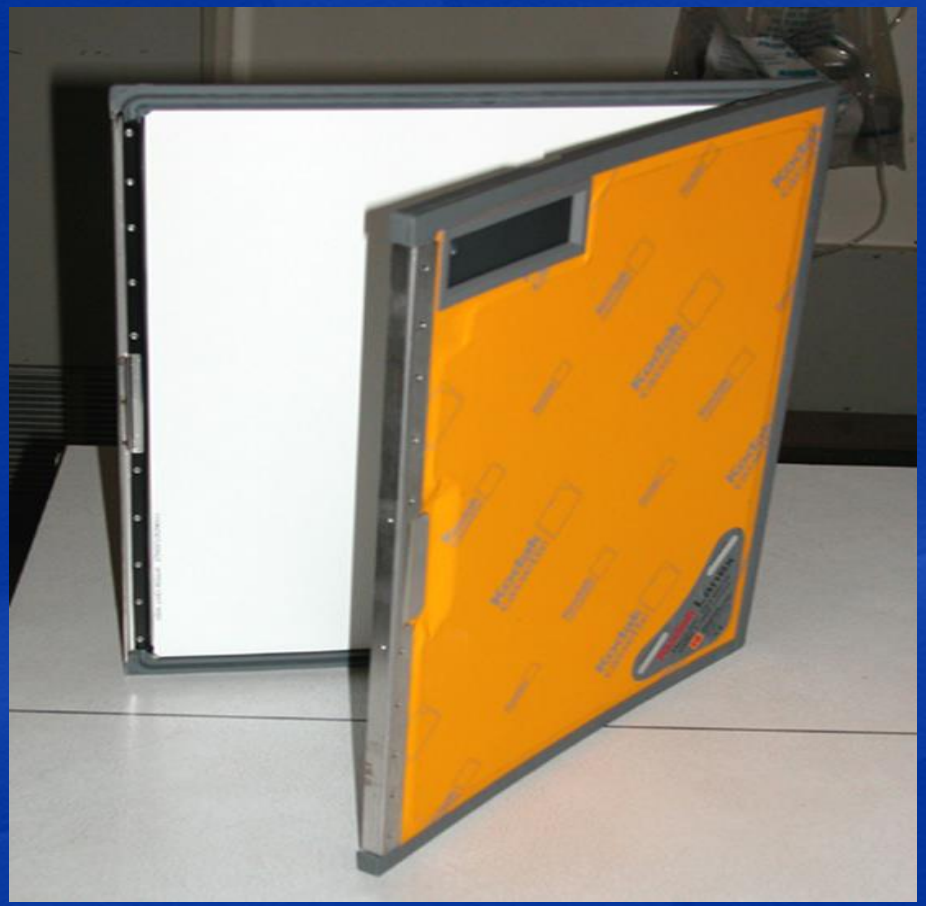
PHOTOSTIMULABLE PHOSPHOR



By:

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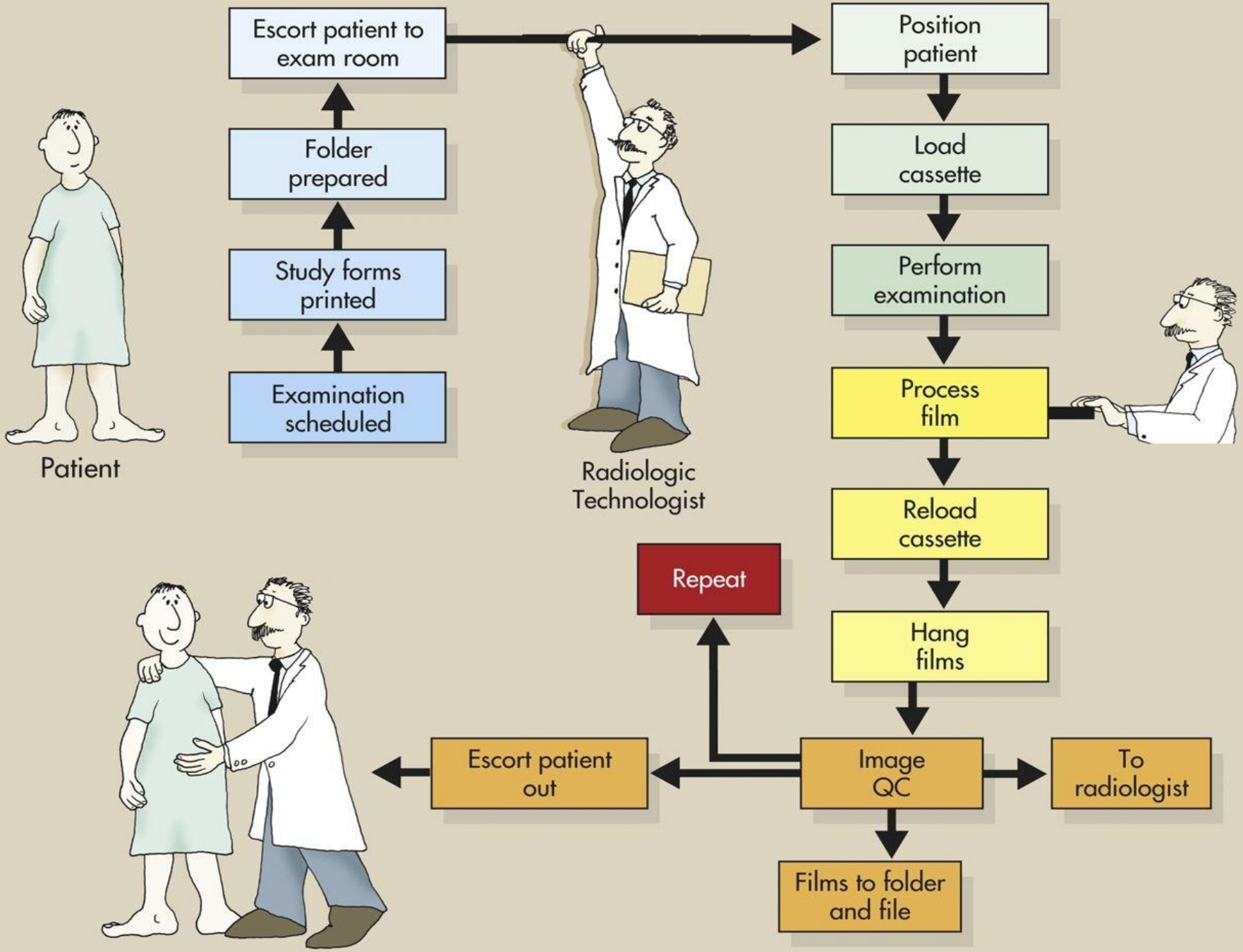
Introduction

