Responding to coronavirus disease 2019: LA County hospital experience

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Abstract

The coronavirus disease 2019 (COVID-19) has rapidly spread across the world since first being identified in Wuhan, China, in late 2019. In order to prepare for the surge of patients and the corresponding increase in radiology exams, clear and detailed policies need to be implemented by hospitals and radiology departments. In this article, we highlight the experiences and policies at LAC+USC Medical Center, the largest single provider of healthcare in LA County. Our policies aim to reduce the risk of transmission, guide patient management and workflow, preserve and effectively allocate resources, and be responsive to changing dynamics. We hope this communication may help other institutions in dealing with this pandemic as well as future outbreaks.

Keywords Coronavirus · COVID · Policy · Precautions · N95 · Mask

Introduction

Coronavirus disease 2019 (COVID-19), first identified in December 2019 in Wuhan, China, has now spread globally. As of June 14, 2020, there are greater than 7.9 million cases of COVID-19 and over 432,000 deaths worldwide. Amongst the countries, the USA has the highest number of cases and deaths with over 2.1 million cases and 117,000 deaths. Amongst the states, California has the 3rd highest number of cases with over 150,000 cases and 7th highest number of deaths with over 5000 deaths [1]. Los Angeles (LA) County has over 72,000 cases and 2800 deaths [2]. The pandemic has radically changed the daily operations of healthcare systems, including that of radiology.

LA County operates four hospitals with over 1900 combined beds and three emergency departments (ED), two of which are level 1 trauma centers [3]. The four hospitals share an electronic medical record system as well as a radiology picture archiving and communication system (PACS).

However, the physician employment structure at each hospital varies. Some hospitals directly employ physicians as LA County employees. In contrast, Los Angeles County + USC Medical Center (LAC+USC) contracts with the University of Southern California (USC) Keck School of Medicine. These USC physicians provide care not only at LAC+USC but also at hospitals within the Keck Medicine of USC network.

LAC+USC is a level 1 trauma center with 600 inpatient beds and 132 ED beds. There are typically more than 33,000 admissions, 560,000 outpatient visits, and 140,000 ED visits per year. In the fiscal year 2019, the USC radiology department performed approximately 332,000 exams at LAC+USC and 218,000 exams at non-county USC hospitals. LAC+USC is the largest single provider of healthcare in LA County, treating more than 28% of trauma victims in this region. As a County hospital tasked with providing care for those who cannot afford it elsewhere, many patients are of low socioeconomic status with chronic poor health maintenance and high incidence of gang and drug-related violence.

In this article, we highlight the COVID-19-related experiences and policies at LAC+USC. The aims of our institutional policies are to:

- 1) Reduce the risk of transmission amongst our patients, workers, and the general community
- 2) Provide clear guidance on patient management and workflow
- 3) Preserve and effectively allocate resources

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4) Be responsive to changing dynamics

Although our policies are continually updated as the situation evolves, we share our experiences in hopes that they may help other institutions in dealing with this pandemic as well as future outbreaks.

Elective imaging

Efforts have been made to reduce unnecessary clinical visits and diagnostic testing during the COVID-19 outbreak to protect our patients and staff from potential exposure and to preserve radiology resources for urgent indications. In accordance with guidance from the LA County department of health services [4] as well as recommendations from the Centers for Disease Control and Prevention (CDC) [5] and the American College of Radiology (ACR) [6], we have deferred or rescheduled all non-urgent outpatient diagnostic imaging and radiology procedures, including but not limited to screening mammography, non-urgent CT, ultrasound (US), MRI, plain radiographs, and fluoroscopy. A notable exception was made for cancer-related short-term follow-up exams (sooner than annual surveillance) and cancer-related therapies and biopsies, which continue to be scheduled. These changes were directly communicated to patients and referring providers.

Inpatient and emergency department imaging studies have not been impacted by this change, although the clinicians have been reminded to prioritize urgent exams. An urgent indication is interpreted as having a significant threat of morbidity or mortality, or otherwise demonstrates compelling clinical need, usually requiring direct provider-to-provider communication.

If providers have questions or concerns about this policy, or feel that an outpatient imaging exam is medically urgent, they can reach out to the radiology department.

As of June 2020, the previously postponed non-urgent exams are now being rescheduled with a gradual transition to normal operations.

COVID-19 screening and diagnosis

Entrance screening

LAC+USC has implemented entrance restrictions and screening procedures for patients and visitors in an attempt to further minimize the spread of COVID-19. These procedures are in place at security stations at all entrances.

