



Canadian Association of Radiologists  
L'Association canadienne des radiologistes

# **Emergency Radiology during the COVID-19 pandemic: The Canadian Association of Radiologists recommendations for practice**

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## Abstract

Coronavirus Disease 2019 (COVID-19) is the disease caused by the novel coronavirus officially named the Severe Acute Respiratory Syndrome Coronavirus 2 (SARS-CoV-2), declared as a pandemic by the World Health Organization on March 11th, 2020. The COVID-19 pandemic presents an unprecedented challenge to Emergency Radiology practice. The continuity of an effective emergency imaging service for both COVID-19 and non-COVID-19 patients is essential, while adhering to best infection control practices. Under the direction of the Board of the Canadian Association of Radiologists, this general guidance document has been synthesized by collaborative consensus of a group of emergency radiologists. These recommendations aim to assist radiologists involved in emergency diagnostic imaging to help mitigate the spread of COVID-19 and continue to add value to patient care in the emergency setting.

This guideline covers the following topics:

- Imaging of ED patients with suspected or confirmed COVID-19
- Role of Radiologist in identification of patients with possible COVID-19 in the ED
- Emergency imaging for non-COVID-19 indications
- Infection prevention and control measures
- Staff health and wellbeing
- Education and research

## Keywords

COVID-19, Emergency Radiology, Recommendations, Guidelines, Coronavirus

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## Resources

- Additional COVID-19 information and resources - <https://car.ca/covid-19/>

## Introduction

Coronavirus Disease 2019 (COVID-19) is the disease caused by the novel coronavirus officially named the Severe Acute Respiratory Syndrome Coronavirus 2 (SARS-CoV-2), first identified in Wuhan, China in December 2019 following the presentation of a group of patients with viral pneumonia (1). In the early months of 2020, COVID-19 has spread globally by human-to-human transmission and was declared as a pandemic by the World Health Organization (WHO) on March 11th, 2020 (2). It is likely that this pandemic will continue for a protracted period of time.

The Emergency Department (ED) is a major access point to healthcare services for new and existing cases of COVID-19. With the COVID-19 pandemic, the subspecialty of Emergency Radiology (ER) is facing its greatest challenge in its relatively short history (3). Experience in Mass Casualty Incident (MCI) planning has assisted emergency radiologists in preparing their response to this pandemic. For emergency radiology departments, the primary goal of “preparedness” is to make operational adjustments to practice and workflow in order to ensure the continuity of a safe and effective emergency imaging service for both COVID-19 and non-COVID-19 patients. The recommendations herein aim to assist radiologists involved in emergency diagnostic imaging to help mitigate the spread of COVID-19 and continue to add value to patient care.

Under the direction of the Board of the Canadian Association of Radiologists, this guidance document has been synthesized by collaborative consensus of emergency radiologists using the best available evidence. These recommendations seek to compliment the guidance on COVID-19 management in imaging departments recently issued by the Canadian Society of Thoracic Radiology/Canadian Association of Radiologists (5). Given the dynamic nature of this pandemic and the considerable rate of emerging research, these recommendations may be subject to future updates or modifications.

## Background

Taxonomically SARS-CoV-2 is member of the Coronaviridae family (6), along with two other viruses that have previously caused disease epidemics - Middle East respiratory syndrome (MERS) and severe acute respiratory syndrome (SARS). COVID-19 exhibits a varied clinical course, ranging from asymptomatic infection and mild disease to very severe disease. The most frequently observed clinical manifestations are fever, cough and dyspnea (6). Severe disease typically manifests as an acute respiratory condition requiring critical care by admission to an intensive care unit (ICU) for acute and often prolonged patient management.

Transmission of SARS-CoV-2 is via droplet-spread, thus human-to-human transmission occurs by direct contact with an infected person or contact with surfaces/objects used by an infected person (7). Airborne transmission can also occur in the setting of aerosol-generating medical procedures. While there is some evidence that SARS-CoV-2 can be detected in feces, to date fecal-oral transmission has not been reported. At time of writing, there is insufficient evidence

regarding the identification of an effective anti-viral agent. In the absence of an effective anti-viral agent or vaccine, reduction of community transmission of SARS-CoV-2 is currently the primary response in most countries. This involves the adoption of physical distancing measures and reduced human movement in order to reduce the risk of acute COVID-19 surges within communities and immense pressure on healthcare resources.

