

Evidence check

4 June 2020

Rapid evidence checks are based on a simplified review method and may not be entirely exhaustive, but aim to provide a balanced assessment of what is already known about a specific problem or issue. This brief has not been peer-reviewed and should not be a substitute for individual clinical judgement, nor is it an endorsed position of NSW Health.

Computed tomography use during the COVID-19 pandemic

Rapid review questions

1. What is evidence for the use of computed tomography (CT) in patients with COVID-19?
2. What alternative imaging/diagnostics are being used if CT is not recommended?

In brief

- Articles published early in the pandemic described the use of CT as a primary or adjunct technique for diagnosing COVID-19. More recently, practice has moved away from the use of CT for primary diagnosis due to poor utility and safety concerns.
- Practice varies in the use of CT on patients with COVID-19. According to five large systematic reviews, CT has been used to identify various lung complications, including round-glass opacity, bilateral compromise, unilateral compromise, peripheral distribution, multilobular involvement and consolidation.
- There are no comparative diagnostic imaging studies, no comparative effectiveness research, nor health technology assessments comparing CT with another technique for diagnosing COVID-19.
- Current Australian and international guidance recommends reverse transcription polymerase chain reaction (RT-PCR) as the primary method for diagnosis.
- CT imaging may be used to detect and manage lung complications.
- Two systematic reviews report a small number of cases where CT imaging identified COVID-19 infected patients after initial negative RT-PCR tests.
- There is a high number of publications including observational studies reporting on CT findings, studies reporting on the use of artificial intelligence (AI) with CT, reports about management of CT machines during the pandemic or narrative reviews.
- There are 10 systematic reviews on CT and COVID-19 that are in production, five are reviewing evidence for CT for diagnosis of COVID-19 and five are summarising the clinical findings stemming from CT.

Limitations

- The current and recommended use of CT evolves.
- Many published CT case studies feature clinical imaging findings in patients with COVID-19. These may not reflect the usual or recommended standard practices for using CT within hospitals or health services.
- There are multiple systematic reviews on CT use for COVID-19 currently in progress. This evidence check will be updated to incorporate newly published systematic reviews as they become available.
- It is likely more publications appear in the future that will retrospectively discuss the use of CT for COVID-19.

Methods

Databases and grey literature sources were searched on 13 and 14 May 2020.

Results (Tables 1 – 3)

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Table 1: Systematic Reviews (Ordered By Publication Date)

Title	Summary
Peer reviewed literature	
<p>Coronavirus Disease 2019 (COVID-19): A Systematic Review of Imaging Findings in 919 Patients, American Journal of Roentgenology</p> <p>Salehi, et al. 2020</p>	<p>Number of studies included: 30. Number of patients: 919. CT use: To detect ground-glass opacity, bilateral compromise, unilateral compromise Relationship with diagnostic tests: CT findings and RT-PCR findings were generally concordant. A few case studies reported ‘remarkable’ CT findings despite initial negative RT-PCR screening test results. Conclusions: The known imaging features of initial CT in COVID-19 cases include bilateral, multilobar ground-glass opacification with a peripheral or posterior distribution (or both), mainly in the lower lobes and less frequently within the right middle lobe. There seemed to be a close relation between the pattern of CT findings and disease course. A combination of chest CT and repeat laboratory testing may be beneficial for COVID-19 diagnosis in the setting of strong clinical suspicion, including individuals showing typical clinical manifestations and those with a history of exposure.</p>
<p>Clinical, laboratory and imaging features of COVID-19: A systematic review and meta-analysis</p> <p>Rodriguez-Morales, et al. 2020</p>	<p>Number of studies included: 19. Number of patients: 656. CT use: To detect ground-glass opacity, bilateral compromise, unilateral compromise. Relationship with diagnostic tests: Not mentioned. Conclusions: The results of this systematic review highlights the clinical, laboratory and imaging findings that may assist clinicians who suspect the possibility of COVID-19 infection in those with recent travel to areas with ongoing transmission or among contacts of confirmed cases.</p>
<p>Coronavirus Disease 2019 (COVID-19) CT Findings: A Systematic Review and Meta-analysis</p> <p>Bao, et al. 2020</p>	<p>Number of studies included: 13. Number of patients: 2,738. CT use: To detect ground-glass opacity, bilateral compromise, unilateral compromise, peripheral distribution, multilobar involvement, consolidation. Relationship with diagnostic tests: Not mentioned. Conclusions: The detection of COVID-19 chest CT imaging is very high among symptomatic individuals at high risk, especially using thin-section chest CT. The most common CT features in patients affected by COVID-19 included ground glass opacities and consolidation involving the bilateral lungs in a peripheral distribution.</p>

