

# DIGITAL CHEST RADIOGRAPHY IN OCCUPATIONAL HEALTH

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# Introduction

- Digital radiography is rapidly replacing analog screen-film radiography in most applications including chest radiography
- +-80 % Radiology services in South Africa are using digital radiography.
- Digital radiography did not only improve communication between radiologists and Clinicians but improved image quality and a further reduction in patient radiation dose
- Advanced post processing including Computer aided diagnosis

# Chest radiography

- Chest radiography is the mainstay of chest imaging in occupational health despite the known diagnostic superiority and increasing availability of cross-sectional techniques like CT scans
- The main advantages of chest radiographs are the speed at which they can be acquired and interpreted, the low cost and the low radiation exposure.
- Chest radiography has technical challenges that include capturing the wide attenuation differences between lungs and mediastinum, a need for depiction of small contrast differences and fine structural detail

cont.

- A radiographic system needs to have a wide dynamic range in order to display
  1. Mediastinal and retrocardiac abnormalities
  2. Should provide a high local contrast to detect focal lesions with subtle contrast
  3. Should have a high spatial resolution in order to be able to display interstitial lung diseases like pneumoconiosis.
- Imaging of interstitial lung diseases such as the pneumoconioses represents one of the most difficult challenges in diagnostic radiology,
- Comprehensive attention to technological, methodological, and human factors is required to assure that the image quality and interpretation are satisfactory for achieving early disease detection.

# Advantages of digital radiography

- Increased dose efficiency.

Increased dose efficiency improves image quality and also decrease patient exposure

- Improved image quality

No cassette artifacts/film processing artifacts

- Efficient handling and increase image throughput

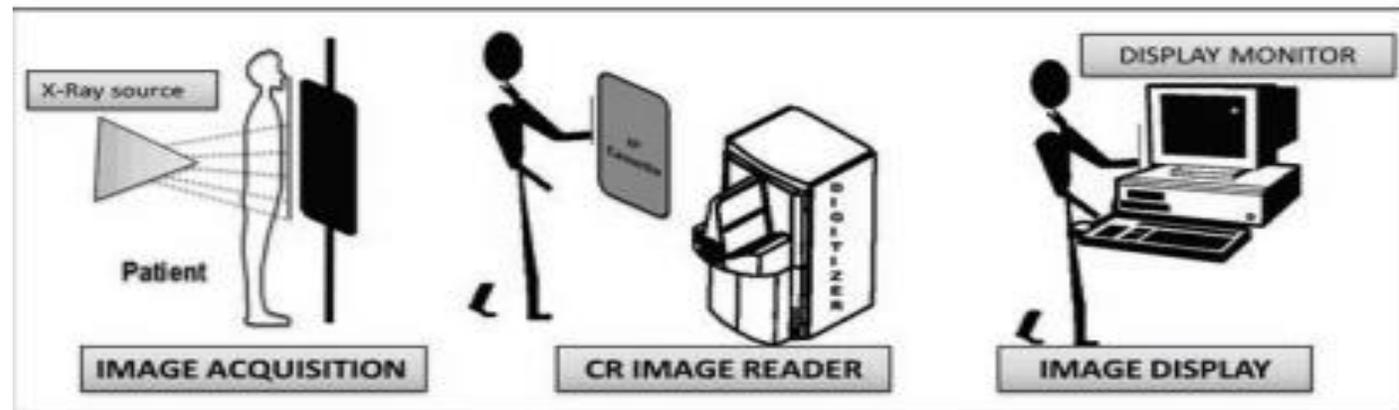
There is instantaneous image availability. Images instantly transferred to computer system for post processing and immediately send to PACS

# Digital radiography technologies

- Computed Radiography (CR)
- Indirect flat panel conversion system
- Direct flat panel conversion system
- Digitizing analog images

# Computer Radiography

- Computed radiography (CR) has provided a ready cost-effective transition from screen film to digital radiography and a convenient entrance to PACS.