## Imaging of ED patients with suspected or confirmed COVID-19

At present, the reference standard diagnostic test for COVID-19 infection is reverse-transcription polymerase chain reaction (RT-PCR) testing of pharyngeal swabs (8). Chest radiography and Chest Computed Tomography (CT) are the primary imaging modalities for the evaluation patients with known or suspected COVID-19 infection in the ED. These imaging investigations require judicious use given the recognized risks and ramifications of imaging COVID-19 patients (potential transmission to healthcare workers and other patients, consumption of personal protective equipment stocks, and the ensuing downtime required to decontaminate emergency imaging equipment and rooms)(9). At present, there is insufficient evidence to support the use of lung ultrasound for the evaluation of patients in the ED with suspected or confirmed COVID-19. Furthermore, the sustained close contact required to perform a lung ultrasound poses a risk of infection transmission to the operator. The aims of imaging for patients with suspected or confirmed COVID-19 is to document the presence of pneumonic change, identify alternative diagnoses and assess for disease severity, progression, or complication. The initial evidence suggests that chest CT has good diagnostic performance for patients presenting to the ED with possible COVID-19: Dangis et al. have reported a study involving 192 ED patients who underwent chest CT and RT-PCR on presentation (10). Low dose chest CT was observed to have a sensitivity of 86.7% and a specificity of 93.6% for the diagnosis of COVID-19. In this study, the use of Chest CT for diagnosis of COVID-19 had a notable rate of false negatives (13%). In terms of the role of chest imaging in the ED for patients with suspected or confirmed COVID-19, we advocate the guidelines on imaging indications issued by the Canadian Society of Thoracic Radiology and Canadian Association of Radiologists (11). These guidelines also make recommendations on the use of reporting structures that ensure consistency and add value to patient management.

## Role of Radiologist in identification of patients with possible COVID-19 in the ED

During the COVID-19 pandemic, radiologists must be cognizant of the wide clinical spectrum of COVID-19 in order to help facilitate a diagnosis of COVID-19 in less typical patient presentations to the ED. While increasing data on the multisystem effects of COVID-19 emerge, recognized specific extra-pulmonary imaging features of COVID-19 are lacking at present. However, there are opportunities to incidentally identify pulmonary imaging features of COVID-9 in patients without typical COVID-19 presentations that undergo pulmonary imaging or partial pulmonary

imaging (such as abdominal CT, neck CT or cardiac CT). This should prompt the radiologist to advise immediate isolation of the patient and pharyngeal swab for RT-PCR.

### Gastrointestinal presentation of COVID-19

A subset of patients with COVID-19 infection initially present with abdominal symptoms. The prevalence of gastrointestinal symptoms in published cohorts of patients with COVID-19 infection is in the range of to date (2-35.6%) (12). The typical gastrointestinal complaints of COVID-19 patients are abdominal pain, nausea, vomiting and diarrhea. At time of writing, two separate case series in the radiological literature describe patients presenting to ED with acute gastrointestinal symptoms (13,14) with typical features of COVID-19 at the lung bases. Subsequent PCR tests prompted by the imaging findings for the majority of these patients were positive. Given the key role of abdominal CT in the assessment of the acute abdomen, as the COVID-19 pandemic continues, this is likely to become a more recognized mode of COVID-19 identification. It is important that radiologists carefully search for typical features of COVID-19 at the lung bases of patients undergoing abdominal CT in the ED.

### Neurological presentation of COVID-19

The neurological manifestations of COVID-19 are gaining increased recognition. In a case series of 214 patients hospitalized with COVID-19 in Wuhan, Mao et al. observed that 78 patients (36.4%) exhibited neurological symptoms and/or signs such as headache, dizziness, impaired level of consciousness and acute stroke (15). Unenhanced head CT should be considered in patients with neurological symptoms to exclude ischemic and hemorrhagic brain abnormalities.

