

INDICATIONS FOR THE MANAGEMENT OF DIAGNOSTIC IMAGING DEPARTMENTS DURING THE EMERGENCY CAUSED BY THE COVID-19 OUTBREAK

Introduction

The purpose of this paper is to provide indications for the management of diagnostic imaging departments during the emergency caused by the COVID-19 outbreak. We all know that the situation is very different in the various regions in this moment and it is thus not possible to propose organizational and management models applicable throughout the national territory.

Warm regards to our colleagues - particularly in the northern regions - we know they are all working very hard these days. We therefore want to take advantage of their experience and provide useful indications to other regions where the peak of contagion is expected soon. The basic objective of this paper is to reduce the possibility of contagion during radiological investigations in order to protect healthcare providers and public health in general, taking into account the actual diagnostic needs and the resources which are in many cases already limited.

The paper will therefore not try to propose an absolute model, but only the best realistically feasible model in case of progression of the COVID-19 contagion. It is based on the synthesis of experience obtained from our colleagues, also with the help of the Department of Radiology of the Spallanzani Hospital in Rome (warm thanks to Dr. Schininà). The need to minimize interpersonal contact in connection with diagnostic imaging requires reflection on practical procedures and instructions that must be contextualized according to the resources of each facility and to the number of suspected and confirmed cases admitted to the various healthcare structures. Another essential issue concerns the clinical indications and the appropriateness of radiological investigation. This issue assumes significant importance due to the consequences that it can possibly have on the response capacity of the entire healthcare system (particularly if and when it becomes necessary to isolate healthcare providers, if they are on sick leave or even hospitalized).

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This paper will address the following issues:

1. Diagnostic imaging in patients with suspected COVID-19 infection
2. Individual and collective protective measures applied to x-ray, CT and ultrasound examinations
3. Sanitation of equipment and in the radiology department
4. Possible exemptions under particular conditions linked to an extraordinary increase in infected patients:

1 “Diagnostic imaging in patients with suspected COVID-19 infection

Definition of patients with suspected COVID-19 infection:

“A person with acute respiratory infection (sudden onset of at least one of the following signs and symptoms: fever, cough and breathing difficulty) in the absence of another medical condition/history that fully explains the clinical picture. The patient has been travelling to or lives in a country or an area where local transmission has been reported or he/she has been in direct contact with a patient with probable or confirmed COVID-19 infection during the 14 days prior to the onset of symptoms.”

or

"A person with severe acute respiratory infection (fever and at least one sign/symptom of respiratory disease, e.g. cough and/or breathing difficulty) which requires hospitalization in the absence of another medical condition/history that fully explains the clinical picture."

Hopefully, each institution will set up a crisis team, where at least one member of the technical board is a radiologist. The aim should be to define diagnostic procedures and operating instructions considering the human and technological resources available and to reduce contact between healthcare providers and patients with suspected or confirmed COVID-19 infection. Also the accuracy of the various diagnostic methods in identifying interstitial pneumonia in the various stages of the disease should be taken into account.

The possible imaging approaches vary according to the number of suspected patients and the resources available:

Cohort high-resolution CT (HRCT) imaging in all patients suspected of COVID-19 infection

Advantages: this approach provides a diagnosis of interstitial pneumonia also in the initial phase. A logistic consideration: this approach will be simpler to organize if a CT scanner can be dedicated to the COVID-19 investigations as close as possible to the triage area.

Disadvantages: restrictions linked to the number of scanners available, to the distance between the triage area and the CT scanner, exposure to ionizing radiation in all suspected patients, human contact and high consumption of PPE for the protection of healthcare providers as well as time required to sanitize the CT rooms (see attachment) and limited clinical impact on the management of the patient.

Cohort x-ray in all patients suspected of COVID-19 infection

Advantages: this procedure is more easily carried out in the vicinity of a triage area or confinement room compared to CT, using a mobile computed radiography (CR) unit in the "isolation" room or a digital radiography (DR) WI-FI mobile unit in the confinement room or directly in the triage tent. However, this solution involves radiation protection problems.

Diagnostic accuracy of x-ray imaging is sufficient for identifying areas of parenchymal opacification due to pulmonary consolidation, which can be detected in the advanced stages of viral pneumonia.

Disadvantages: Poor sensitivity to signs of interstitial pneumonia which can be detected in the early stages of the disease using CT. TSRM protection kit is required (see attachment). If the examination has to be performed in the radiology department, the risk of interhuman contact during the transport of the patient must be considered.

