

## **Policies and Guidelines for COVID-19 Preparedness: Experiences from the University of Washington**

Mahmud Mossa-Basha, MD<sup>1</sup>, Jonathan Medverd, MD<sup>1</sup>, Kenneth Linnau, MD<sup>1</sup>, John B. Lynch, MD, MPH<sup>2</sup>, Mark H. Wener, MD<sup>2</sup>, Gregory Kicska, MD<sup>1</sup>, Thomas Staiger, MD<sup>2</sup>, Dushyant Sahani, MD<sup>1</sup>

<sup>1</sup>Department of Radiology, University of Washington

<sup>2</sup>Department of Internal Medicine, University of Washington

**Corresponding author:** Mahmud Mossa-Basha, MD, University of Washington School of Medicine 1959 NE Pacific St, Seattle, WA 98195 (email: [mmossab@uw.edu](mailto:mmossab@uw.edu)).

**Funding:** None related to this project

**Manuscript type:** Review article

### **Abstract**

The Coronavirus Disease 2019 (COVID-19) pandemic initially presented in the United States in the greater Seattle area, and has rapidly progressed across the nation in the past 2 months, with the United States having the highest number of cases in the world. Radiology departments play a critical role in policy and guideline development both for the department and for the institutions, specifically in planning diagnostic screening, triage, and management of patients. In addition, radiology workflows, volumes and access must be optimized in preparation for the expected COVID-19 patient surges. This article discusses the processes that have been implemented at the University of Washington in managing the COVID-19 pandemic as well in preparing for patient surges, which may provide important guidance for other radiology departments who are in the early stages of preparation and management.

### **Essentials**

- Radiology policy goals are to reduce COVID-19-related morbidity and mortality through early diagnosis, appropriate treatment and prevention of disease dissemination.
- Imaging currently is not routinely used to screen for COVID-19 unless access to RT-PCR results for COVID-19 is limited.
- Postponing elective imaging and procedures will preserve resources and hospital beds, while also limiting patient population exposures.
- Determination of time-sensitivity of procedures and imaging tests is by consensus with input from radiologists, patients, and/or ordering clinicians.
- Radiology departments must prepare for patient surges through streamlined approaches to imaging that will limit exposures to healthcare workers and patients.

Since the initial report of the SARS-CoV-2 virus outbreak in Hubei province in China in late December 2019, the virus has spread across the world, infecting more than 858,000, and killing more than 42,000 individuals over the span of 3 months(1). Washington state reported the first known case of COVID-19 in the United States in February 2020, and subsequently became the site of the first major outbreak in the country. In the current pandemic, it is vital for radiology departments to partner with the emergency operations teams in the healthcare enterprise for planning and coordinating diagnostic algorithms, for patient management, treatment and disposition, and for management of patient surges.

Our healthcare system consists of our school of medicine, two academic, urban hospitals, 1 community hospital, a network of outpatient primary and urgent care clinics and an air transportation service. There are a total of 1,173 inpatient beds and 186 intensive care unit (ICU) beds between the 3 hospitals. Our hospital system is centered in King County, which currently accounts for 52% of all known COVID-19 cases in the state. Current forecasts indicate a potential need for 30% to 60% additional acute care and ICU hospital beds over current capacity across our healthcare system.

During the COVID-10 pandemic, the goal of our policies and preparedness has been to a) reduce patient morbidity and mortality related to infection through early diagnosis and appropriate treatment, and b) prevent disease dissemination to our employees, patients and the general community. We have also focused on preservation of healthcare resources, management of essential equipment such as personal protection equipment (PPE) and ventilators and preparation for patient surge.

In this communication, we highlight the University of Washington experience, programs and policies. Although guidelines are constantly changing as we learn more about this disease process, we hope our experiences will help other institutions as they prepare to deal with the COVID-19 pandemic.