### Cardiac presentation of COVID-19

There is new evidence documenting the occurrence of myocardial injury in patients with COVID-19. On retrospective review of cardiac clinical, biochemical and imaging data for a cohort of 112 COVID patients at a hospital in Wuhan, Deng et al. observed that 12.5% of patients had features suggestive of myocarditis (16). In New York over a one-month period during a COVID-19 case surge, Bangalore et al. reported myocardial injury associated with ST-segment elevation in a cohort of 18 patients with a high prevalence of non-obstructive coronary disease (17).

### Emergency imaging for non-COVID-19 indications

The COVID-19 pandemic presents a challenging environment for the management of time-sensitive non-COVID-19 conditions due to the strain on resources and need for infection control measures (18-20). The potential adverse ramification of this pandemic on outcomes for non-COVID-19 related disease has been declared as the "untold toll" in a recent article in the New England Journal of Medicine (21). The 24/7 provision of radiology services in the ED should not be disrupted or curtailed. Emergency Radiologists must make every effort possible to support the delivery of best practice treatment to patients presenting to the ED with non-COVID-19 related disease. All patients presenting to the ED requiring emergent imaging should undergo imaging without delay. The establishment of dedicated departmental protocols for imaging

pathways during the pandemic for emergencies (such as acute stroke or trauma) is advised. The provision of "hot reads" by emergency radiologists at the CT console should be provided in appropriate circumstances. Given the potential uncertainties regarding COVID-19 patient status and difficulties to maintain physical distancing in these emergencies, staff should utilize COVID-19 appropriate PPE as appropriate per institutional protocol.

## Infection prevention and control measures

In order to reduce the risk of SARS-CoV-2 transmission to healthcare workers and other patients in the Emergency Radiology Department, the implementation of measures to minimize potential pathogen exposure are required. These involve appropriate use of PPE, disinfection of contaminated equipment and physical distancing. All personnel must receive adequate communication and education on all departmental infection control protocols.

### Personal protective equipment

Emergency Radiology Department staff having patient contact during the COVID-19 pandemic must have access to adequate PPE as per institutional protocol. For contact with possible COVID-19 patients, the Centers for Disease Control and Prevention (22) and Health Canada (23) recommend the donning of gloves, a full-length gown, a facemask and eye protection. Additional airborne precautions including the use of N-95 certified masks are required in the setting of aerosol generating medical procedures. Given the broad clinical spectrum of COVID-19 and the potential for patients to be asymptomatic during admission to the ED, it seems prudent that droplet precaution level PPE be worn for all patient encounters.

### Source control and decontamination

There should be a rigorous departmental standard operating procedure for the imaging pathway of patients with suspected or confirmed COVID-19 (referred hereafter as "suspected COVID-19 patients"). Source control is a key element of the protocol: this involves maintaining isolation of suspected COVID-19 patients from other ED patients undergoing imaging. Furthermore, suspected COVID-19 patients should be provided with a facemask to wear to reduce droplet emission. Ideally, there will be a physically separate access route to a dedicated imaging suite for suspected COVID-19 patients (24). However, this will not be achievable in many EDs due to resource limitation and structural layout. To reduce movement of suspected COVID-19 patients, radiographs should, where possible, be acquired using portable units. A single anterior-posterior projection is usually sufficient. Imaging suites and equipment (especially CT scanners) should be decontaminated after every use by a suspected COVID-19 patient according to hospital protocol. This cleaning process should be performed by personnel who have received adequate training. Frequently touched surfaces need to be cleaned using hospital-grade disinfectant approved for use against SARS-CoV-2 by Health Canada (25). Imaging suites should be kept adequately ventilated.