X-ray or CT only in patients with acute respiratory insufficiency

Advantages: this approach involves reduced interhuman contact compared to cohort studies, less transport of patients and a reduced use of personal protection equipment (PPE). Particularly CT scanning provides evaluation of the degree and extent of pulmonary damage.

Disadvantage: early interstitial pneumonia may be underestimated in patients without acute respiratory failure.

Diagnostic imaging activities in non-urgent cases

As a precautionary measure to reduce the possibility of contagion among inpatients, outpatients and healthcare providers, we suggest that all other imaging services are suspended unless they are urgently

required on the basis of the patient's clinical condition to be assessed on a case-by-case basis. Also private diagnostic imaging inside and outside the hospital as well as private imaging activity carried out by managers of the National Healthcare Service should be suspended like any other non-urgent outpatient activity carried out at accredited or entirely private healthcare facilities.

Please refer to the SIRM guidelines to select the correct examination or procedure, also according to the scenario existing in the healthcare structure in question.

2. Individual and collective protection measures established for x-ray, CT and ultrasound CT? and ultrasound examinations

- Adequate dressing of transport staff.
- Adequate dressing of TSRMs and nurses. Optimize the use of PPE.

CT SCANNING

Procedures to be performed in the patient preparation room:

Staff obliged to wear PPE:

Two TSRMs for CT scanning without contrast enhancement

Two TSRMs and a nurse for contrast-enhanced CT scanning

Safety measures including personal protective equipment (PPE):

- Identification of a path from the triage area to the CT scanner limiting the transport through common areas.
- Use of devices to isolate the patient from the environment during transport (a surgical mask)
- Two pairs of gloves
- Disposable water-repellent coats,
- Protective eyewear
- Surgical mask or respiratory filter type FFP2 or FFP3; powered, air-purifying respirator (PAPR) for invasive or resuscitation procedures.

Dressing procedure:

The following sequence is obligatory:

1. Remove all jewelry and personal items. PRACTICE HAND HYGIENE using water and soap or alcoholic solution.
2. Check the integrity of the devices; use only intact devices.
3. Put on the first pair of gloves.
4. Put on the disposable gown over the uniform
5. Put on a surgical mask (FFP2 or FFP3 or PAPR for invasive or resuscitation procedures)
6. Put on protective goggles
7. Put on the second pair of gloves and a hair cap

To be performed in the CT room:

CT scanning without contrast-enhancement requires two TSRMs, whereas contrast-enhanced CT scanning requires also a nurse in addition to the two TSRMs. In both cases a radiologist must be present in the supervised area or the reporting room.

Place a water-repellent sheet on the CT table.

1. After dressing according to the above procedure, TSRM 1 enters the CT room and accommodates the patient on the CT bed, possibly assisted by the accompanying healthcare providers if the patient does not/cannot collaborate.
2. After centering the patient, TSRM 1 removes the “outer” pair of gloves and disinfects the “inner” gloves using hydroalcoholic gel. He/she leaves the CT room and stays in the patient preparation room.
3. TSRM 1 puts on the “outer” pair of gloves again and waits in the filter area.
4. TSRM 2 performs the examination without leaving the control room. Complete PPE is not required.
5. TSRM 1 takes the patient out of the CT room and sends him/her back to the hospital ward.

Undressing procedure:

1. Avoid any contact between potentially contaminated PPE and the face, mucous membranes or skin.
2. Disposable PPE should be disposed of in an appropriate container in the undressing area.
3. Reusable PPE must be decontaminated.

The prescribed sequence is essential; undressing must take place in front of a mirror or if possible surveyed by a second trained healthcare provider, who wears gloves and a surgical mask. He/she must stay at least one meter away from the potentially contaminated healthcare provider and pour hydroalcoholic gel onto TSRM1’s hands/gloves each time a PPE is removed:

1. Pour hydro-alcoholic gel onto the “outer” gloves.
2. Remove the disposable gown and dispose of it in the container.
3. Remove the “outer” gloves and dispose of them in the container.
4. Pour hydroalcoholic gel onto the “inner” gloves.
5. Remove the goggles, sanitize them using hydroalcoholic gel and place them in a suitable container (a small ROT?). The surveying operator will subsequently wash them using soap and water
6. Remove the hair cap if any.
7. Pour hydroalcoholic gel onto the “inner” gloves.
8. Remove the FFP2 mask touching only the rear elastics and dispose of it in the container.
9. Remove the “inner” pair of gloves.
10. Practice hand hygiene using alcoholic solution as well as soap and water.

X-ray examination in the hospital ward, emergency department or confinement room

Two TSRMs are required.