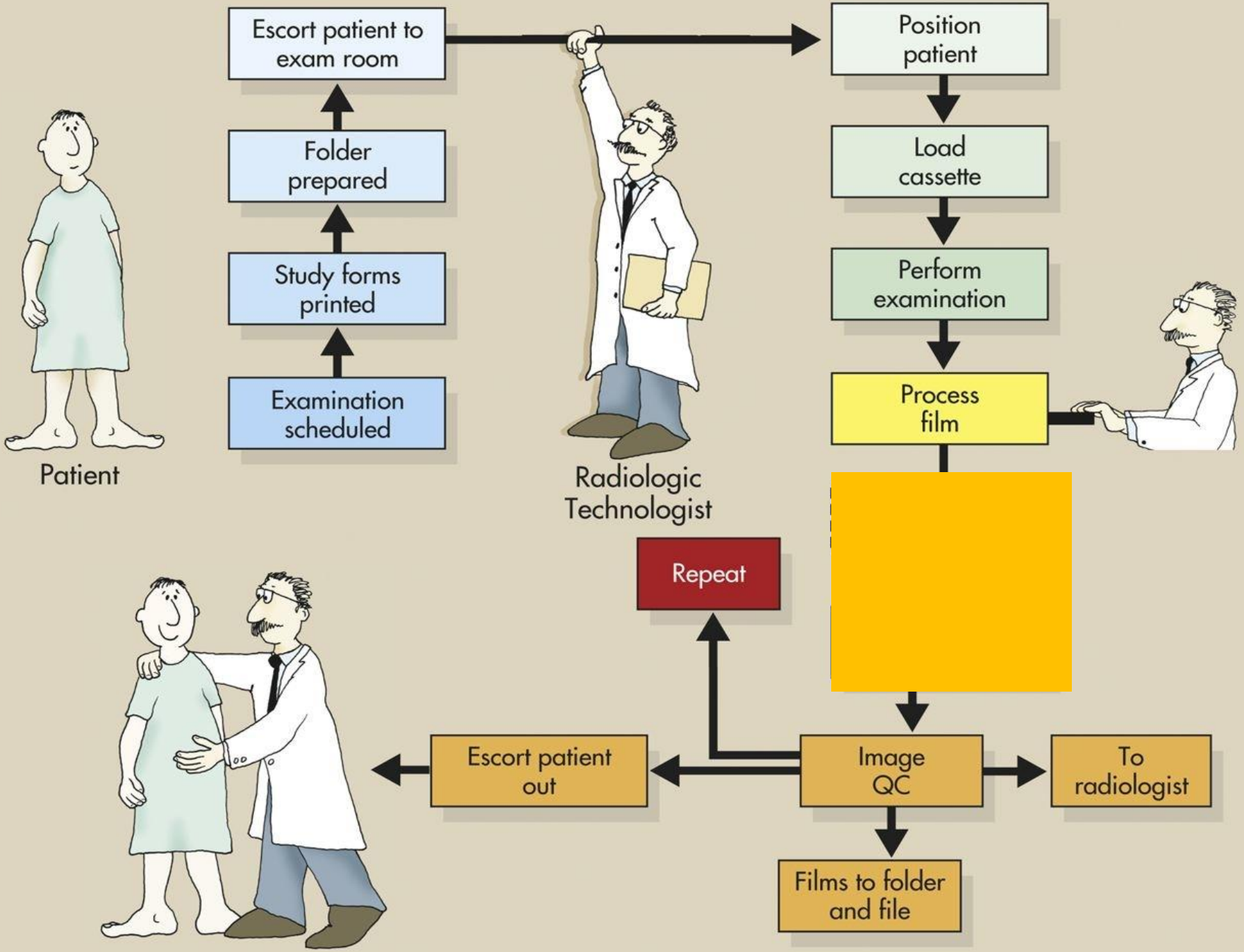
- Conventional radiography uses an x-ray intensifying screen, x-ray film, or both as the image receptor. The exposed film is then developed and viewed.
- Now, a process sometimes called computed radiography (CR) uses a photostimulable phosphor as the image receptor.
- A phosphor that is currently used is composed of europium-activated barium fluorohalide.
- The phosphor crystals are coated on a screen that looks like an intensifying screen and is contained in a cassette

- A radiographic exposure is made using conventional x-ray equipment.
- The photostimulable phosphor absorbs some of the energy in the x-ray beam and stores a portion of this energy to create a latent image.
- When this latent image is scanned by a laser beam, the trapped electrons are released with the emission of light.
- This light is viewed by a photomultiplier tube, and the output of the photomultiplier tube constitutes the signal.
- The signal is fed to a computer where it is processed and stored, and may be displayed. This technology is sometimes called "filmless," or "electronic," or "computed“ radiography.

- In radiology, there are two such applications. One is thermoluminescent dosimeter (TLD), in which the phosphor is encouraged to emit its light by heating.
- A thermoluscent dosimeter is a small chip of activated lithium fluoride that is exposed to radiation. The chip is then heated, and emits light in proportion to the amount of radiation it received (the term "thermoluminescence" indicates heating to liberate luminescence).
- The second application of phosphorescence is photostimulable phosphors as used in computed radiography

- The material used in one commercially available photostimulable phosphor is europium- activated barium fluoride bromide (BaFBr:Eu). Europium is an activator added to BaFBr.
- The reason for using an activator is to make traps at the activator site in the crystalline structure.
- In BaFBr:Eu, the image will be readable for up to about 8 hours at room temperature.


Escort patient to exam room
Position patient
Folder prepared
Load cassette
Study forms printed
Perform examination
Examination scheduled
Process film
Patient
Radiologic Technologist
Reload cassette
Repeat
Hang films
Escort patient out
Image QC
To radiologist
Films to folder and file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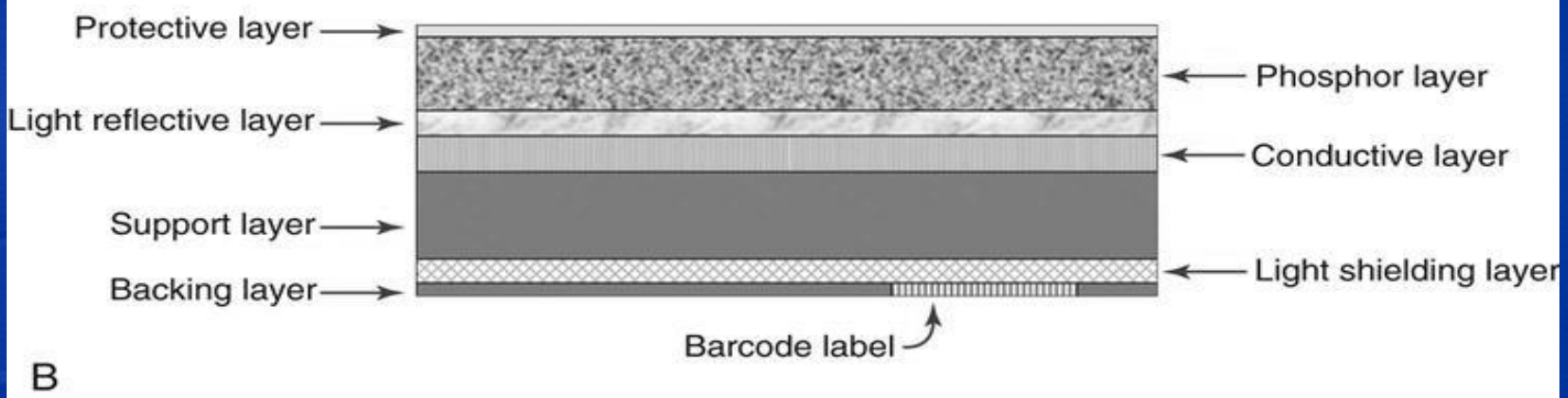
Construction

- In PSP systems, the radiographic image is recorded on a thin sheet of plastic known as the **imaging plate**.
- The imaging plate consists of several layers
- A **protective layer**. This is a very thin, tough, clear plastic that protects the phosphor layer.
- A **phosphor layer** (or active layer). This is a layer of **photostimulable phosphor** that “traps” electrons during exposure. It is usually made of phosphors from the barium fluorohalide family (e.g., barium fluorohalide, chlorohalide, or bromohalide crystals).

- A **reflective layer**. This is a layer that sends light in a forward direction when released in the cassette reader.



- A **conductive layer**. This is a layer of material that absorbs and reduces static electricity.
- A **support layer**. This is a semi-rigid material that gives the imaging sheet some strength.
- **A light shielding layer**. It prevents light from erasing any data and is sensitive to light.
- A **backing layer**. This is a soft polymer that protects the back of the cassette.