The entrance screening questionnaire consists of the following:

- 1) In the last 24 h, have you had a fever ≥ 100.4 °F (≥ 38 °C) and/or thought you had a fever?
- 2) In the last 24 h, have you had cough, shortness of breath, or difficulty breathing?
- 3) Have you had any contact with someone who had the confirmed case of coronavirus?
- 4) Have you traveled out of the country during the last 14 days?

Patients answering “Yes” to any of the above questions are sent to a clinical triaging station. They are also required to sanitize their hands and wear a surgical mask for the duration of their visit. Patients are allowed one visitor to accompany them as long as the said person answered “No” to all 4 screening questions. Visitors and vendors answering “Yes” to any of the abovementioned questions are not allowed to enter and are asked to leave the premises.

Testing

Given limitations imposed by a national shortage of testing supplies and capacity for testing, LA County has provided specific criteria to guide clinicians on who to test for COVID-19. Testing targets those at high risk for complications and those at high risk for transmission to at-risk populations. We have recently increased our testing capacity to include all new inpatient admissions regardless of symptoms or diagnosis. Patients who present with acute respiratory infection but do not require hospitalization are only tested if they also have high-risk factors, such as being employed as a health care worker or having comorbid conditions. Details of LAC testing criteria are provided in Table 1.

Turnaround time

LAC+USC uses Cepheid Xpert® Xpress SARS-CoV-2 assay for COVID-19 evaluation. This is an automated reverse transcriptase polymerase chain reaction test that is currently validated for nasopharyngeal swab specimens. The test turnaround time is 2 h or less depending on lab staffing.

Management of COVID-19 confirmed or suspected cases

Categories of patient precautions

LA County has provided guidelines for the management and care of COVID-19 confirmed patients and persons under investigation (PUI). These guidelines have been applied to the radiology department as well as all inpatient and outpatient settings.

Table 1 COVID-19 testing criteria

Admission	Clinical factors	COVID-19 test
Patient being admitted		Yes
Patient NOT being admitted	No symptoms of acute respiratory infection (fever, cough, new shortness of breath)	No
Patient NOT being admitted	Symptoms of acute respiratory infection but no high-risk factors*	No
Patient NOT being admitted	Symptoms of acute respiratory infection with high-risk factors*	Yes

* High-risk factors include health care workers, age > 65 with comorbid conditions, working or living in congregate setting (such as skilled nursing facility, rehab center, correctional facility), and other at-risk populations with immunosuppression, malignancy, severe chronic lung disease, coronary artery disease, and pregnancy

Under these guidelines, both suspected and confirmed cases are to be cared for under droplet and contact precautions. The personal protection equipment (PPE) for such cases includes surgical mask, face shield, gown, and gloves. An exception is made when aerosol-generating procedures (AGP) are performed. In this case, the provider should follow contact and airborne precautions using N95 mask, face shield, gown, gloves, and surgical cap. Alternatively, powered air purifying respirator (PAPR) or controlled air purifying respirator (CAPR) are acceptable in place of N95 and face shield. Guidance on precautions and mask use is detailed in Fig. 1. Both surgical and N95 masks are kept at the nurses' stations throughout the hospital. Providers are to ask for indicated mask given precautions recommended by the guidelines.

Given scarcity of N95 masks, guidance has also been provided for when reuse of the N95 is appropriate. For all COVID-19 confirmed or suspected patients in airborne precautions, health care workers are not to reuse N95 masks. For patients that are not confirmed or suspected of COVID-19, and are in airborne precautions (such as patients with tuberculosis), N95 mask reuse is acceptable up to 5 times in a given shift. Each time the mask is removed, the provider is to place the mask in a paper bag (available in each unit) labeled with the provider's name. After the fifth use (or if mask becomes soiled/damaged/damp/difficult to breathe through), the mask and bag are to be discarded.

Aerosol-generating procedures

Radiology procedures explicitly designated as AGP include lung biopsies, lung ablation, bronchial stenting, and bronchial artery embolization.

Other potentially high-risk procedures include nasogastric or orogastric tube placement, chest tube placement for pneumothorax, upper GI studies, gastrostomy/jejunostomy/gastrojejunostomy tube placements, and thoracentesis. However, hospital guidelines do not explicitly mandate an N95 mask for these procedures, instead recommending a surgical mask.

When to image

For COVID-19 confirmed or suspected patients, portable radiographs can be obtained as needed. CT is not used for screening or diagnosis of COVID-19 but can be obtained for inpatients to evaluate for complications such as lung abscess or empyema. Furthermore, CT, MRI, and portable ultrasound can be obtained to evaluate for alternative diagnoses that are considered urgent and will affect patient management.