## Adapting the ER reading room

Given a risk of COVID-19 transmission from asymptomatic/pre-symptomatic healthcare workers, the importance of strategies to prevent infection in reading rooms (5,26) and other similar non-clinical healthcare areas have been recognized (27). Informed by scientific understanding on droplet transmission, the maintenance of a physical distance of at least six feet between colleagues is recommended (28). This may necessitate the removal of several workstations and repositioning of the remaining workstations. Workstations and associated equipment should be wiped down with disinfectant wipes prior to use. For the duration of each shift, radiologists should be each be designated their own desk, workstation, and telephone for their sole use. Alcohol-based hand sanitizer should be made available to facilitate the maintenance of hand hygiene. Case discussion and consultation with referring physicians by telephone or online platforms should replace face-to-face consultations where possible. A temporary sign should be placed at the door of reporting rooms encouraging telephone consultation in order to reduce reading room traffic and congestion. The use of paper radiology request forms may cause fomite transmission, thus radiology requests should be inputted and vetted by electronic means. While the provision of an on-site Emergency Radiology clinical service is preferable, the establishment of remote coverage capability using teleradiology is recommended in case of scenarios of staff quarantine or shortage.

## Staff health and wellbeing

Any staff who develop symptoms concerning for COVID-19 should put on a facemask, immediately leave the department, undergo RT-PCR testing and self isolate at least until the test result is available, with further guidance provided by institutional occupational health services (OHS). In cases where COVID-19 is confirmed, an infected member of staff should not return to work until they recover fully and meet the return to work criteria of the hospital OHS. Staff who have had unprotected contact with a person with COVID-19 should self-isolate away from the workplace in accordance with their local public health authority guidelines or hospital OHS. Special working arrangements should be considered for staff that are pregnant or fall within high risk categories for developing severe COVID-19, such as with chronic illness.

Working in emergency radiology settings can prove demanding and stressful during normal conditions. COVID-19 considerably adds to the burden of emotional strain on radiologists. Maintaining positive engagement and communication between all stakeholders in the ER department is a priority for leaders. Frequent team meetings and update briefings can be facilitated using videoconferencing platforms. A group of Radiologists from Singapore General Hospital have helpfully shared advice for the COVID-19 pandemic based on their experience from the SARS epidemic (29). They emphasize the emotional challenge that this pandemic will present and urge radiologists to "look out for each other" throughout the course of this pandemic. Supporting the wellbeing of radiology trainees during the pandemic is particularly important, given the prevalence of burnout among this group (30). Departmental leaders should seek to facilitate methods and interventions to help alleviate stress and anxiety among staff.

Simple measures such as incorporating the "micropractices" advocated by Fessell et al. into daily routine may help radiologists improve their emotional wellbeing during the pandemic (31). Many institutions recognize the need for wellbeing of their teams and have made resources available to deal with extra burden, if not previously already available.

## Education and research

Providing education is a core component of ER. The COVID-19 pandemic presents unique challenges to the training of residents and fellows in ER. Prior to COVID-19, the apprenticeship model has served as a fundamental teaching strategy in the reading room where learning occurs with trainer and trainee located side by side at the workstation. The adoption of technology to overcome physical distancing barriers is critical for the continuity of ER training during the pandemic. Virtual platforms that provide videoconferencing with screen sharing capabilities are most suited to replicate the interactive case-based teaching previously occurring in the reading room. The COVID-19 pandemic significantly impacts on the education of medical students, for whom ER has gained recognition as a valued option for an elective. ER electives for medical students should be put on hold during the pandemic due to physical distancing measures and potential for COVID-19 exposure. During this period, the creation of dedicated e-learning modules and adoption of simulation is recommended to help offset the loss of clinical exposure to ER for medical students. It has been postulated that these enforced transitions to medical student radiology teaching may offer some benefits such as the greater potential to reach learners across the world and positively convey the subspecialty of ER.

During the COVID-19 pandemic, Emergency Radiologists must help with the collaborative worldwide efforts to advance the understanding of this new disease. Research projects pertaining to COVID-19 should be prioritized in academic ER departments.

## Summary

The important role of Emergency Radiology in the global medical response to the COVID-19 pandemic has been outlined. The aforementioned operational adjustments aim to ensure the protection of the health of both staff and patients in the ER department. These recommendations seek to enable emergency radiologists to support the delivery of high-quality care to patients presenting to the emergency department with COVID-19 and non-COVID-19 related disease.