- Cassette-based PSP systems contain a window with a **barcode label** or barcode sticker on the cassette that allows the technologist to match the image information with the patient-identifying barcode on the examination request
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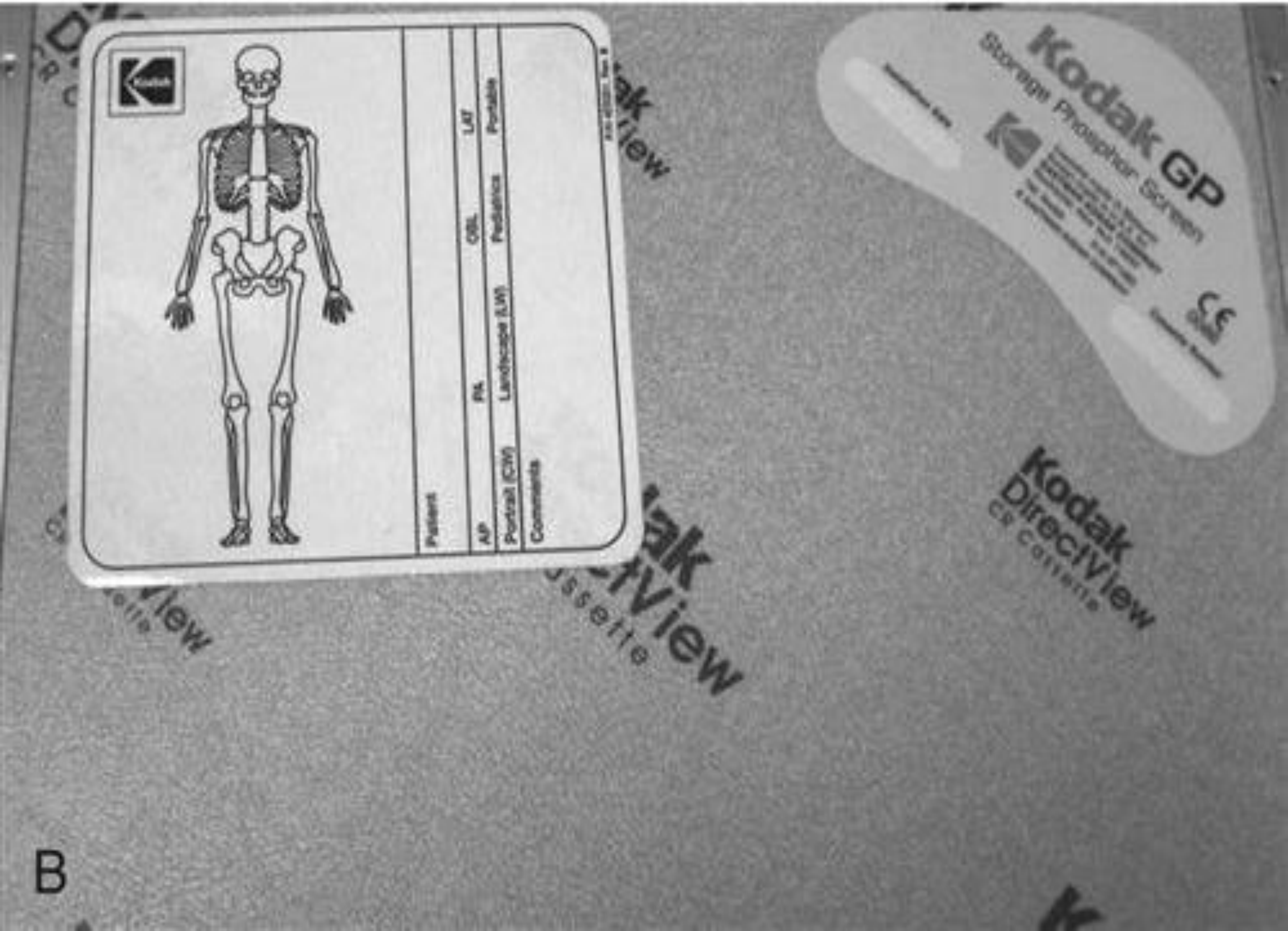
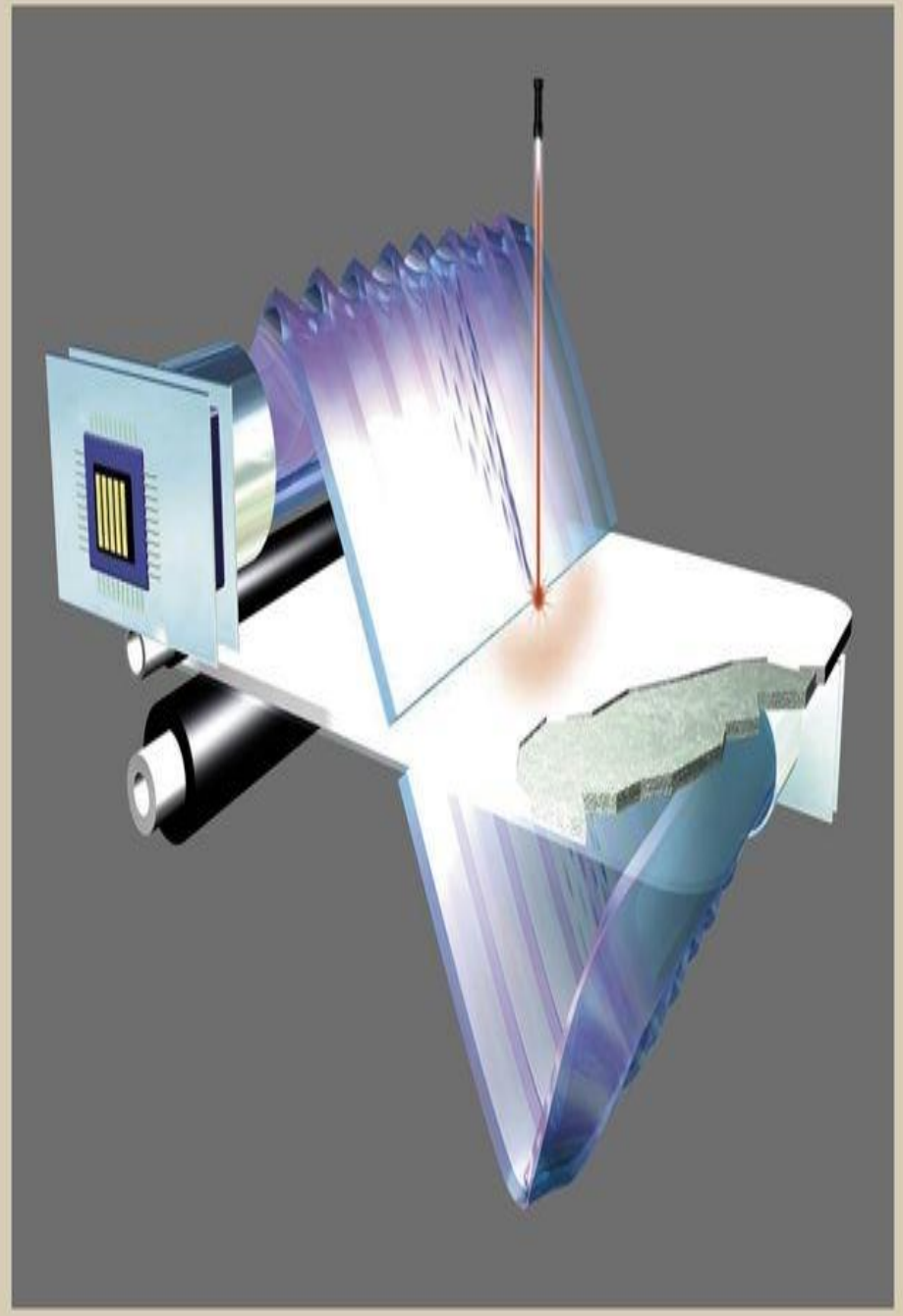
- The cassette-based system may also have a label such as a colored mark or sticker where applicable to indicate the appropriate orientation of the cassette in relation to the patient.
- When the cassette is oriented correctly, less image manipulation is required after processing. When the examination type is associated with the cassette, an automatic screen orientation of the image is built within the software.
- If the cassette was correctly oriented, the image will be displayed correctly; if not, the image will need to be rotated or flipped on the screen to display the image in correct anatomic orientation.


