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The role of radiologic technologists during the COVID-19 pandemic

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Abstract: During the pandemic, stress of coronavirus disease 2019 (COVID-19) on a radiology department has caused major change in the workflow and protocol, which can inflame unnecessary anxiety among the staff. We have adapted and responded quickly however, to the volatile clinical situations owing to a close consultant in infection control. Our repeatedly revised procedures since the 2014 Ebola outbreak possess the expertise and were very useful. In-house training sessions have been held and updated accordingly. In-house networking service has now become more common in our department instead of the emergency contact network relaying the message to the person on the phone tree. Up until January 2022, we examined 10,861 chest X-rays with no in-hospital infection. We sincerely hope our chest X-ray strategies comply with infection prevention and control standards and minimize use of personal protective equipment will be embraced as a positive initiative by frontline radiologic technologists and relieve their anxiety.

***Keywords*:** coronavirus disease 2019 (COVID-19), chest X-ray, sustainable operation, personal protective equipment (PPE), pandemic, staff management

Introduction

The first case of coronavirus disease 2019 (COVID-19) in Japan was reported on 16 January 2020. The total number of infected reached 8,876,504 and the number of deaths reached 30,659 as of June 1, 2022. The main symptoms of COVID-19 are fever and respiratory symptoms (*1*). Despite the absence of dyspnea, some patients with COVID-19 may have markedly reduced oxygen saturation. In Japan, every time there was a major COVID-19 wave, the medical facilities became overwhelmed.

The decision to image patients who are positive for COVID-19 or are suspected of having COVID-19 is based on how the imaging will impact patient care. Although we do not routinely use imaging for COVID-19 screening, imaging is performed in patients positive for or suspected of having COVID-19 to rule out other diagnoses that can be treated. Chest X-ray (CXR) and computed tomography (CT) are the most commonly used imaging techniques for the management (diagnosis, hospitalization, and follow-up) of patients with COVID-19 (*2,3*), and several authors have found that both modalities are useful predictors of patient outcome (*4-10*).

In this scenario, the radiologic technologists accepted their crucial roles in the management of infected and non-infected patients. They need to work safely to limit the spread of the virus to decrease morbidity and mortality rate, which may result from delayed diagnosis and treatment of the infected patients.

Another important consideration is conserving PPE by avoiding excessive precaution and resource utilization. These stresses of COVID-19 on a radiology department have caused major changes in the workflow and protocol, which can vary among institutions and inflame unnecessary anxiety among the staff.

Ever since the 2014 Ebola outbreak, we have employed and revised procedures and held in-house training sessions repeatedly. From the first acceptance of a COVID-19 case in January 2020, our radiology department has worked safely up to January 2022 (10,861 chest X-rays and 3,985 CT cases).

The purpose of this article is to describe and suggest our procedures to assist in combating not only this pandemic but also another one, which may emerge in the future.

Approach

Following hospital policy, close contacts of people infected with coronavirus are to stay at home and self-isolate while they are suspected of being infected with the coronavirus, including their family members. With the exception that employees exposed to COVID-19 who are asymptomatic are required to return to work, to attest to their health daily, and to self-monitor for symptoms before the time they leave home. We worked

on an assignment of minimizing close contacts with COVID-19 so as to maintain the state.

Our approaches to COVID-19 cases are summarized in Table 1 and below:

Staff management for sustainable radiology operation

Our existing radiology management structure was too large to effectively respond to the rapid scenario changes. In order to reduce risk from outbreak of clusters happening and to have multiple backups in case of a cluster, we broke up all radiologic technologists into four hybrid groups and operated as individual organizational structures dealing with daily routine. Each group was equally composed of experts in X-ray, CT, Magnet Resonance Imaging, Interventional Radiology, Nuclear Medicine, and Radiation Therapy. Every member had restricted access to the others outside his or her group members. Meetings were conducted online to avoid congregation. Staff were encouraged to maintain social distancing and encouraged to stay home if exhibiting cold-like symptoms or fever (37.0℃ and over). The unit supervisor kept health status records of every staff member and reported with them and consulted with our Infection Control Team when necessary.

Monitor and respond to rapid changes in the COVID-19 pandemic

The same trend that was seen for the number of patients with severe symptoms in Tokyo reported on Tokyo Metropolitan Government COVID-19 Information Website was also seen for the number of CXR for COVID-19 cases at NCGM between September 2020 and November 2021 (Figure 1). The website served as a good indicator to predict waves of COVID-19 and to allocate more radiologic technologists and resources for CXR to cope with the sharp increase in infections.