# Disadvantages of CR

- CR requires the cassette be removed from the X-ray machine and then placed into a reader
- The PSPs used in CR require longer readout and processing time.
- When single-plate readers are used, overexposures entail additional delay as the old signals are not completely erased very quickly.

# CR ARTIFACTS

The following artifacts result from poor acquisition

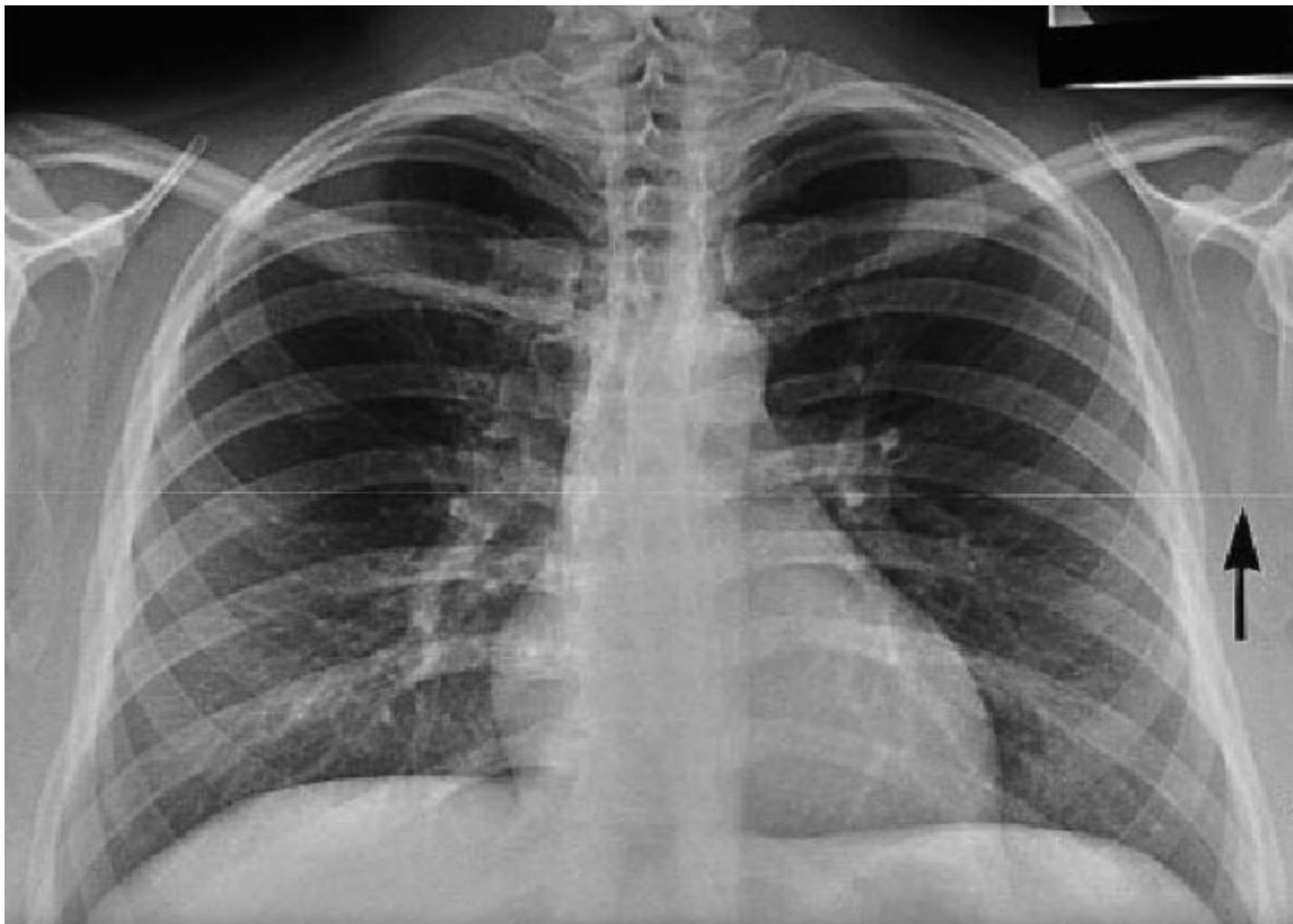
1. Twin artifacts-Double exposure
2. Over exposure-Dark images
3. Under exposure-grainy images
4. Scatter radiation-
5. Care and carelessness-kink marks
6. Light bulb effect-Darkening of the lower and outer portions of the image
7. Exposure through back of cassette-
8. Uncollimated images