Kodak GP
Storage Phosphor Screen
Kodak
DirectView
CR Cassette
Patient
AP
PA
OBL
LAT
Portrait (CW)
Landscape (LW)
Pediatrics
Portable
Comments

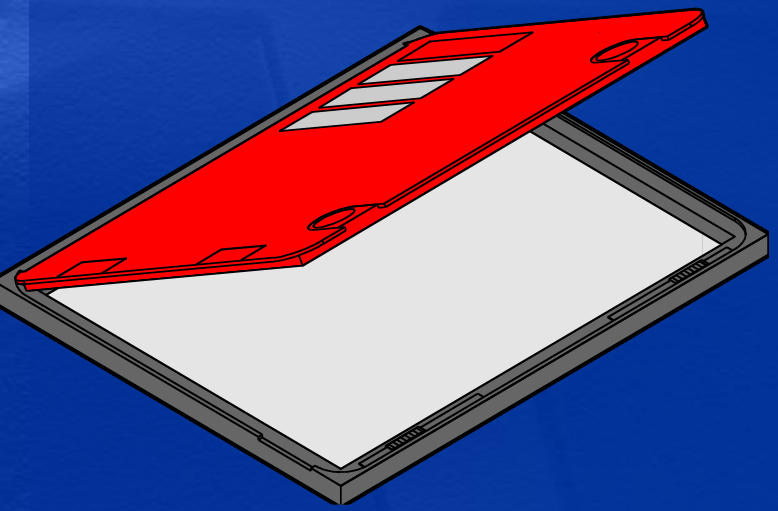
B


FUJIFILM
FUJI IMAGING PLATE
富士イメージングプレート ST-VI
CR Standard ST-VI
医療用 / Medical
Für medizinischen Gebrauch
Usage medical / Uso médico
Per uso medico / Para uso médico
25.2×30.3cm (10×12)



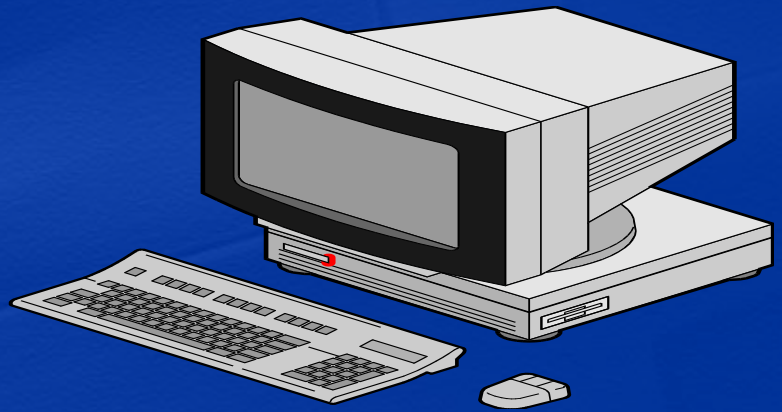
Basic Modules of CR

Cassette with Imaging Plate



Cassette Reader/Scanner

Processing Server



Film Printer

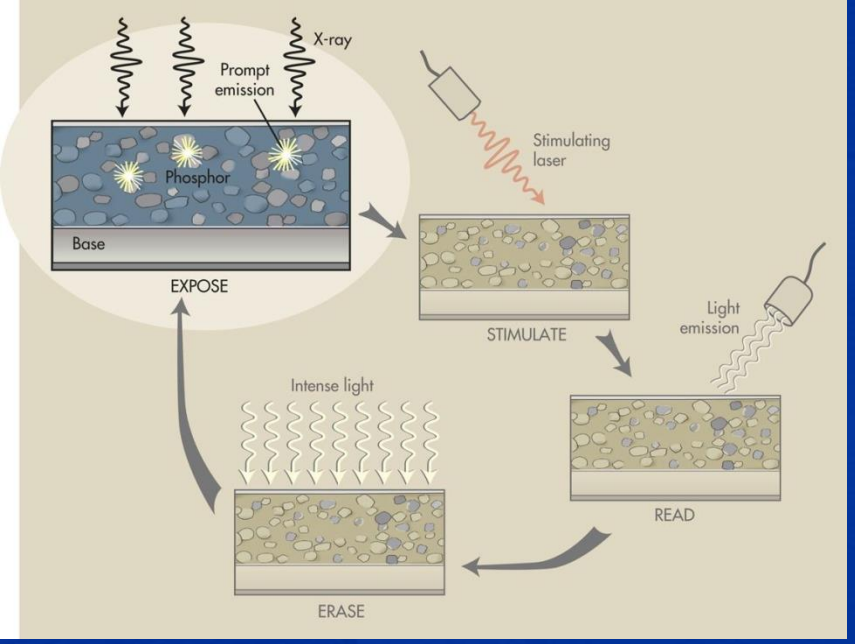
Sequence of events

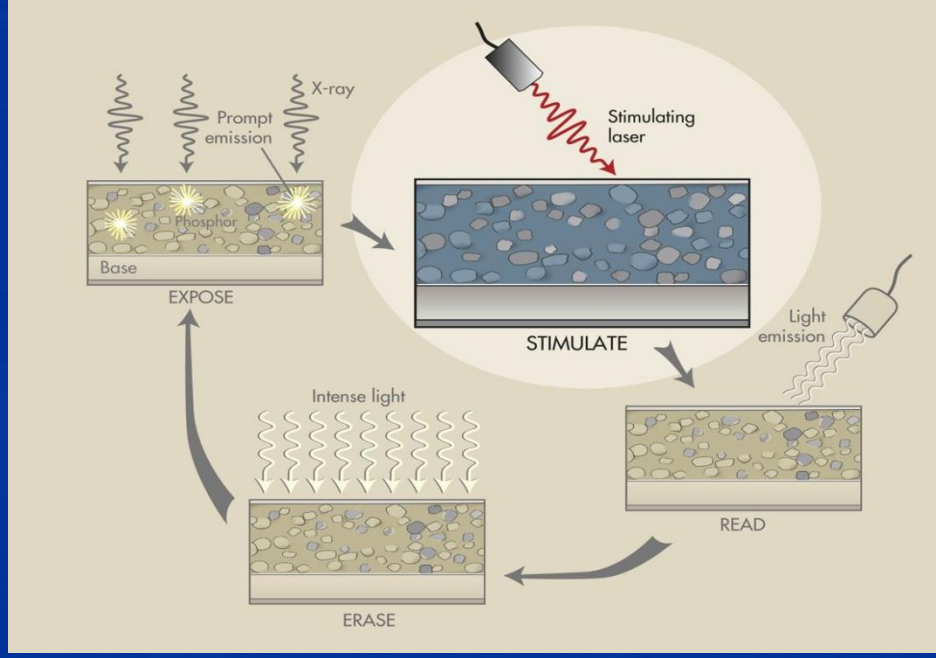
1.Expose- results into X-ray induced image (latent image)

2.Stimulate- stimulation of latent image results from the interaction of laser beam with PSP