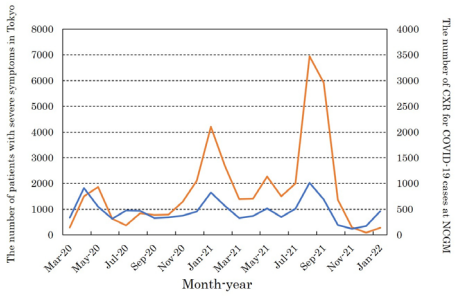

Figure 1. Patients with severe symptoms in Tokyo Metropolitan Government Website and CXR cases for COVID-19 at NCGM. This figure nicely illustrates the website served as a good indicator of allocation of radiologic technologists for CXR. The same trend that is seen for the number of patients with severe symptoms in Tokyo reported on Tokyo Metropolitan Government COVID-19Information Website (orange line) is also seen for the number of CXR for COVID-19 cases at NCGM (blue line) between September 2020 and November 2021.

Table 1. Summary of the standard approach and procedure during the pandemic

Approach	Procedure
1) Staff management for sustainable radiology operation	● Breaking up radiologic technologists into four hybrid groups. ● Restricting access to only his or her group members. ● Conducting meetings online. ● Maintaining social distancing and encouraging members to stay home if exhibiting cold-like symptoms or fever (37.0 oC and over). ● Keeping health status records of every staff member.
2) Monitor and respond to rapid changes in the COVID-19 pandemic	Using the website as an indicator to predict waves of COVID-19 and to allocate radiologic technologists and resources to cope with the sharp increase in infections.
3) Education	● Discontinuing the existing training program and not accepting external students and trainers. ● Training all staff regularly for donning and doffing of personal protective equipment (PPE), hand hygiene and infection prevention protocols. ● Composing an infectious disease clinical team in radiology department.
4) General environment	● Setting up a waiting area to keep social distancing and temperature checks before entering the hospital. ● Scheduling suspected and confirmed COVID-19 patients at the end of morning work and at the end of clinic day. ● Informing suspected or confirmed patients in radiology information system prior to imaging.
5) COVID-19 chest X-ray	● Designating and covering mobile X-ray equipment and flat panel detectors (FPDs) with plastic bags. ● Working in pairs to promote the contract/non-contract technique. ● Keeping track of all staff involved in scanning.
6) COVID-19 CXR Procedure	● Identifying patients in the clean area. ● Covering the FPD with a plastic bag and touching and manipulating the mobile X-ray only on the designated landmarks. ● After imaging, carrying out the PPE to avoid self-contamination. ● Cleaning all visible surfaces of the room with approved disinfecting agents, if necessary.

Education

We discontinued the existing training program and did not to accept external students and trainers for the time being at this stage. All staff were trained regularly for donning and doffing of PPE, hand hygiene and infection prevention protocols. Radiology department selected and composed an infectious disease clinical team to fulfill the key role of infection control. The team actively disseminated useful information and provided guidance to all staff members electronically.

General environment

We set up a designated waiting area for patients keeping social distancing and submitted all out-patients and visitors to temperature checks and inquiries before entering the hospital. We extended time between exams for cleaning and disinfecting equipment and scheduled suspected and confirmed COVID-19 patients at the end of morning work and at the end of clinic day. We informed suspected or confirmed patients in radiology information system prior to imaging.

Preparing COVID-19 CXR

Mobile X-rays are the mainstay imaging tool for emergency department and inpatient settings. We designated and covered mobile X-ray equipment and flat panel detectors (FPDs) with plastic bags to reduce transmission risk. We worked in pairs to promote the contract/non-contract technique; one radiologic technologist positioned the X-ray tube and made the exposure and another positions the patient and set the covered FPD. We cleaned and disinfected the imaging equipment after each procedure. We kept track of all the staff involved in scanning.

Following are our standard procedures:

i) Landmarks for touch of the equipment We designated some landmarks as red circles on the equipment for touching to operate. These reduced number of contact points not only economized time and labor to sanitize the equipment but limited the spread of the virus (Figure 2).

ii) Suggested personal protective equipment (PPE) set Body protection: long-sleeved water-resistant gown; Head protection: cap; Respiratory protection: particulate respirator type N95 mask (N95); Eye protection: face shield or goggles; Hand protection: inner and outer gloves.

iii) Protective equipment for indirect transmission Plastic cover for operator console and FPD

iv) Wearing (donning) the PPE

Before wearing the PPE, proper hand hygiene should be performed following international recommendations (*11*). This is a critical aspect in this setting and should be performed using an alcohol-based solution in accordance with the manufacturer's instructions.