To promote our efforts to protect our patients and employees from potential exposure, while performing critical and time-sensitive non-invasive diagnostic imaging studies, we are rescheduling elective examinations. This is being accomplished via automated patient texting services and direct calls to patients from radiology scheduling. We seek to reschedule elective examinations for patients with flu-like symptoms (fever, new cough, dyspnea, weakness) and with pre-existing conditions making them vulnerable to infection. As of now, the postponement will extend to May 18, 2020.

Our plan for planned postponement of elective diagnostic imaging has been communicated to referring physicians. We also requested that all orders for outpatient imaging include information on examinations that are critical for patient care versus those that may be postponed (including the length of time for postponement). Each outpatient imaging requisition now includes in the indication section the dates between which the imaging should be performed. Screening mammography, lung cancer screening and dexa scans are considered to be elective and all of these examinations are postponed until late May.

Implementation of these processes resulted in a rapid decline in our imaging volumes. Across our medical system, radiology imaging volumes have declined 39-60%, with 55-70% decrease in outpatient imaging volume. The estimated total RVU loss during the 2-month time period of reduced outpatient scanning is 14,923.

### Lab Testing

Our institutions virology program began working on a reverse transcription polymerase chain reaction (RT-PCR) test for COVID-19 in early January, when reports of the outbreak in China first surfaced(2). At present, we are fortunate to provide 3000 RT-PCR tests for COVID-19 per day with 10-24-hour turnaround time. Testing capacity and turnaround time is expected to improve in the coming weeks. In comparison with CDC and Department of Health comparator specimens, our RT-PCR test has near 100%

sensitivity. However, in actual practice the sensitivity of testing is lower due to variation in swabbing technique and viral load of the specimen source (nasopharyngeal likely more sensitive than nasal and oropharyngeal in early stages, and sputum often more sensitive in late stages in the presence of pneumonia). Early studies suggest that sensitivity of RT-PCR ranges from 32-93%, depending on the source of the clinical specimen (3). In order to protect our health care workers, we screen all patients who are admitted as inpatients for COVID-19 with RT-PCR, regardless of the reason for admission.

#### Imaging of COVID-19 Positive or Suspected Patients

The decision to image patients who are COVID-19 positive or suspected is based on how the imaging will impact patient care. We do not routinely use imaging for COVID-19 screening, but imaging *is* performed in COVID-19 positive or suspected patients, to rule out other diagnoses that can be treated, including pulmonary embolism. In addition, emergent imaging may be necessary for evaluation of other urgent conditions, including stroke, trauma, infection and other disease conditions (**Figure 1**). Clinics and inpatient units are directed to call ahead regarding COVID-19 positive or suspected cases so that precautionary preparations to receive the patient can be made.

CT imaging and chest x-ray performance in COVID suspected or COVID positive patients is based on whether the imaging will change patient management. In approximately 5000 COVID-19 tested patients across our hospitals, we have performed 4700 chest imaging exams, including 1300 CT and 3400 x-ray examinations. These include screening exams, follow-up exams, and other exams including ICU films, CT chest as part of trauma protocols and CT pulmonary embolism protocols. Through communication, education and case discussion with our emergency department colleagues, COVID-19 screening imaging requests anecdotally have progressively decreased at our primary COVID-19 hospital from 6-7 CT chest without contrast and 5-6 chest radiographs requested per day for COVID-19 screenings at our primary

COVID hospital, to few or no chest CT without contrast or radiograph exams ordered on most days. CT pulmonary embolism studies continue to be ordered at this hospital, typically 2 to 3 per day, when there is concern for COVID-19 and other disease processes.

*Screening prior to imaging procedures.* All patients are screened at the hospital entrances for COVID-19 symptoms, with a second layer of symptom screening at the radiology front desk. For elective imaging, if the patient did not reschedule their study, arrives at our department and is symptomatic per front door or front desk screening, the patient is provided with a surgical mask and placed in an isolation room.