## References

- 1) Lu H, Stratton CW, Tang YW. The Wuhan SARS-CoV-2—What's next for China. *Journal of Medical Virology*. 2020 Jun;92(6):546-7.
- 2) WHO Director-General's opening remarks at the media briefing on COVID-19 - 11 March 2020. World Health Organization. <https://www.who.int/dg/speeches/detail/who-director-general-s-opening-remarks-at-the-media-briefing-on-covid-19---11-march-2020> (accessed April 18, 2020).
- 3) Redmond CE, Gibney B, Nicolaou S et al. Emergency Radiology in 2020: Moving Forward Together. *Canadian Association of Radiologists Journal* 2020:084653712091895. doi:10.1177/0846537120918954.
- 4) Nasir MU, Roberts J, Muller NL, et al. The role of emergency radiology in COVID-19: from preparedness to diagnosis. *Canadian Association of Radiologists Journal*. 2020 Mar 28: 0846537120916419
- 5) The Canadian Association Of Radiologists (CAR) And The Canadian Society On Thoracic Radiology (CSTR) Recommendations On COVID-19 Management In Imaging Departments. <https://car.ca/wpcontent/uploads/2020/03/CAR-CSTR-COVID-19-Recommendations-En.pdf> (Accessed 25 April 2020)
- 6) Rodriguez-Morales AJ, Cardona-Ospina JA, Gutiérrez-Ocampo E, Villamizar-Peña R, Holguin-Rivera Y, Escalera-Antezana JP, Alvarado- Arnez LE, Bonilla-Aldana DK, Franco-Paredes C, Henao-Martinez AF, Paniz-Mondolfi A. Clinical, laboratory and imaging features of COVID-19: A systematic review and meta-analysis. *Travel medicine and infectious disease*. 2020 Mar 13:101623.
- 7) Modes of transmission of virus causing COVID-19: implications for IPC precaution recommendations. World Health Organization. <https://www.who.int/publications-detail/modes-of-transmission-of-virus-causing-covid-19-implications-for-ipc-precautionrecommendations> (accessed April 30, 2020).
- 8) Interim national case definition: Coronavirus disease (COVID-19). Public Health Agency of Canada. <https://www.canada.ca/en/publichealth/services/diseases/2019-novel-coronavirus-infection/healthprofessionals/national-case-definition.html#nat> (accessed April 30, 2020).
- 9) Rubin GD, Ryerson CJ, Haramati LB, Sverzellati N, Kanne JP, Raoof S, et al. The Role of Chest Imaging in Patient Management during the COVID-19 Pandemic: A Multinational Consensus Statement from the Fleischner Society. *Chest* 2020. doi:10.1016/j.chest.2020.04.003.
- 10) Dangis A, Gieraerts C, Bruecker YD, Janssen L, Valgaeren H, Obbels D, Gillis M, Ranst MV, Frans J, Demeyere A, Symons R. Accuracy and reproducibility of low-dose submillisievert chest CT for the diagnosis of COVID-19. *Radiology: Cardiothoracic Imaging*. 2020 Apr 21;2(2):e200196.
- 11) Dennie C, Hague C, Lim R et al. Canadian Society of Thoracic Radiology/Canadian Association of Radiologists Consensus Statement Regarding Chest Imaging in Suspected and Confirmed COVID-19. *Canadian Association of Radiologists Journal* 2020 (accepted, in press).
- 12) Wong SH, Lui RN, Sung JJ. Covid-19 and the Digestive System. *Journal of Gastroenterology and Hepatology*. 2020 Mar 25.
- 13) Dane B, Brusca-Augello G, Kim D et al. Unexpected Findings of Coronavirus Disease (COVID-19) at the Lung Bases on Abdominopelvic CT. *American Journal of Roentgenology*. 2020 Apr 3:1-4.
- 14) Siegel A, Chang PJ, Jarou ZJ et al. Lung Base Findings of Coronavirus Disease (COVID-19) on Abdominal CT in Patients With Predominant Gastrointestinal Symptoms. *American Journal of Roentgenology*. 2020 Apr 17:1-3.
- 15) Mao L, Jin H, Wang M et al. Neurologic manifestations of hospitalized patients with coronavirus disease 2019 in Wuhan, China. *JAMA neurology*. 2020 Apr 10.