3.Read- light signal emitted after stimulation is detected and measured

4.Erase- image will be automatically erased from the IP


X-ray
Prompt emission
Phosphor
Base
EXPOSE
Stimulating laser
STIMULATE
Light emission
READ
Intense light
ERASE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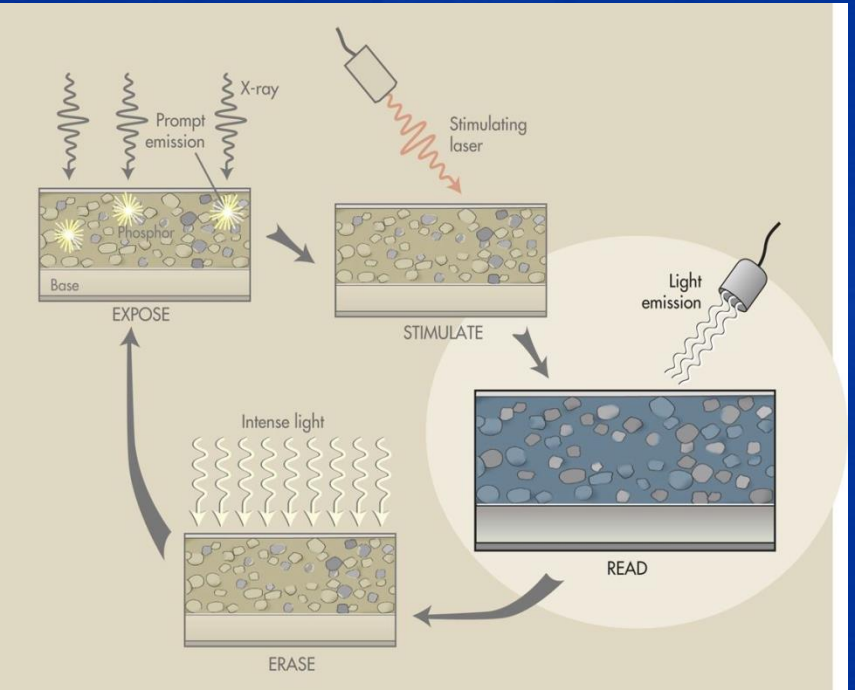
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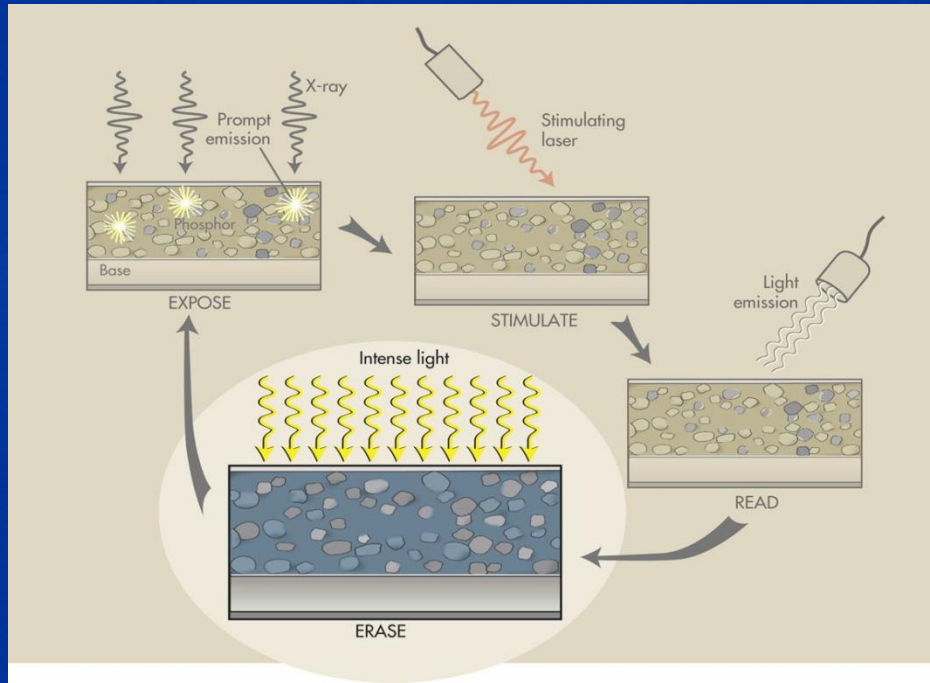
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Prompt emission
Phosphor
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EXPOSE
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Light emission
READ
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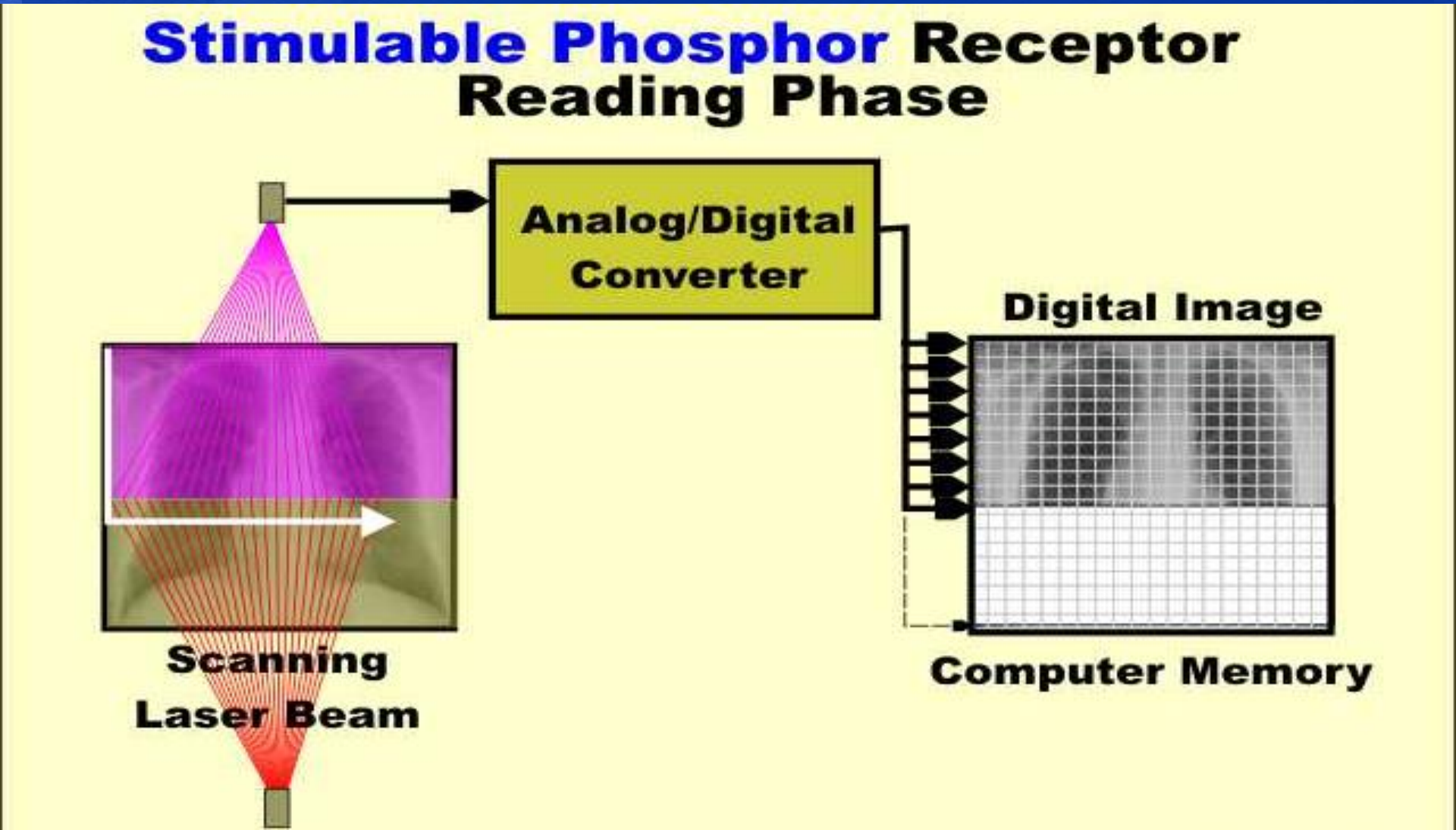
ERASE

Acquiring and Forming the Image

- With PSP systems, the patient is X-rayed exactly the same way as in conventional radiography.
- The patient is positioned using appropriate positioning techniques, and the body part is aligned with the image receptor.
- The patient is then exposed using the proper combination of kilovoltage peak (kVp), milliamperage seconds (mAs), and distance.
- In PSP, the X-ray beam interacts with electrons in the barium fluorohalide crystals contained within the imaging plate.
- This interaction stimulates, or gives energy to, electrons in the crystals, trapping them in an area of the crystal known as **phosphor center**.