# CR ARTIFACTS

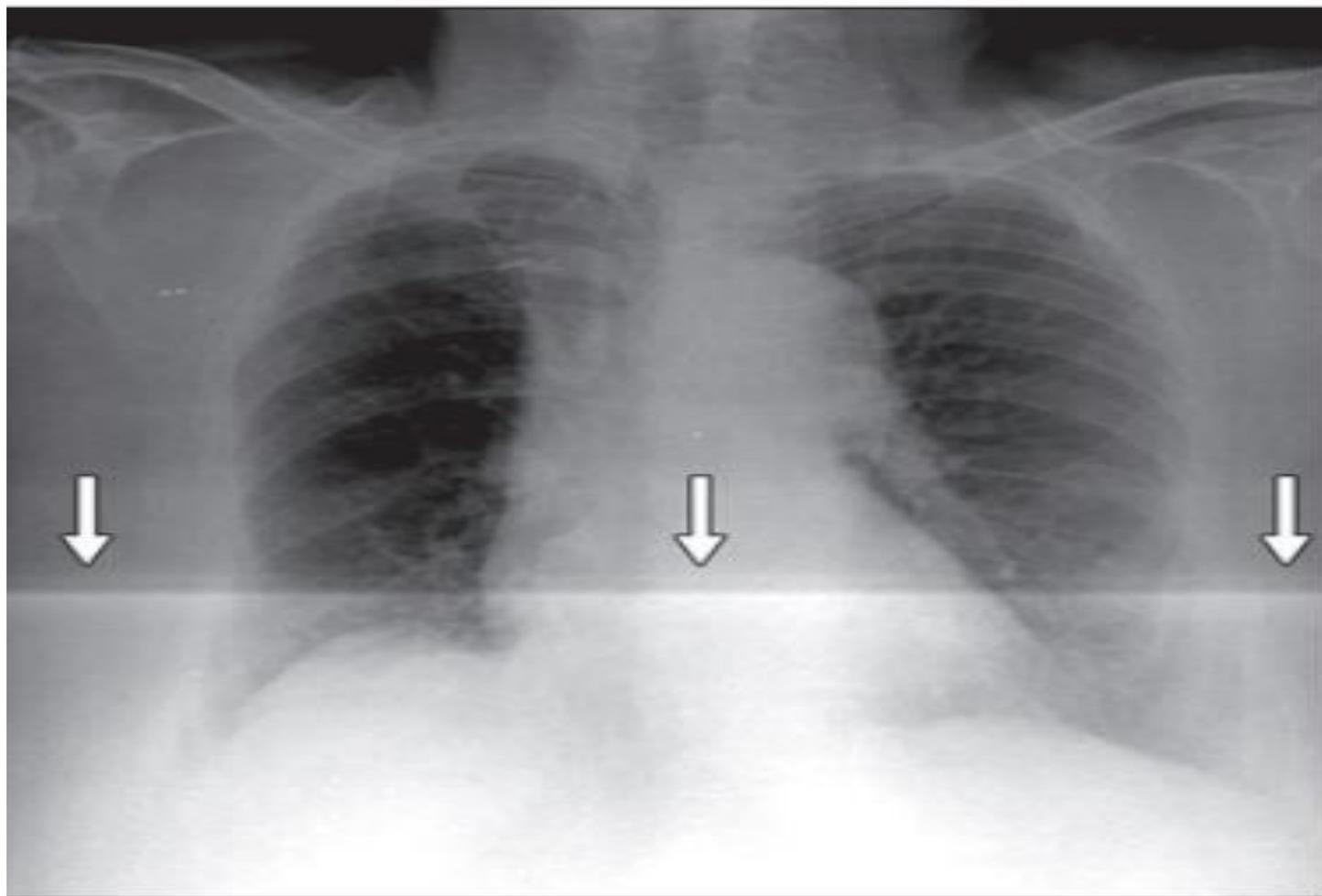
## HARDWARE INDUCED

- Cracks on image plate
- Dust particles artifacts
- Plate reader artifacts-dust on light bulb or
- Malfunctioning rollers and dust on rollers
- Cracks on cassette-linear radiolucent line
- Improper eraser function