- 16) Deng Q, Hu B, Zhang Y et al. Suspected myocardial injury in patients with COVID-19: Evidence from front-line clinical observation in Wuhan, China. *International Journal of Cardiology*. 2020 Apr 8.
- 17) Bangalore S, Sharma A, Slotwiner A et al. ST-segment elevation in patients with Covid-19—A case series. *New England Journal of Medicine*. 2020 Apr 17.
- 18) Coffey S, Moynagh A, Green B et al. Changes to management of a nonpandemic illness during the COVID-19 pandemic: case study of invasive management of acute coronary syndrome | OPEN ACCESS. *Changes*. 2020 Apr 24;133(1513).
- 19) Khosravani H, Rajendram P, Notario L et al. Protected code stroke: hyperacute stroke management during the coronavirus disease 2019 (COVID-19) pandemic. *Stroke*. 2020 Apr 1:STROKEAHA-120.
- 20) Mayor S. COVID-19: impact on cancer workforce and delivery of care. *The Lancet Oncology*. 2020 Apr 20.
- 21) Rosenbaum L. The Untold Toll—The Pandemic’s Effects on Patients without Covid-19. *N Engl J Med*. 2020 Apr 17.
- 22) Use Personal Protective Equipment (PPE) When Caring for Patients with Confirmed or Suspected COVID-19. Centers for Disease Control and Prevention. [https://www.cdc.gov/coronavirus/2019-ncov/downloads/A\\_FS\\_HCP\\_COVID19\\_PPE.pdf](https://www.cdc.gov/coronavirus/2019-ncov/downloads/A_FS_HCP_COVID19_PPE.pdf). (accessed April 27, 2020).
- 23) Coronavirus disease (COVID-19): For health professionals. Public Health Agency of Canada. <https://www.canada.ca/en/public-health/services/diseases/2019-novel-coronavirus-infection/health-professionals.html#i> (accessed April 27, 2020).
- 24) Huang Z, Zhao S, Li Z et al. The battle against coronavirus disease 2019 (COVID-19): emergency management and infection control in a radiology department. *Journal of the American College of Radiology*. 2020 Mar 24.
- 25) Hard-surface disinfectants and hand sanitizers (COVID-19): List of hard-surface disinfectants. Public Health Agency of Canada. <https://www.canada.ca/en/health-canada/services/drugs-health-products/disinfectants/covid-19/list.html> (accessed April 27, 2020).
- 26) Chong A, Kagetsu NJ, Yen A et al. Radiology Residency Preparedness and Response to the COVID-19 Pandemic. *Academic Radiology*. 2020 Apr 11.
- 27) Ling L, Wong WT, Wan WT et al. Infection control in non-clinical areas during COVID-19 pandemic. *Anaesthesia*. 2020 Apr 8.
- 28) Siegel JD, Rhinehart E, Jackson M et al. Health Care Infection Control Practices Advisory Committee. 2007 guideline for isolation precautions: preventing transmission of infectious agents in health care settings. *American journal of infection control*. 2007 Dec;35(10):S65.
- 29) Cheng LT, Chan LP, Tan BH et al. Déjà Vu or Jamais Vu? How the Severe Acute Respiratory Syndrome Experience Influenced a Singapore Radiology Department’s Response to the Coronavirus Disease (COVID-19) Epidemic. *American Journal of Roentgenology*. 2020 Mar 4:1-5.
- 30) Guenette JP, Smith SE. Burnout: prevalence and associated factors among radiology residents in New England with comparison against United States resident physicians in other specialties. *American Journal of Roentgenology*. 2017 Jul;209(1):136-41.
- 31) Fessell D, Cherniss C. Coronavirus Disease 2019 (COVID-19) and Beyond: Micropractices for Burnout Prevention and Emotional Wellness. *Journal of the American College of Radiology*. 2020 Mar 24.