask

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Software Systems

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Hospital Systems

- EPIC
- PACS
- iSite
- Primordial Communicator
- Teletracking
- RL Solutions
- Vocera

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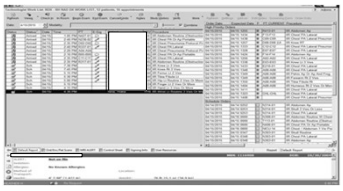
EPIC

- Electronic health records software ("One stop shop")
  - Assists in coordination of care, improved efficiency, lower health care costs
  - Utilized to check orders, allergies, medication lists, document histories…



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PACS

Picture Archiving and Communication System

- Manages images electronically
- Stores images
- Uses a network infrastructure to pass information
- Linked to the Hospital Information System (HIS) and all pieces of digital imaging equipment

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ISITE

- RH – PACS
- Radiologists view the images through iSite in order to provide a dictation
- Utilized to quality control (QC) your images before ending a procedure
- Review images after ending

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PRIMORDIAL Communicator

- Allows communication to occur between healthcare workers in the Radiology department
- Part of the iSite system
- Document verbal reports
- Radiology protocols
- Radiology Policies
- Radiology phone list
- EPIC guides
- Locate Radiologist/Others signed on to iSite

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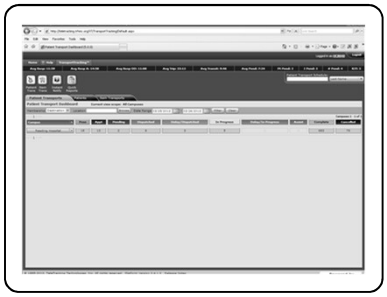
Teletracking

- Utilized to schedule inpatient transportation
  - To the department
  - Return to their rooms



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RL Solutions

- Online incident reporting
- Risk Management

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Vocera

- Wireless communication badge
- Used to streamline communication and improve workflow
- Notification of alerts
  - Internal/External
  - Emergencies

**Since it is wireless be aware of HIPAA

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Health Insurance Portability & Accountability Act

- Federal protection for patients' health information
  - http://www.hhs.gov/ocr/privacy/hipaa/understanding/consumers/index.html
- Covers all aspects of health information from hard copy to electronic

HIPAA
Health Insurance Portability and Accountability Act

Access to any patient information should only be obtained if there is direct contact with the patient and their care

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Imaging Fundamentals

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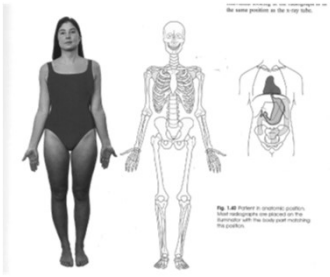
Anatomical Position



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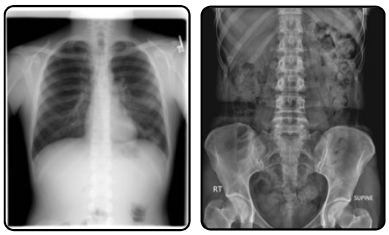
Display of Radiographs

- Images are oriented on the display as if the person were facing you
  - Their right on your left, and their left on your right



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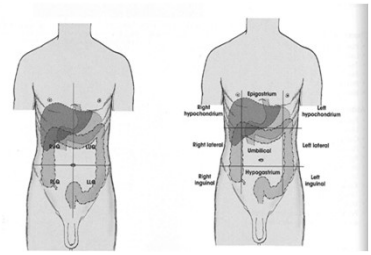
Anatomic Regions



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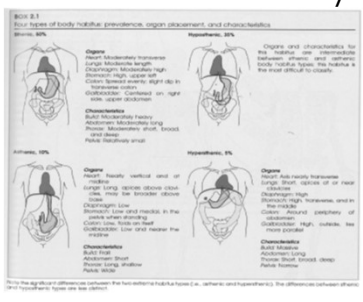
Body Habitus



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Body Habitus – Affect Within X-ray

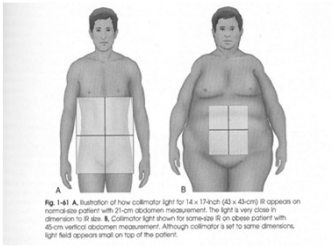

Fig. 1-61 A, Illustration of how collimator light for 14 x 17-inch (40 x 43-cm) IR appears on normal-size patient with 21-cm abdomen measurement. The light is very close in dimension to IR size. B, Collimator light shown for same-size IR on obese patient with 45-cm vertical abdomen measurement. Although collimator is set to same dimensions, light field appears small on top of the patient.

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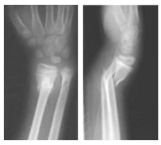
Radiographs

- Usually need at least **two** views
  - 90 degrees from one another due to anatomical superimposition



- Minimum 3 projections, when joints are prime area of interest
  - AP or PA
  - Oblique
  - Lateral

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Radiographs

Radiolucent vs. Radiopaque

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Technique Books

- Includes the proper techniques that should be utilized for various procedures
- Located in all radiographic rooms, as well as on the portables

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Patient Movement

Involuntary

- Peristalsis
- Heart pulsation
- Chill
- Tremor
- Spasm
- Pain

Voluntary

- Nervousness
- Fear
- Discomfort
- Excitability
- Mental illness
- Age
- Breathing

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Identification of Radiographs

Must include:

- Date
- Patient name and ID number
- Institution identity
- Right or Left marker

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Anatomic Markers

- Required by medicolegal requirements
- Typically made of lead and are included in the radiograph
- Right and left side of patient must be properly marked
  - Writing a R or L on the image post processing is not acceptable
  - Not recommended to electronically place an R or L due to error and legal implications
  - Exceptions are projections performed

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Basics of Marker Usage

- Always placed on the edge of the collimation border
- Always be placed outside of lead shielding
- Must be used, even on CR & DR
- Never obscure anatomy
- Never placed over patient ID

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