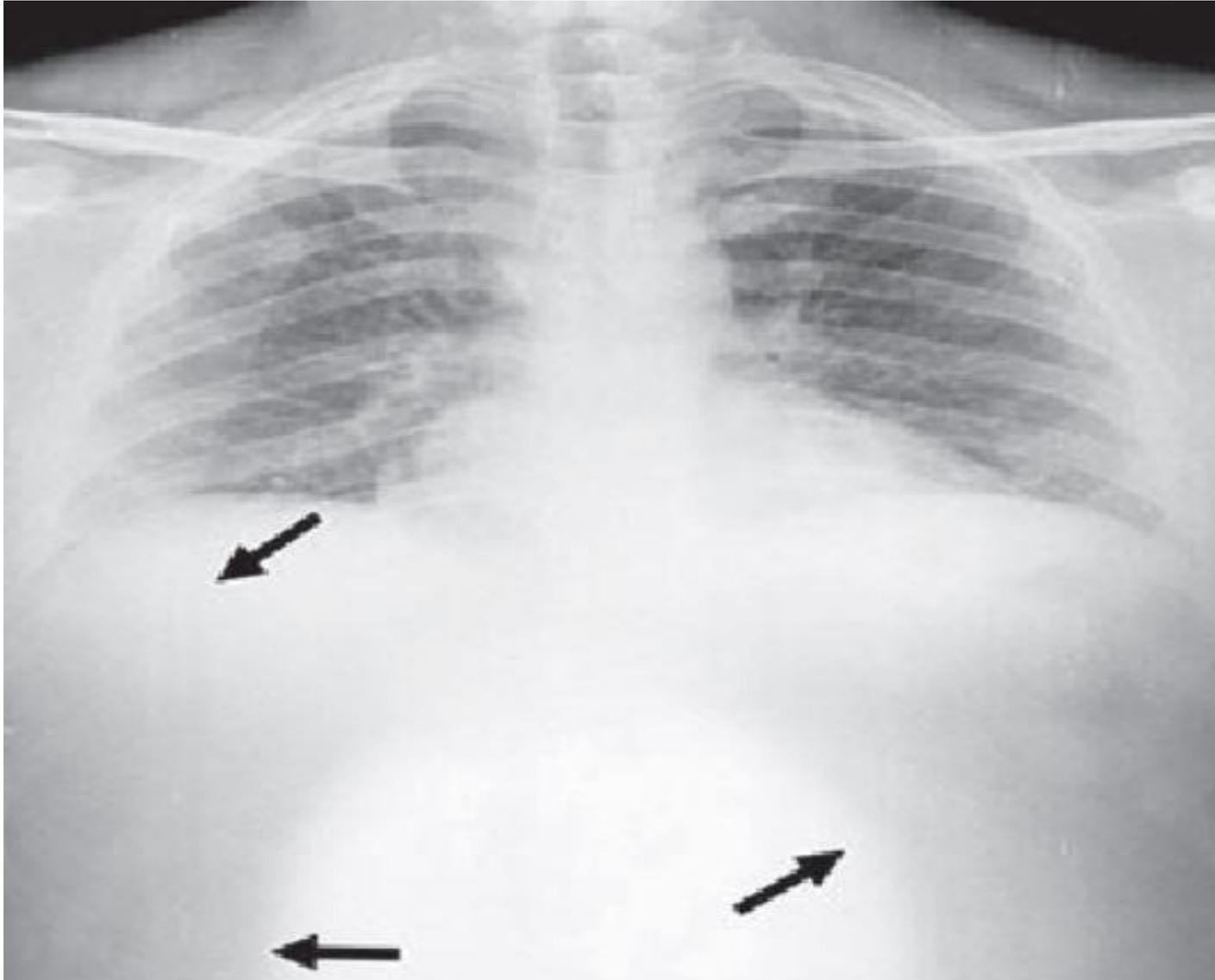
# PLATE READER ARTIFACT