*Approaches to imaging.* Portable radiography is the mainstay imaging tool for emergency department and inpatient settings. If imaging can be done using portable equipment (chest or abdominal x-ray), the technologist dons personal protective equipment (PPE) consistent with the potential exposure and performs the portable x-ray in the isolation room. For most imaging procedures, PPE consists of a gown, gloves, eye protection and a mask (standard/contact/droplet). Once x-ray is complete, the technologist doffs PPE gear, preferably with a trained observer monitoring removal, ensures that the patient continues to wear a mask, and will direct the patient out of the department. Similar measures are taken for patients imaged in non-portable x-ray, MRI, CT, ultrasound or nuclear medicine sections, except imaging is performed in the respective imaging suites.

We limit patient transfers in order to limit staff exposures and to conserve PPE. By employing a modified version of processes developed during the 2014 Ebola outbreak, we can obtain portable chest radiography either a) through the glass of an isolation room door or b) at a greater than usual distance (10-15 feet) across a semi-isolation antechamber into an isolation room. The patient is placed in a wheelchair or gurney inside the isolation room, facing the glass door or window. A nurse (who has already donned PPE) places a double-bagged x-ray cassette behind the patient. A radiology technologist outside of the closed room, indicates optimal positioning adjustments via speaker phone and/or hand

gestures. After the exposure, the nurse disinfects the cassette outer bag and brings the cassette to the room door. The technologist pulls the inner bag containing the cassette from the outer bag, which stays in the room. The technologist disinfects the inner bag, removes the cassette and then processes the film. Afterward, the plastic bags are appropriately disposed. This technique has been highly successful when performed through clear and wire-reinforced glass windows as well as glass windows with opened metal venetian-type blinds (**Figure 2**) with few repeat exposures needed. Using this technique, staff exposure is reduced, PPE use is reduced and operational and conservation efficiencies are gained by decreased post-exam equipment cleaning.

### Protection of Radiology Staff

An important consideration that radiology departments must weigh is taking appropriate precautions for imagers, staff and radiologists while conserving PPE by avoiding excessive precaution and resource utilization. We have two types of precautions for patients with COVID-19: a) less stringent standard/droplet/contact precautions and b) more resource-intensive standard/airborne/contact precautions. Standard/droplet/contact precautions apply to most patients, while standard/airborne/contact precautions apply to patients who are critically ill and intubated or are or could undergo aerosol-generating procedures while in the room(4) (**Figure 1**).

*Airborne/contact precautions.* These precautions require the use of N95 filtering facepiece respirators (FFR) or powered air-purifying respirators (PAPR) replacing the conventional surgical mask used for droplet protection. N95 FFRs and PAPRs protect health care workers from small infectious particles (> 5 micrometers) and are adequate in the setting of aerosolizing COVID-19. N95 FFRs require individual fitting (facial shape and size). Advantages of PAPRs include protection of head and neck (hood), use with facial hair and filtration of particles as small as 0.3 micrometers (equivalent to high-efficiency particulate (HEPA) filters) as well as those individuals who cannot be fit to an N95 FFR.

Correct donning and doffing of protective measures is instrumental for the efficiency of PPE. At our hospitals, donning and doffing was practiced by each staff member in group sessions available during day and night shifts for all staff who are expected to come in contact with patients. Rapid N95 mask fit testing is offered concomitantly.

*Airborne precautions.* SARS-CoV-2 is believed to be primarily transmitted via droplets. Very small droplets (less than 4 micrometers) can be produced by virus-shedding patients through forceful coughing. As such, health care providers may become exposed to aerosols theoretically able to permeate N95 FFRs. Increasing air-exchange per hour (ACH) or HEPA filtration of room air represent potential supplemental mitigation measures(5). Air exchange rates varies between imaging suites, depending on ventilation, air circulation and room configuration. Infection control has reviewed our imaging suites to assess air circulation and the need for air exchange measures. For standard/airborne/contact precaution, we use HEPA filtration systems to increase air exchange, with the exception of MRI, as these units cannot be used in the MRI suite. Our MRI suites have better ventilation and hence better air exchange, so this is not thought to be an issue.