Patient transport

For confirmed COVID-19 patients or PUI, any procedures that are feasibly performed at the bedside should be done in the patient's room to minimize exposure to other parts of the hospital. However, many types of imaging and image-guided procedures cannot be performed at the bedside and thus require the patient to be transported to the department of radiology.

Droplet and contact precautions with eye protection are implemented for the receiving department as well as the transport team in the patient's isolation room as they prepare the patient for transport. The patient wears a surgical mask and is covered by a clean sheet that was not stored in his/her room. While transporting the patient, the transport team does not wear PPE except for a mask. The team will carry PPE including extra masks, face shields, and gloves in case of emergencies during the transport. One transport team member is designated as having "clean hands" in order to interact with the environment, such as pushing elevator buttons.

After the patient has returned to his/her room, any equipment that came into contact with the patient, including wheelchairs and gurneys, must be cleaned and disinfected before use with the next patient.

In the ambulatory setting, COVID-19 confirmed patients or PUI should wear a mask and be escorted to the nearest entrances and exits by a masked staff member.

Fig. 1 Guidance on precautions and mask use

Room and equipment cleaning

Use of radiology rooms and equipment by either confirmed or suspected COVID-19 patients creates a potential vector for transmission to both patients and healthcare workers. While plain radiographs and ultrasounds were performed portably at bedside, the patients were brought to the CT and MRI suites. Therefore, radiology departmental policies have been created to guide cleaning for each modality after each use by a COVID-19 confirmed patient/PUI.

Two modes of cleaning have been implemented: regular and terminal cleaning. For portable radiographs and ultrasounds, regular cleaning of the equipment and patient contact surfaces is performed. For CT and MRI, the cleaning method depends on the COVID-19 status of the patient previously imaged in the room as well as the COVID-19 status of the following patient. Regular cleaning is performed following asymptomatic patients, or if a confirmed COVID-19 patient/PUI is to be followed by a confirmed COVID-19 patient. Terminal cleaning is performed when a confirmed COVID-19 patient/PUI is to be followed by an asymptomatic patient or a PUI.

Regular cleaning involves the technologists to wipe down the medical equipment and patient contact surfaces with hospital-approved disinfectants or as available when specific wipes are in shortage. These wipes include Super Sani-Cloth™ (alcohol-based, 2 min contact time), Sani-Cloth™ (bleach-based, 4 min contact time), CaviWipes™ (quaternary ammonium and alcohol-based, up to 3 min contact time), and Oxivir™ (hydrogen peroxide-based, 1 min contact time). Contact time, also known as wet time, is the time required for a disinfectant to remain wet on a surface to ensure efficacy.

Terminal cleaning involves aeration of the radiology room based on the air exchange rate. In our facility, the CT suite allows for a 15-min aeration time while the MRI suite allows for a 30-min aeration time in accordance with CDC guidance [7]. Following aeration, a terminal clean is performed by environmental services staff with PPE (N95, gown, gloves, face shield/goggles), spanning approximately 45 min. Therefore, the overall downtime for CT suites is approximately 1 h and

for MRI suites is approximately 1 h 15 min. There are 4 CT and 3 MRI scanners in our facility. One CT scanner is designated for the use of COVID-19 confirmed or suspected patients with the potential to utilize other scanners in case of COVID-19 patient surge. There is no designated MRI scanner—any of the three can be used. Given the availability of extra scanners and decreased patient volume, there was no significant increase in the ED patient length of stay despite the scanner downtime for cleaning.

Exposed or sick radiology staff

Potential exposure to COVID-19

LA County has created a risk assessment guide for healthcare workers who are exposed to COVID-19 confirmed individuals in and out of the hospital based on the type of interaction and the use of PPE.

In brief, high-risk encounters include direct exposure to droplets from respiratory secretions (cough or sneeze) or close proximity to aerosol-generating procedures without proper PPE. For such cases, exposed healthcare workers (self-reported) are to be excluded from work and self-monitor under employee health services (EHS) supervision until 14 days after last potential exposure.

Sick employees

Our hospital policy directs employees who become symptomatic with fever, cough, or shortness of breath to stay home to prevent risk of transmission. Those with symptoms must also notify their supervisor and pursue medical care as appropriate. Personnel may return when they have been free of fever > 72 h (without the use of fever reducing medication) and respiratory symptoms have significantly improved.

If an employee tests negative for COVID-19, 72 h period of no fever and symptom improvement must still be pursued prior to return to work.