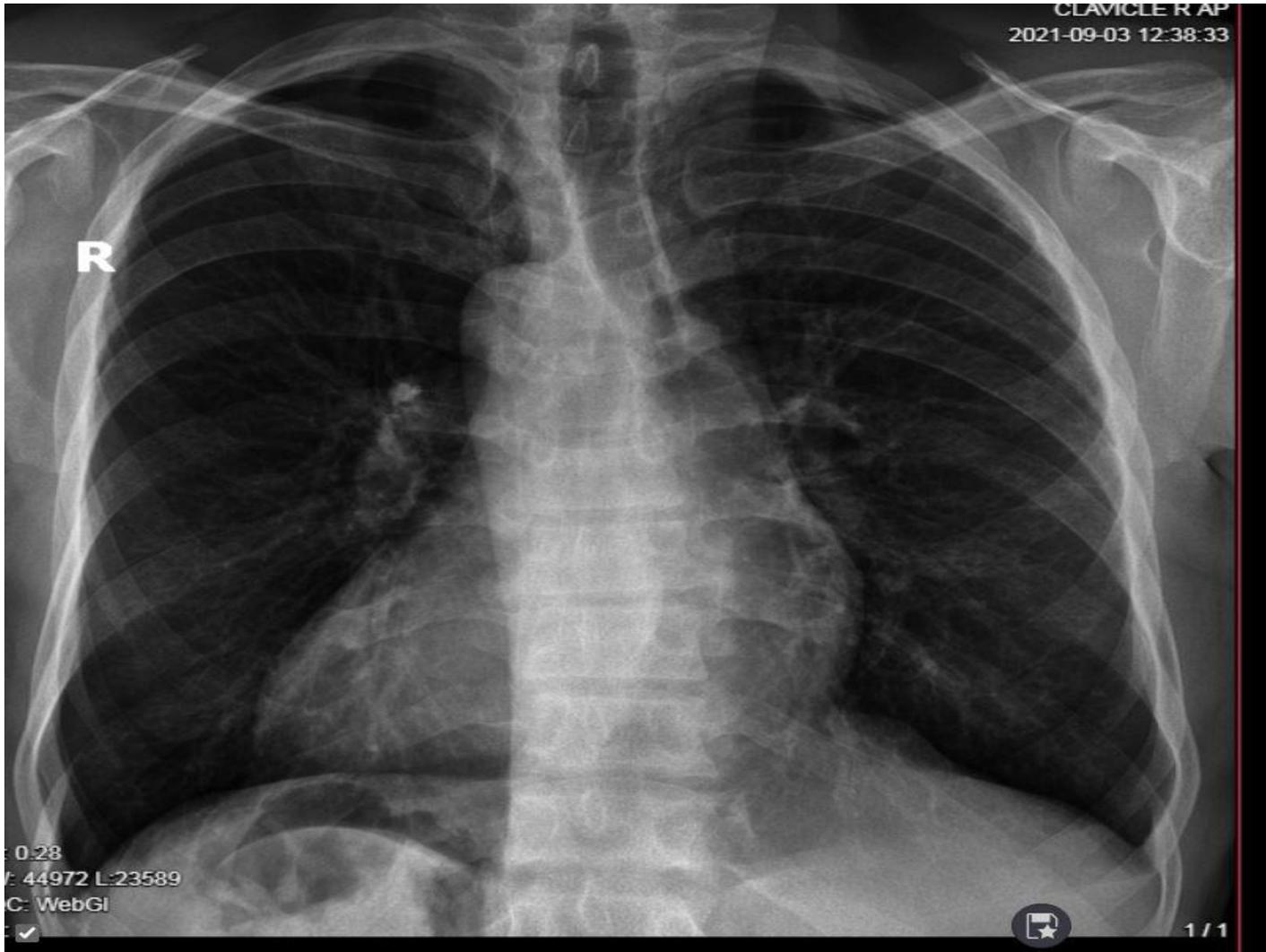
# DISPARITY ARTIFACT(ROLLER MALFUNCTION)