### Room Cleaning

Imaging suites are sanitized using standard cleaning procedures between patients. Our standard cleaning procedure uses quaternary ammonium/alcohol impregnated wipes or other Environmental Protection Agency (EPA) -approved disinfectants(6). For patients requiring airborne/contact precautions, radiology technologists will perform room sanitizing after imaging while still wearing the same set of PPE as used during patient transfers. Although evidence about the effectiveness of air-exchange measures is limited, use of large stationary HEPA filters (except in MRI) in temporarily closed imaging suites can allow for sedimentation and removal of small aerosol particles. At our hospitals, imaging rooms are

closed for 1 hour for airborne precautions in rooms with a minimum of 6 air exchanges per hour. We start the clock immediately after the patient leaves the imaging suite and cleaning time is included in the room closure downtime. Interventional radiology suites at one of our hospitals are closed for one hour after every COVID-19 positive or suspected patient (droplet or airborne precaution) due to limited air circulation, while at the other hospitals, the interventional suites are shut down for 1 hour only for airborne precaution.

### Sick or Exposed Employees

In our healthcare system, COVID-19 exposed employees who are asymptomatic are required to return to work, to attest to their health daily and to self-monitor for symptoms twice per day. We do not require that employees wear masks following exposure to patients with COVID-19. This is because most exposures are unreported exposures occurring in the community. We do not perform RT-PCR tests on asymptomatic employees.

Employees who exhibit symptoms of acute respiratory infection are asked to undergo RT-PCR testing for COVID-19 at drive-through testing clinics and are instructed to stay home. If COVID positive, employees are required to stay in isolation for a minimum of 7 days from symptom onset and must be symptom-free for 72 hours before returning to work (7). For those that are COVID negative, they may return to work when symptom-free for 24 hours. In the radiology department, we have had one faculty member, two technologists and one transporter test positive, all presumed to be community acquired. We had a clinical fellow who had a false positive RT-PCR test, then on re-assessment of the sample by the state lab, was determined to be negative.



### Invasive Procedures in COVID-19 Patients

We use a 3-tiered approach for scheduling procedures under consideration (**Table 1**). Procedure requests are reviewed individually by subspecialty radiologists (interventional radiology, body imaging, musculoskeletal radiology and neuroradiology) and assigned a category in consensus with the ordering provider.

We perform critical procedures that would adversely impact patient care if not immediately scheduled. For all critical and time-sensitive procedures and imaging studies that involve anesthesia and may require intubation, a RT-PCR test for COVID-19 is performed prior to the procedure to ensure healthcare worker protection. To accomplish this, a rapid 75-minute RT-PCR test has been employed for these emergency procedures. For critical trauma cases, stroke interventions and active bleeding cases, the in-house rapid COVID-19 RT-PCR test is not performed. For these patients, we employ airborne/contact precautions with assumption of COVID-19 infection.

### Distribution of Patients for Imaging Procedures

In radiology, we direct patients with COVID-19 infection or suspected infection who have or suspected time-sensitive imaging away from hospital centers with a high-volume of critically ill patients (i.e., patients without COVID-19 infection) to outpatient imaging centers with lower patient volumes. A limitation of this approach is that patients may develop symptoms of infection between the time of infection and the date of the imaging examination.

### Radiology Faculty and Staff Protections

Our department has accelerated the process of providing home workstations for radiologists. We upgraded our PACS servers to support an increased volume of radiologists doing remote interpretation. For on-site radiologists, we established 21 single workstation reading room outposts across our various institutions to isolate radiologists. We have online sign-up sheets to reserve and use the above outpost rooms, and an automated dashboard that tracks home and outpost interpretations. Employees are now provided with daily standard 3-layer disposable earloop surgical masks for use during direct patient care. In addition, employees are permitted to wear these masks during non-patient care. If masks become soiled or if working with a COVID positive or suspected patient, the mask will be replaced with a new mask for use.

Due to the reduced imaging volumes and need for social distancing, we have restructured our shift coverage for faculty and trainees. We have 1 faculty radiologist, 1 imaging fellow and 1 resident in the reading room at any given time. Staff and trainees site at every other workstation to maximize their separation. Trainees have their own workstation and communication is achieved by conversation in the same room at a safe distance, or via screen control enabled video conference with trainee and staff sitting at different physical locations. On some services, such as nuclear medicine, we also created two rotating teams for in-person clinical daytime coverage, with each consisting of 1 faculty, 1 fellow and 1 resident that exclusively work together for service coverage for a week at a time, and rotate one week on and one week off. The off team provides remote support when needed. This limits cross-exposure between teams to limit transmission of disease that may negatively affect the team.