- In fact, the trapped signal is never completely lost. That is, a certain amount of an exposure remains trapped so that the imaging plate can never be completely erased.
- However, the residual trapped electrons are so few in number that they do not interfere with subsequent exposures.

CR Readout


Stimulable Phosphor Receptor
Reading Phase
Analog/Digital
Converter
Digital Image
Scanning
Laser Beam
Computer Memory

The Reader

- There are two types of PSP readers: point scan and line scan.
- Point scan readers have an optical stage, a scanning laser beam, translation mechanics, a light pickup guide, a photomultiplier, a signal amplifier, and an analog-to-digital converter (ADC). At any point in time, only a single laser point radiates the imaging plate.
- Line scan readers are based on simultaneous stimulation of the imaging plate one line at a time, and with line scan readers, the acquisition of the photostimulated luminescence (PSL) occurs.
- PSL refers to the emission of light from the phosphor layer after stimulation by the relevant light source.
- With PSP systems, no chemical processor or darkroom is necessary. Instead, following exposure, the cassette is fed into a reader that removes the imaging plate and scans it with a laser to release the stored electrons.

Using the Laser to Read the Imaging Plate

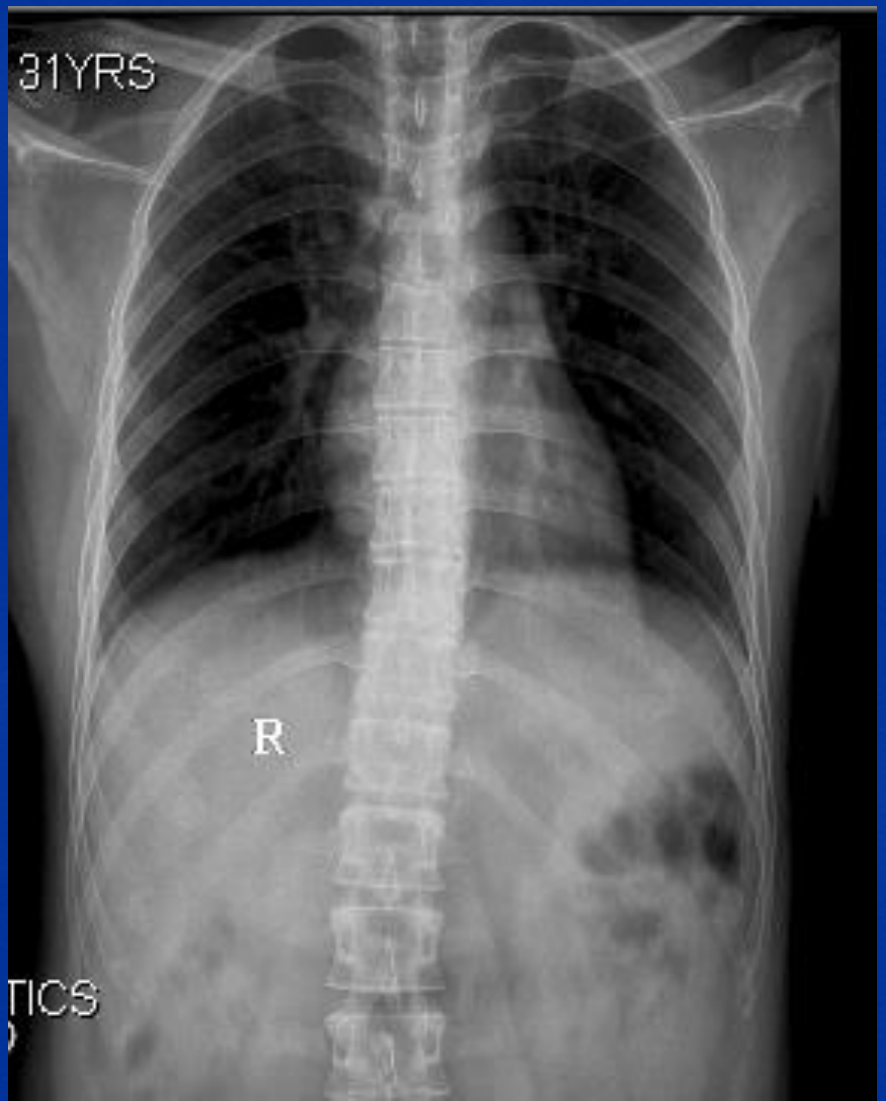
- During the reading process, the imaging plate is scanned with a helium laser beam. This beam, about 100 micrometers (μm) wide with a wavelength of 633 nanometers (nm), scans the plate with red light and gives energy to the trapped electrons.
- The red laser light is emitted at approximately 2 electron volts eV, which is necessary to energize the trapped electrons.
- This extra energy allows the trapped electrons to escape the active layer where they emit visible blue light at an energy of 3 eV.

Features of Digital X-ray

- Image enhancement
- Manipulation
- Printing
- Annotation
- Black border
- Panoramic dental package

Under/over exposure

Soft tissue and bone windows



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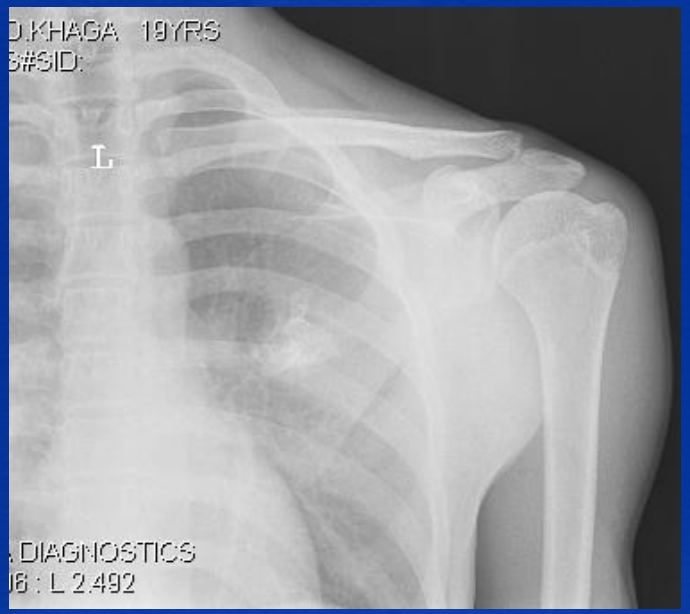