If an employee tests positive for COVID-19, further guidelines are provided for symptomatic and asymptomatic individuals. Symptomatic individuals are directed to stay home on self-isolation, only to return to work after they are asymptomatic > 72 h AND > 7 days have elapsed since the onset of symptoms. Asymptomatic individuals must stay home until they have remained asymptomatic for 7 days since the test collection. If symptoms arise during this period, they are to follow the aforementioned protocol for symptomatic individuals.

Radiologist workflow

Remote work

As the outbreak developed, our radiology department has increased funding to provide adequate remote radiology capability. This includes the supply for computers, monitors, and dictation microphones to the radiologists. In addition, our virtual radiology network capacity was increased to accommodate a greater number of concurrent users. At present, the vast majority of the radiology faculty has been equipped to read remotely from home, rendering final interpretations on plain radiographs, CT, MRI, and US. Diagnostic mammography, fluoroscopy, nuclear medicine, and interventional radiology were excluded from remote work due to their procedural nature and/or the need for on-site tech supervision. At least 1 radiology faculty from each subspecialty division was required to be on-site, with the remainder working remotely. Additionally, the number of on-site residents was reduced from approximately 50 to 20 residents during the work week, with regular rotation of roster amongst them. While the resident workflow varies between subspecialties, the offsite residents commonly have reduced or no clinical work. However, they still observe sign out sessions between radiology attendings and on-site residents by video conferencing.

Educational and interdisciplinary conferences

All educational and interdisciplinary radiology conferences are held on video conferencing platforms rather than in-person. This applies to daily didactic noon conferences for the radiology residents as well as weekly conferences within the radiologic subspecialties.

Image interpretation

Our radiology department has been utilizing standardized report templates prior to the COVID-19 outbreak. Following the outbreak, the radiologists are also encouraged (but not required) to use standardized language in their CT impression for COVID-19, which is recently discussed in the expert

consensus statement by Radiological Society of North America (RSNA) [8]. In this language, the CT lung findings are divided into four categories: (1) typical appearance for COVID-19, (2) indeterminate appearance, (3) atypical appearance, and (4) negative for pneumonia. Standardized language is not used for radiographic lung findings.

Hospital communication

The hospital status dashboard website is updated daily and clearly displays various relevant information including the occupancy of the hospital and its different units, the cumulative number of in-hospital deaths related to COVID-19, the number of positive COVID-19 patients currently within the hospital, the number of various PPE's in stock, the number of test kits, and the number of staff exposed to COVID-19, tested, and quarantined. There are COVID-19 virtual "town hall" meetings twice a week as well as frequent hospital wide email updates. There are also weekly meetings between the radiology representatives from each of the four LA County hospitals.

An electronic alert has been implemented when accessing a COVID-19 confirmed patient's electronic medical record. This aids in increasing awareness and the need for precautions by the providers. However, no such alert system has been implemented when accessing the patient's radiologic exams via PACS.

Readiness for patient surge

Our hospital has prepared a surge plan to increase bed capacity with two methods:

- 1) Decreasing the overall census to free up existing capacity by deferring elective appointments, discharging as soon as safely possible, and transferring some of the patients (who are negative or asymptomatic for COVID-19) to United States Naval Ship Mercy, which has a 1000 bed capacity.
- 2) Expanding ICU, step down unit, and medical-surgical beds to other clinical areas within the hospital. This results in addition of 100 ICU beds and 136 step down units/medical-surgical beds across four LA County hospitals.

In addition, disaster tents have been set up outside of the LAC+USC emergency department entrance in case of surge of patients for rapid triaging. Fortunately, there has not been a need to operationalize these tents at present.

There are approximately 350 ventilators within the LA County department of health services, of which approximately 25% are in use at this time.

COVID-19 effect on hospital metrics

The total number of radiologic exams across all modalities throughout the hospital was decreased by approximately 20% in March and 45% in April compared with those of 2019, likely due to a combination of elective imaging deferral and decreased patient visits (emergent, urgent, and elective). Similarly, the number of patient visits in the ED was decreased by approximately 25% in March and 50% in April compared with those of 2019. The median length of stay in the ED was decreased by approximately 10% in March and essentially unchanged in April compared to those of 2019, which may be due to the aforementioned decreased volume of exams and patient visits despite the addition of new policies and procedures.

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 1. Substantially contributed to the conception or design of the work
 2. Writing and/or revision of the manuscript
 3. Approved the final version of the manuscript
 4. Be accountable for the manuscript's contents

Compliance with ethical standards

Conflict of interest The authors declare that they have no conflict of interest.

Statement of data integrity The authors declare that they had full access to all of the data in this study and the authors take complete responsibility for the integrity of the data and the accuracy of the data analysis.

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