On-site radiology employees fill out mandatory daily online attestations to their health status when they arrive at work. For radiologists, these attestations pop up on PACS workstations every four hours. Answers get routed to supervisors to inform them of symptomatic team members.

All meetings are encouraged to be held by video conference. We require that any meeting with more than 6 attendees be virtual or be cancelled. All faculty and trainee interviews are online, and our grand rounds and visiting professorships are held online as well.

#### Enterprise-wide Coordination and Communication

Early in the outbreak, our healthcare system created a command center to coordinate the system response to the myriad facility, staffing, safety and resource needs. A secure central repository was established for COVID-19 related policy and procedure documents and outbreak related resources, such as childcare and personal counseling ([covid-19.uwmedicine.org](https://covid-19.uwmedicine.org)). Daily command center briefings are available to all employees. Weekly enterprise huddles summarize recent actions, remunerate on-going initiatives and review regional and enterprise situation status.

At the department level, communication is facilitated through virtual daily huddles with department leadership and weekly faculty meetings. Daily huddles at each radiology site maintain safety and practice standards and provide an opportunity to answer questions.

#### Disaster Preparedness

Most models predict exponential increases in COVID-19 cases, hospitalizations and deaths over the next few weeks, with depletion of hospital resources, including hospital beds, specifically intensive care unit beds, ventilators and PPE. Hospital systems, and radiology departments need to prepare for a COVID-related patient surge.

UW Medicine hospitals are erecting triage tents outside the hospital to keep the non-critical COVID-19 patients and other patients with respiratory symptoms outside the hospital. Radiology is providing

supporting imaging equipment, including portable chest x-ray equipment in adjacent spaces with imaging performed through glass doors or in adjoining triage tents. At HMC, access to MRI, CT and ultrasound equipment for those COVID patients that may require advanced imaging for other indications—including the evaluation for pulmonary embolism, brain or spine pathology—is available in adjacent HMC dedicated scanners. HMC has 2-1.5T and 1-3T MRI scanners, 3-128 slice, 1-dual energy and 1-SPECT-CT scanners, 7 ultrasound units, and 4 angiography suites. For potential surges, the plan is to dedicate the SPECT-CT scanner for COVID-19 CT imaging, with protocols developed for contrast-enhanced imaging and an additional CT scanner if needed, as well as dedicating 1-2 x-ray imaging suites beyond the portable equipment deployed and an ultrasound unit. There has been planning of placement of a portable CT scanner in the triage tent at UWMC-ML. At UWMC-NW, the plan is to scan those patients that need CT to be scanned in the isolated SPECT/CT scanner in close proximity to the tent in order to limit in-hospital transit.

The hospital has prepared for the inpatient surge through rental of 180 patient beds and ventilators that are truck loaded. We have created scanner throughput plans, including designated CT scanners and imaging suites for COVID-19 positive patients. In addition, we have created imaging screening mitigation plans in case our lab testing algorithm gets overwhelmed.

