COVID-19: Imaging Through the Glass

Emily Tsai, MD
Sarah McKenney, PhD
Daniel Inouye, RT
Imaging Through the Glass

• Background and Motivation
• Technical and Safety Considerations
• Technologist Workflow
• Examples
• Acknowledgements
Background and Motivation

• COVID-19: 6+ million cases and 370,000+ deaths worldwide (1.7+ million cases and 100,000+ deaths in the United States)¹

• Protocol for portable chest radiography through the glass of an isolation room door developed by the University of Washington during the 2014 Ebola outbreak²

• Motivation:
  • To reduce infection
  • To conserve personal protective equipment (PPE)

Patient and Staff Safety

• To the extent that your institution has access, employ a medical physicist to evaluate patient and staff safety.

• The following slides provide basic guidance as a starting point to implement this technique.
The Interaction of Radiation with Glass

• Glass, composed primarily of Silicon, acts much like an Aluminum filter because they are atomically similar.

• A typical 0.25 inch glass window will attenuate an x-ray beam by ~60% with the same imaging techniques and geometry.

Patient Safety

- The glass window *hardens* the beam, meaning that the effective energy of the x-ray beam increases.

- At the same source-to-image distance (SID)
  - we can double (x 2) our tube current-time product (mAs) to achieve a similar entrance exposure to the patient.
  - We estimate that the beam filtering of the glass decreases the effective dose by 20%.

Patient Safety: Increasing the Source-to-Image distance (SID)

- The SID may have to be increased for some rooms

- If a technique with glass has been established at 72 inches, to get the same detector dose you must use the inverse square law:
  - Increase the mAs by 35% at 84 inches
  - Increase the mAs by 75% at 96 inches
  - Increase the mAs by 225% at 108 inches
  - Increase the mAs by 275% at 120 inches
Staff Safety: Outside of the patient room

- It is essential that the x-ray tube is as close to the window as possible.

- The tube acts as shielding from radiation backscatter off the glass.

- In this geometry, the tube & glass reduce scatter to the workers outside of the room by 35%.
Staff Safety: Inside the patient room

• There is scatter from both from the patient and the glass inside the room. Maximize staff distance from both scatter sources.

• Scatter to staff is dependent both on
  1. The imaging techniques, scatter increases with increases in mAs and kV
  2. The workload, i.e. the number of x-rays performed per week
  3. The staff distance from the patient
  4. The staff distance from the glass.

• The 4 items above vary between institution and staff safety can vary between maintaining a 6 ft distance to including shielding.
  • For example, because of the small size of our patient rooms, rolling lead shields are used to protect our staff
NEW WORKFLOW IMPLEMENTATION

Radiology and ED Collaborative Effort

- Buy-in and support from ED and Nursing Leadership
- Education and training of Radiology technologists and ED nurses using powerpoint workflow presentation as an educational tool

Radiology Team: Technologists, Medical Physicists, and Radiologists

- Core of well-trained technologists to perform exams and guide ED nursing staff
- Dedicated portable X-ray machines
- CXRs reviewed by radiologists as a sustained QA measure
CASSETTE HAND-OFF

• Technologist will be wearing a surgical mask and gloves
• Cassette is “double bagged” in plastic covers
• Through a small opening in the door, the Technologist hands the cassette to the Nurse and immediately closes the door (or ante room door)
CASSETTE POSITIONING IN SEATED PATIENT

- The Nurse will raise the back of the gurney so that patient sits as upright as possible
- The Nurse will then place and center the cassette (black side facing forward) behind the patient’s thorax
- Voices carry easily through the glass and the Technologist will verbally guide the nurse to ensure proper cassette placement
SOURCE-DETECTOR DISTANCE

• The Nurse will push the gurney as close to the glass door as possible
X-RAY ACQUISITION

• The Technologist will position the tube close to the glass door to limit source-detector distance

• The Nurse will stand behind a rolling lead shield for radiation protection during the exposure
CASSETTE HANDLING

• The Nurse will remove the cassette from behind the patient and clean the outer bag
CASSETTE HAND-OFF

- Nurse will pull back slightly the outer bag and place the cassette through a small opening in the door. The Tech will receive the cassette with the inner bag still in place.
- Nurse will dispose of outer back.
CASSETTE HANDLING

• Technologist will clean the external surface of the remaining inner bag before the cassette is removed
• Technologist will then clean the external surface of the cassette before image upload
CASSETTE POSITIONING FOR STANDING PATIENT

- Cassette handling and hand-offs remain the same before and after image acquisition
- Nurse will hand the cassette (black side facing the patient’s body) to the Patient
PATIENT INSTRUCTIONS

• Technologist will communicate with Nurse to ensure proper patient positioning and cassette placement
• Patient will be positioned approximately 60 inches from the X-ray tube
• Patient will be instructed to hold cassette against their anterior thorax
X-RAY ACQUISITION

- Technologist will align tube and take exposure
- Nurse will stand behind lead shield during exposure
Acknowledgements

• Radiology Technologists:
  • Natalie Dell Immagine, RT

• ED staff:

• Medical physicists:
  • Jessica Clements, MS
  • Virgil Cooper, PhD
  • Amirh Johnson, MS
  • Sarah McKenney, PhD
  • Matt Wait, MS
  • Jia Wang, PhD

• Radiologists:
  • David Larson, MD
  • Ann Leung, MD
  • Nayeli Morimoto, MD