Follow the above described dressing and undressing procedures and remember to put on a lead apron under the water-repellent disposable gown.

Preparation and performance of the examination:

TSRM 1:

1. The x-ray cassette is prepared in the radiology department by wrapping it up in plasticized insulating material.
2. Place a label to indicate the side and sensitive part.
3. Before the examination in the hospital ward, the cassette is placed in a clean pillowcase.
4. Put on PPE as described above.

5. Take the portable device to the patient's room and center the device.
6. Place the cassette under the patient. If the patient does not or cannot collaborate the nurse in the hospital ward can help.
7. Remove the "outer" gloves and practice hand hygiene.
8. Perform the examination from the front room.
9. When the examination has been performed, put on a new pair of "outer" gloves and return to the hospital room.
10. Pull the x-ray cassette out from under the patient.
11. In the front room or filter area, remove the cassette from the pillowcase and give it to TSRM 2 who is wearing gloves and who is waiting in the filter area; dispose of the pillowcase in a dedicated container.
12. Return to the hospital room to remove the x-ray unit and take it to the front room for subsequent sanitization.
13. Sanitize the x-ray unit and power cable
14. Proceed to undressing.

TSRM 2 wearing gloves, a surgical mask and disposable protective goggles (not attached to a mask) removes the cassette from the plastic wrapping. He/she then sanitizes the x-ray unit and the power cable, assisted by the ward staff. He/she undresses, practices hand hygiene and leaves the front room taking the cassette to the radiology department for development. Once sanitized, the x-ray unit remains available in the ward.

RECOMMENDATIONS FOR THE PERFORMANCE OF ULTRASOUND EXAMINATION IN CONNECTION WITH THE COVID-19 OUTBREAK

Recommendations according to the SIUMB-SIRM indications:

In order to protect healthcare providers from occasional contact with infected patients, the following is recommended:

1. Check the indications for ultrasound examination to avoid transporting patients from the wards to the radiology department to undergo inappropriate ultrasound investigation. Non-urgent examinations should be suspended.
2. Health care providers must wear disposable gloves, a surgical mask (FPP2 or FPP3) and a water-repellent gown.
3. In order to protect both inpatients and outpatients, in case the examinations are urgently required or linked to oncological conditions, and in order to protect both healthcare providers and patients with oncological diseases, also the patient should wear a surgical mask. This is due to the prolonged close contact with the radiologist during an ultrasound examination which excludes the recommended safety distance. The ultrasound probe must be cleaned using appropriate sprays or disinfectants before and after use.
4. If an ultrasound examination is absolutely necessary and cannot be postponed in a patient who has tested positive for COVID-19 or is suspected of infection, the healthcare provider must wear complete PPE (see indications for CT scanning) and perform the investigation as a bedside examination, if possible.
5. In patients tested positive for COVID-19 or suspected of infection, the use of FPP2-FPP3 devices is recommended. However, this type of contact and interaction is not explicitly described in the WHO standards.

3. Sanitizing of radiology equipment and facilities

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Portable CT and x-ray equipment:

Sanitizing follows the normal rules provided for contact isolation including sanitizing of the portable equipment cable following the rules established by WHO. The cleaning and disinfection material must be dedicated and possibly disposable. Reusable material requires adequate treatment, either sterilization or using detergent + disinfectant products for effective chlorine-based disinfection.

Cleaning material:

1. Dedicated trolley
2. Disposable cloths for surfaces
3. Disposable floor cleaning cloths
4. Disinfectants for the environment

The following should be used:

1. Sodium hypochlorite, also containing possible non-ionic surfactants, for hard surfaces and plastic surfaces (two washings, each with a contact time of 5 minutes).
2. 70% ethyl alcohol for metal surfaces or surfaces that can be damaged by hypochlorite.
3. The surfaces of equipment that has potentially been in contact with the patient must be thoroughly sanitized. Disposable plastic sheets can also be used to cover the CT table. After the cleaning operations, a short machine downtime is required to permit exchange of air through the CT room ventilation system, varying between 15 and 30 minutes according to the work-flow.

4. Possible exceptions in extraordinary conditions of significant increase in infected patients:

1. PPE

In the event of a continuous influx into the emergency room of patients with COVID-19 infection, the use of devices with a higher degree of safety must be considered (FPP2 -FPP3) in view of the high-risk exposure to contagion.

2. Sanitization procedures

To reduce machine downtime, cohort sterilization should be considered during/after examination of patients who have tested positive for Covid-19 disease.

References

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