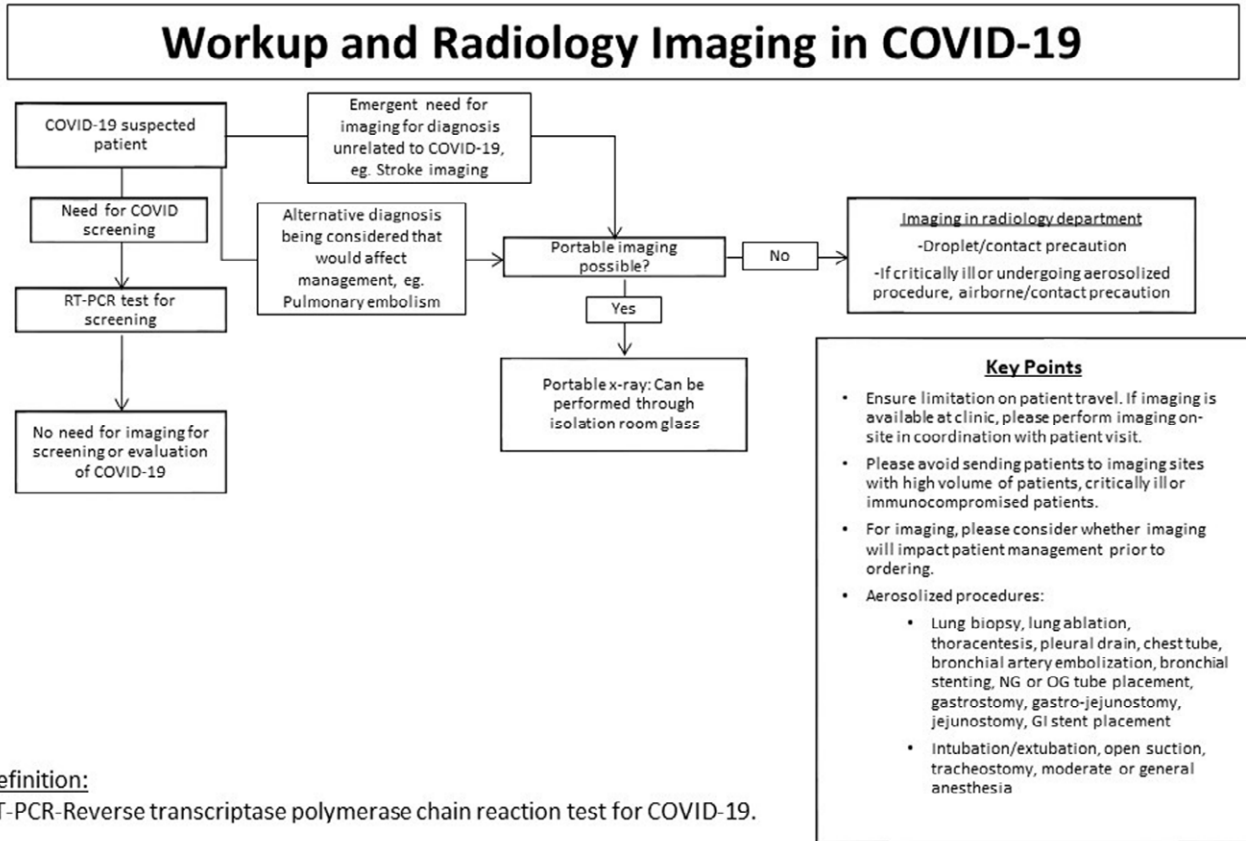
The radiology department has submitted all able-bodied and non-vulnerable faculty into a general faculty pool that may be recruited for ED and inpatient direct patient care with support and guidance provided. There is a separate pool of residents and ACGME fellows.