# LIGHT BULB EFFECT



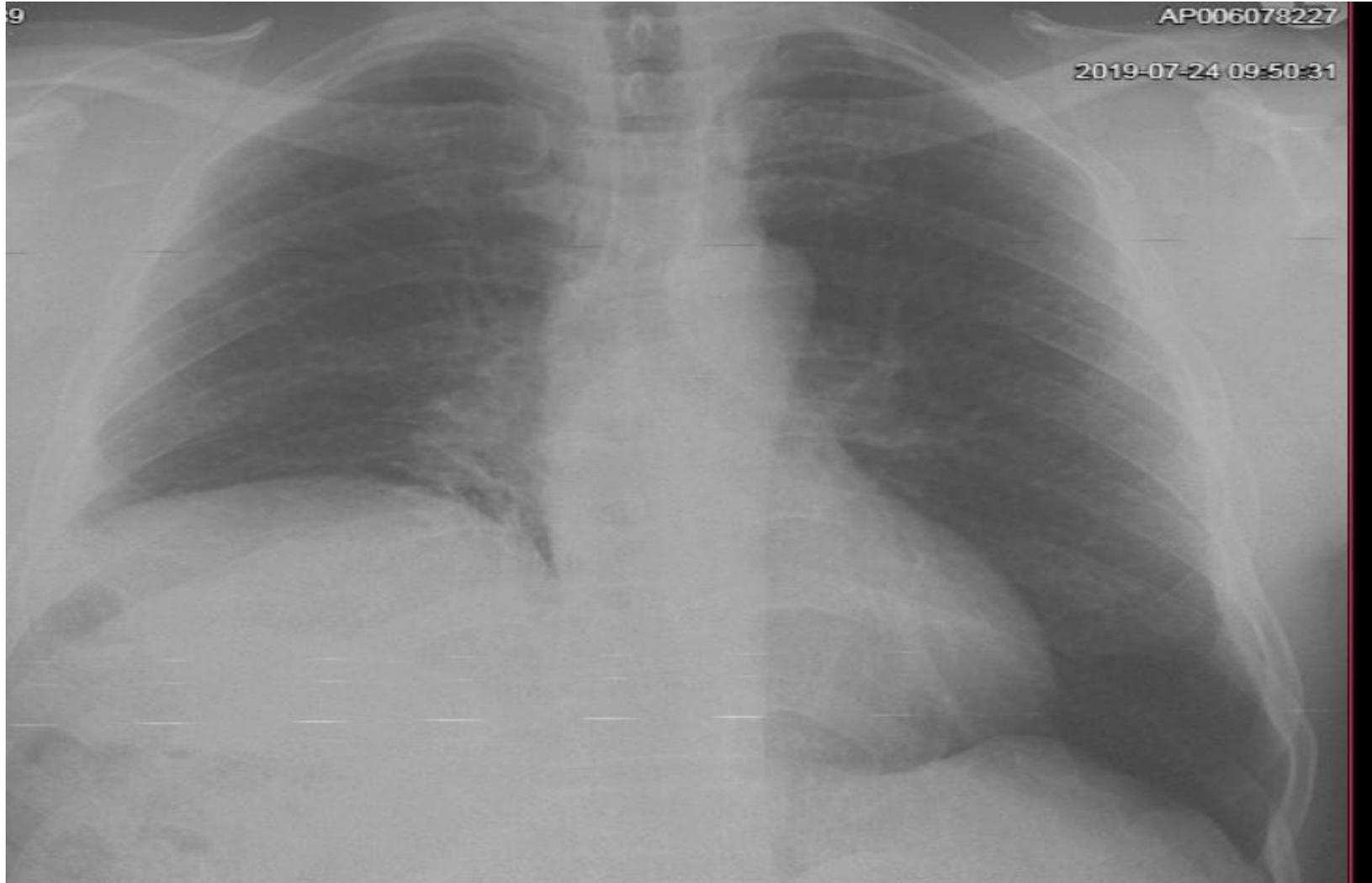
# OVEREXPOSED AND WRONG DIGITAL MARKER



# OVEREXPOSED AND ARTIFACTS



# POST MANIPULATION



# DISADVANTAGE OF DIGITAL RADIOGRAPHY

The main disadvantages of direct digital radiography are

1. The thickness and rigidity of the digital detector
2. Hardware and software maintenance,
3. The higher initial cost of the system
4. Digital radiography also poses risks: increase in patient dose may go unnoticed because increased dose no longer leads to overexposed films, and suboptimum image processing may lead to suppression of diagnostic information.

# DIGITIZING OF ANALOG IMAGES

- A digital image is obtained by digitizing the analog screen film That can provide a digital representation of the analog image, which can be used for electronic archival, transmission, and display.
- While this approach for digital radiography has merits in enabling integration of prior analog images or those from other facilities with an existing digital operation, it has certain important shortcomings. These include
  1. Loss of image quality in the digitization process
  2. Inconsistent image appearance from film to film due to variations in exposure levels or film/screen type
  3. Sub-optimal display of the images which are optimally gray-scaled for viewing on a view-box as opposed to an electronic display.

Because of these reasons, this mode of digital radiography is considered sub-optimal and supplemental at best.

# QUALITY CONTROL

- Discourage use of digital anatomic markers to avoid misdiagnosis e.g. Dextrocardia
- Collimation during acquisition of image
- Electronic post-image acquisition “shutters” available on some digital systems that limit the size of the final image and that simulate collimator limits should not be used.
- Computerized Radiography (CR) imaging plates should be inspected at least once a month and cleaned when necessary and at the frequency and by the method recommended by the manufacturer.