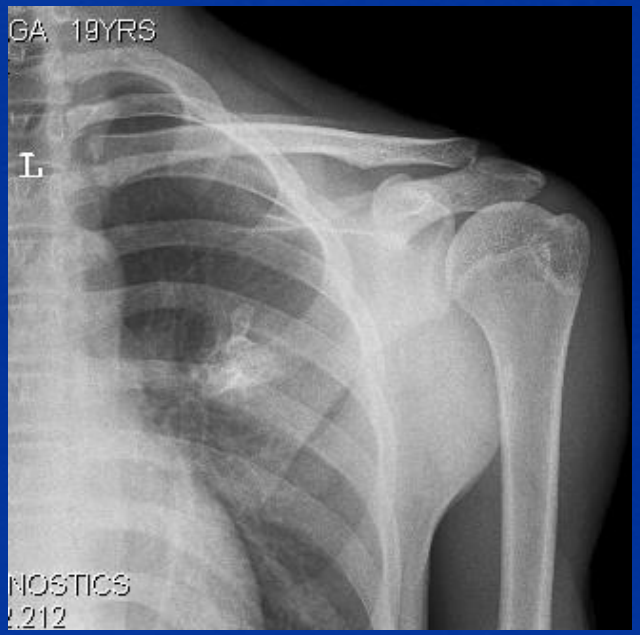

Zoom


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ACCES#SID:
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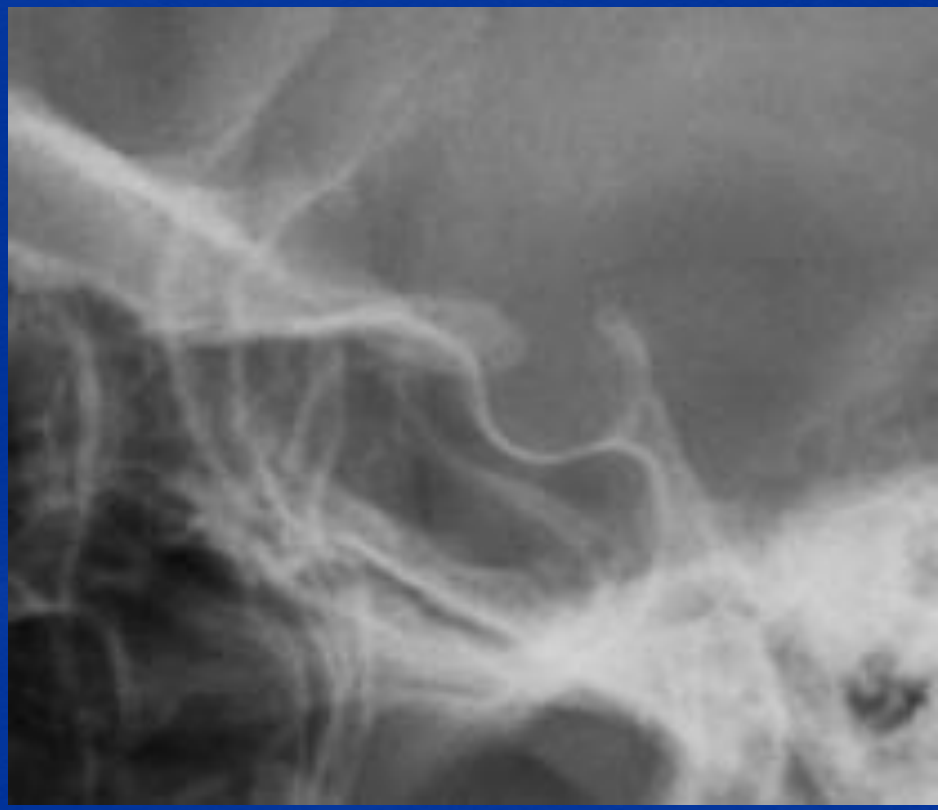
VIJAYA DIAGNOSTICS
W 1.195 : L 2.452



Collimation

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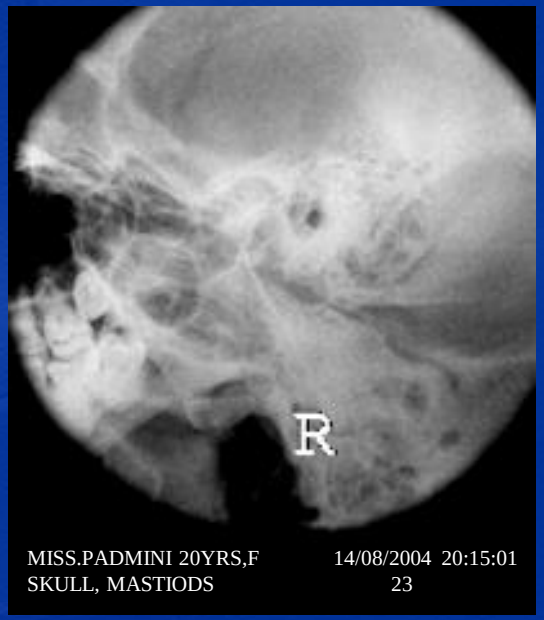
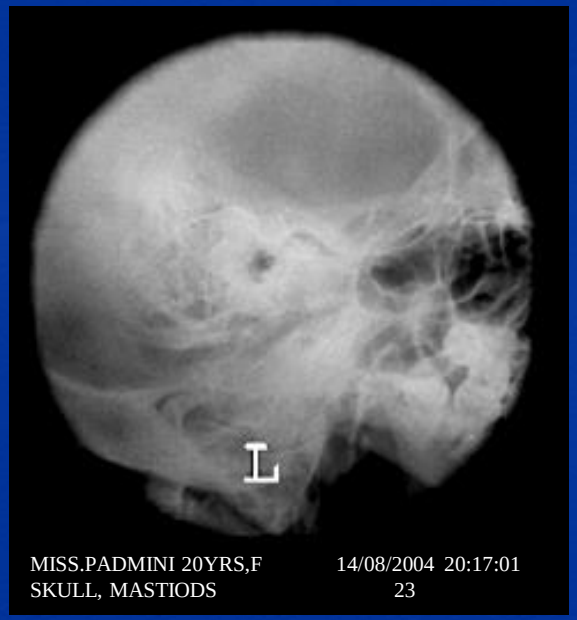
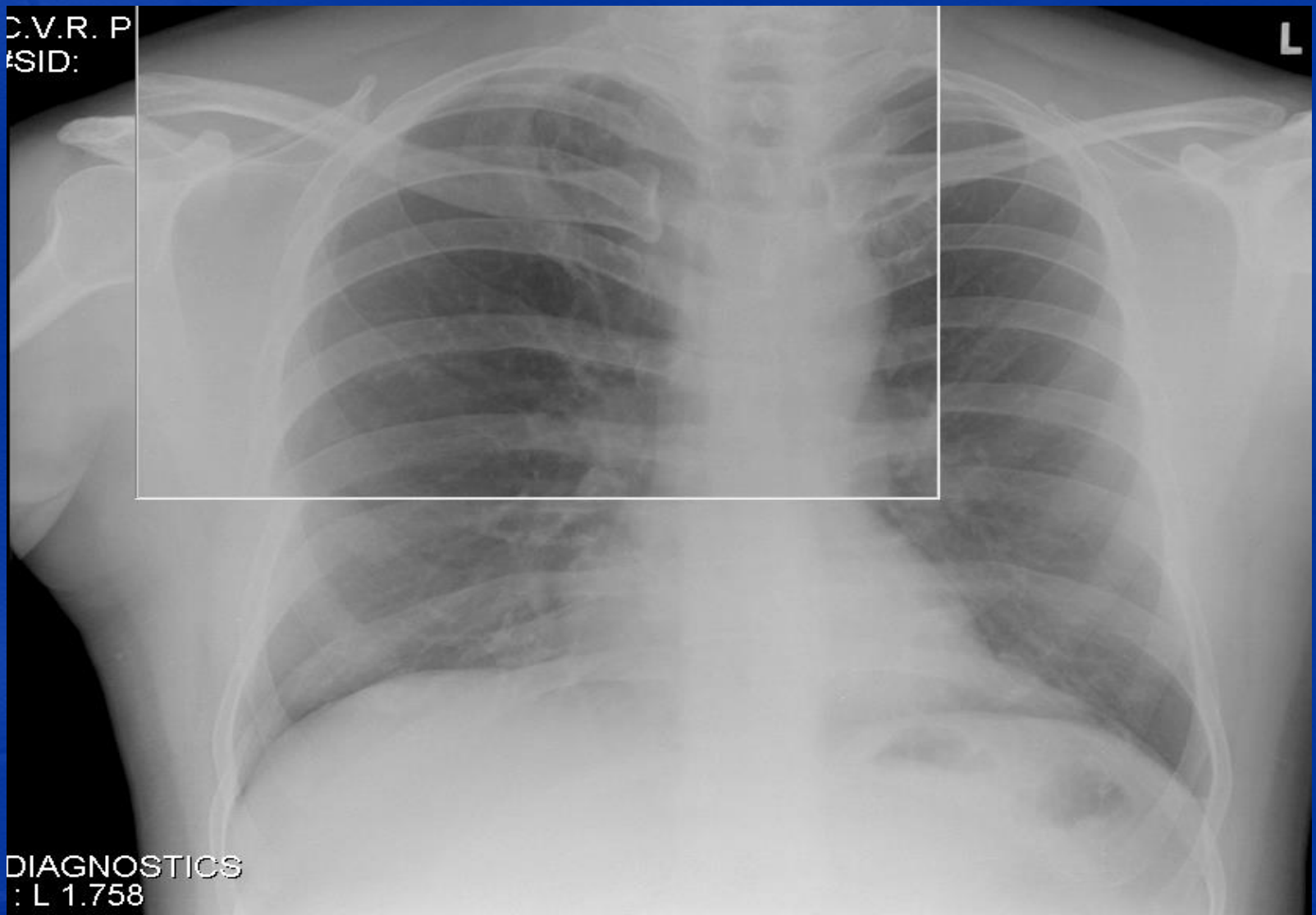