## References

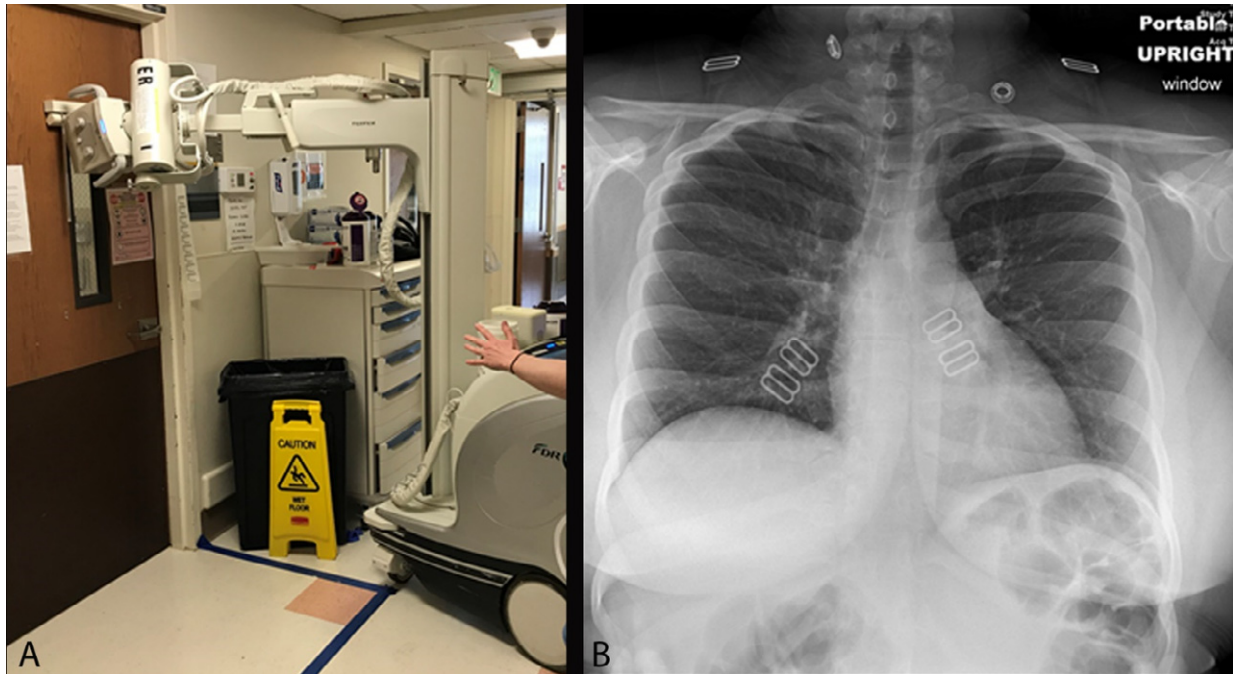
1. The Center for Systems Science and Engineering of Johns Hopkins University. <https://coronavirus.jhu.edu/map.html>. Published 2020.
2. Yan W. Coronavirus Testing Goes Mobile in Seattle. The New York Times 2020.
3. Wang W, Xu Y, Gao R, Lu R, Han K, Wu G, Tan W. Detection of SARS-CoV-2 in Different Types of Clinical Specimens. *Jama* 2020. doi: 10.1001/jama.2020.3786
4. Society of Interventional Radiology. <https://www.sirweb.org/practice-resources/covid-19-resources/covid-19-clinical-notification-3-26-20/>. Published 2020.
5. Adhikari U, Chabrelie A, Weir M, Boehnke K, McKenzie E, Ikner L, Wang M, Wang Q, Young K, Haas CN, Rose J, Mitchell J. A Case Study Evaluating the Risk of Infection from Middle Eastern Respiratory Syndrome Coronavirus (MERS-CoV) in a Hospital Setting Through Bioaerosols. *Risk Anal* 2019;39(12):2608-2624. doi: 10.1111/risa.13389
6. Environmental Protection Agency. <https://www.epa.gov/pesticide-registration/list-n-disinfectants-use-against-sars-cov-2>. Published 2020.
7. Centers for Disease Control. <https://www.cdc.gov/coronavirus/2019-ncov/healthcare-facilities/hcp-return-work.html>. Published 2020.

Table 1. Three-tiered Approach For Scheduling Procedures Under Consideration

Category	Designation	Description	Evaluator
Category 1	Elective/Non-Urgent	If delayed, will not harm patients in the next 2-6 months. These procedures can be delayed until after postponement period	Radiologist in consensus with ordering clinician
Category 2	Time-Sensitive	Short delay is acceptable, within a certain time frame.	Radiologist in consensus with ordering clinician
Category 3	Critical	Cannot be delayed. Schedule these procedures right away.	Radiologist in consensus with ordering clinician



**Figure 1.** Workup and radiology imaging in COVID-19 suspected patients.



**Figure 2.** Chest radiography through glass. Technologists position the portable x-ray unit outside the patient room, with the tube peering through the wire-reinforced isolation room window (A). AP chest x-ray through obtained is of diagnostic quality (B).