Figure 2. Landmarks (red circles) for touch on the X-ray tube. These landmarks served not only to limit the spread of the virus but also to economize time and labor to sanitize the X-ray tube.

The first PPE to be worn is the gown. When using a gown with back closure, a second operator assisted in buttoning up the back.

After wearing the gown, it is suggested to proceed with the respirator (N95) that protects from the inhalation of droplets and particles. It is important to perform a fitting test after the respirator has been put on, following the manufacturer's instructions. The metal nose clip needs to be adjusted and the straps have to be tightened to have a firm fit. Once the respirator has been properly positioned, put on the face shield or goggles for eye protection. Position the face shield or goggles properly and ensure it fits well.

After the goggles, wearing gloves is next. It is important to extend the glove to cover the wrist over the gown's cuffs. For individuals allergic to latex gloves, an alternative option, for example nitrile gloves, should be available.

COVID-19 CXR procedure

i)Patient identification Patients should be identified not in the contaminated but in the clean area. We employed the modality work list passing a barcode scanner in a Digital Imaging and Communications in Medicine (DICOM) process for this purpose.

ii) Patient positioning and imaging We moved the mobile X-ray to the contaminated area and covered the FPD with a plastic bag. The mobile X-ray should be touched and manipulated only on the designated landmarks to prevent the spread of infection in the hospital. After imaging, we removed the plastic bag carefully and disposed of it in a designated infectious waste container.

iii) Removing (doffing) the contaminated outer gloves After disposing of the plastic bag, we removed the PPE; the PPE should by now be contaminated and this is an important step to be carefully carried out to avoid self-

contamination. The outer gloves were removed first because they are considered heavily contaminated. Alcohol-based hand disinfectant was done before removing the outer gloves. We disposed of the removed gloves in a biohazard bin.

iv) Imaging equipment cleaning Mobile X-rays and other devices including FPDs and barcode scanners were sanitized with sodium hypochlorite solution focusing on the predetermined contact points. Then adequate ventilation was ensured.

v) Room cleaning With approved disinfecting agents following a clockwise, linear, from top to bottom pattern of cleaning all visible surfaces was done, if necessary.

vi) Removing Gowns and inner gloves After disinfection of the equipment and room, the inner gloves were disinfected with an alcoholic solution. The gown and inner gloves were removed by grabbing the back of the gown and pulling it away from the body, keeping the contaminated front part inside the gown.

vii) Removing eye protection After the gown, either the goggles or face-shields were removed. When removing face-shields, hand disinfection was performed, and care was taken not to touch the surface of the mask. In order to remove the goggles, a finger was placed under the textile elastic strap in the back of the head and the goggles were taken off. Touching the front part of the googles, which can be contaminated, should be avoided.

viii) Removing cap Hand disinfection was performed before removing the cap, and the cap was removed from the inside so that the outside of the cap should not touch hair or face.

ix) Removing respirator In order to remove the respirator, a finger or thumb was placed under the straps in the back and the respirator to be taken off. The respirator was disposed of after removal. It is important to avoid touching the respirator with hands during its removal. After glove removal, hand hygiene was performed.

Outcomes

During the COVID-19 pandemic, the clinical environment has been constantly changing. Constantly updated Tokyo Metropolitan Government COVID-19 Information Website and research on COVID-19 have been valuable sources of information reflecting the latest status. We have adapted and responded quickly to the volatile clinical situations owing to a close consultant in infection control. Since employing procedures during the 2014 Ebola outbreak, those manuals have been revised and enlarged repeatedly. In-house training sessions have been held and updated accordingly. The number of face-to-face meetings has been minimized, while that of online meetings has been proven fast and effective means of communication among the staff. In-house networking service has now become more common in our department instead of the emergency contact network relaying the message to the person on the phone tree.

Up until January 2022, we examined 10,861 CXRs with no in-hospital infection. In this article, we described our chest X-ray strategies to comply with infection prevention and control standards and to minimize use of personal protective equipment: patient identification, patient positioning and imaging, removing the contaminated outer gloves, imaging equipment cleaning, room cleaning, removing gowns and inner gloves, removing eye protection, removing cap, and removing respirator. We sincerely hope this technique will be embraced as a positive initiative by frontline radiologic technologists and relieve their anxiety.

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