# QUALITY CONTROL

- To facilitate uniformity of image files used for pneumoconiosis classification, images should be stored as Digital Imaging and Communications in Medicine (DICOM)
- Identification of the image, patient, facility, date and time of the examination should be included within the file header according to the DICOM standard format.
- Exposure parameters should also be saved for auditing purposes, either in the DICOM file when possible, or in another accessible file.

# QUALITY CONTROL

- Comprehensive procedures should be implemented to assure radiation exposures are as low as reasonably achievable, following current professional recommendations.(ALARA)
- If automated exposure control devices are used, calibration for chest imaging should be documented.
- Each digital radiography device and system, performance monitoring should comply with the equipment manufacturer specifications, applicable industry guidelines, and Radiation control
- Regular quality control tests including quarterly tests and annual tests should be perform

# QUALITY CONTROL IMAGE DISPLAY

- Because of the inherent difficulty in recognizing small pneumoconiosis shadows, it is important that image display hardware and software used for interpretation of chest images meet or exceed professionally recommended specifications
- To further enhance consistency when performing ILO classifications of chest images, the reader should use two side-by-side flat panel colour matched diagnostic quality medical displays capable of monochrome display and compliant with the DICOM<sup>®</sup> Grayscale Standard Display Function (GSDF) standard
- The viewing devices should be of the identical make and model, displaying at least 3 MP at 10 bit depth; 12 bit and 5 MP are preferred

# CONCLUSION

- The quality of images in the classification of pneumoconiosis is extremely important.
- Avoid deferral of claims due to poor quality radiographs
- Decrease radiation exposure to claimants