Magnifying glass

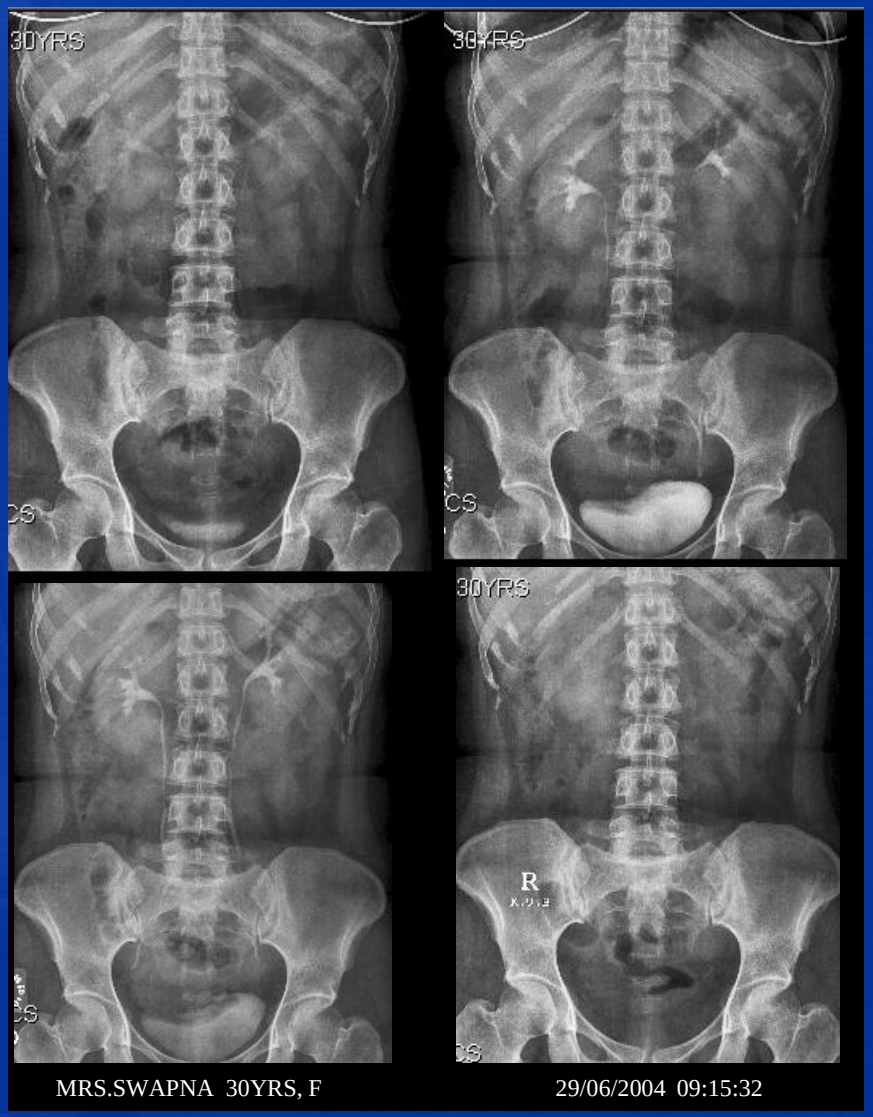


Invert image

Annotation

Vertical flip

Multiple images on single film



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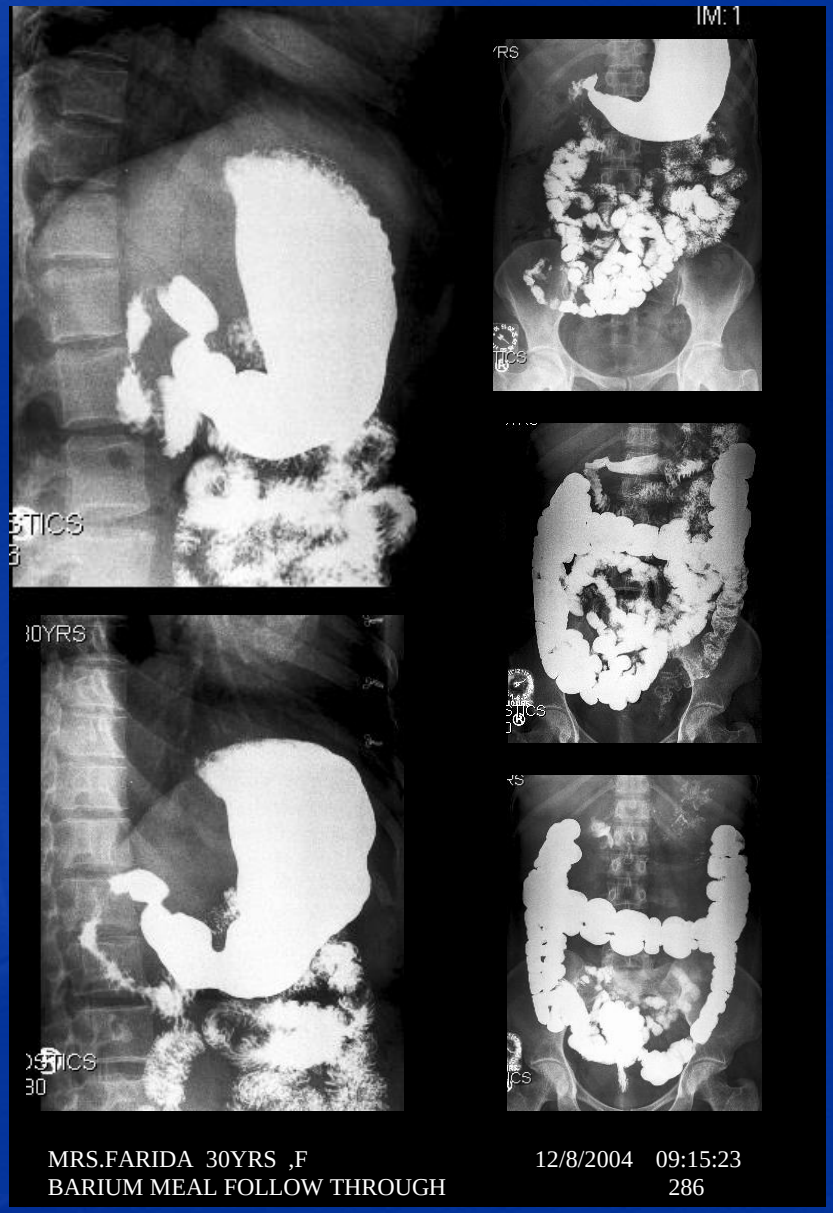

Care of IP

- Screens must be kept clean
- Any foreign material on screen such as paper, blood, scratches, hair dust, will block light photons and produce area of under exposure, leading to image artifact.