Title	Summary
Peer reviewed literature	
COVID-19 pneumonia manifestations at the admission on chest ultrasound, radiographs, and CT: single-center study and comprehensive radiologic literature review Lomoro, et al. 2020	Number of studies included: 26. Number of patients: 3,886. CT use: All studies reported chest CT abnormalities. This included bilateral and unilateral lesions, lobe involvement and various appearances of lesions. Relationship with diagnostic tests: Not mentioned. Conclusions: Different CT manifestations have been associated with the disease progression, based on the physiopathology of the acute lung injury induced by viral pneumonia.
Chest CT for detecting COVID-19: a systematic review and meta-analysis of diagnostic accuracy Xu, et al. 2020	Number of studies included: 16. Number of patients: 3,186. CT use: Ground-glass opacity and consolidative opacities were some of the most common CT findings. Interlobular septal thickening, pleural thickening and bronchiectasis were also reported with various rates across the studies. Relationship with diagnostic tests: After combining data among three studies, 36 patients had initial false-negative RT-PCR but 31 of 36 patients had positive initial chest CT. Conclusions: Chest CT plays an important role in detection of COVID-19, especially in the initial and peak periods of epidemic, in China. Chest CT offers the great sensitivity for detecting COVID-19, especially in a region with severe epidemic situation. However, the specificity is low.

Table 2: Guidelines and Position Statements (Ordered By Publication Date)

Title	Summary
Peer reviewed literature	
The Role of Chest Imaging in Patient Management during the COVID-19 Pandemic: A Multinational Consensus Statement from the Fleischner Society Rubin, et al. 2020	Country: International. Imaging is not indicated in patients with suspected COVID-19 and mild clinical features unless they are at risk for disease progression. Imaging is indicated in a patient with COVID-19 and worsening respiratory status. In a resource-constrained environment, imaging is indicated for medical triage of patients with suspected COVID-19 who present with moderate-severe clinical features and a high pre-test probability of disease.
A British Society of Thoracic Imaging statement:	Country: UK.

<p>considerations in designing local imaging diagnostic algorithms for the COVID-19 pandemic</p> <p>Nair, et al. 2020</p>	<p>The putative role of CT in the diagnosis, triage and prognostication of patients with COVID-19 infection continues to be refined. The clinical value of CT, compared to alternative strategies incorporating quick and immediately scalable standard clinical and laboratory assessment (even in the absence of RT-PCR availability) is unknown, because published studies on thoracic CT in COVID-19 infection to date have, frustratingly, described these assessments without analysing their relative merit as part of an alternative diagnostic strategy. In the absence of such data, we can only reiterate the need for strategic thinking that explores all available options to achieve maximum public benefit, optimise throughput in the shortest timeframe, and minimise detriment.</p>
<p>Imaging of coronavirus disease 2019: A Chinese expert consensus statement</p> <p>Yang, et al. 2020</p>	<p>The current gold standard for the diagnosis of COVID-19 is the detection of coronavirus nucleic acids, but imaging has an important role in the detection of lung lesions, stratification, evaluation of treatment strategies and differentiation of mixed infections. This Chinese expert consensus statement summarises the imaging features of COVID-19 pneumonia. In general, combined chest CT, clinical symptoms and laboratory tests facilitates the diagnosis of COVID-19.</p>
<p>Use of CT and artificial intelligence in suspected or COVID-19 positive patients: statement of the Italian Society of Medical and Interventional Radiology</p> <p>Neri, et al. 2020</p>	<p>SIRM (Italian Society of Medical and Interventional Radiology) recommends chest X-ray as first-line imaging tool and CT as additional tool that shows typical features of COVID-19 pneumonia and ultrasound of the lungs as monitoring tool. SIRM does not support the use of CT with artificial intelligence for screening or as first-line test to diagnose COVID-19. Chest CT with artificial intelligence cannot replace molecular diagnosis tests with nose-pharyngeal swab (rRT-PCR) in suspected for COVID-19 patients.</p>
<p>Canadian Association of Thoracic Radiology/Canadian Association of Radiologists Consensus Statement Regarding Chest Imaging in Suspected and Confirmed COVID-19</p> <p>Dennie, et al. 2020</p>	<p>Country: Canada. Provides guidance on:</p> <ul style="list-style-type: none"> • Performing chest CT as per standard clinical practice guidelines is acceptable for workup of a non-COVID-19 indication (i.e., CT pulmonary angiography [CTPA]). • Imaging algorithm for repeat presentation and initial negative COVID-19 reverse transcriptase polymerase chain reaction test. • Potential clinical scenarios in which CT of the chest may be helpful. • How to interpret clinical findings.
<p>Grey literature</p>	
<p>Society for Thoracic Radiology and The American Society of Emergency Radiology, 2020, STR/ASER COVID-19 position statement 2020</p>	<p>Country: USA. At this time, the STR and ASER do not recommend routine CT screening for the diagnosis of patients under investigation for COVID-19. Chest CT can be restricted to patients who test positive for COVID-19 and who are suspected of having complicating features such as abscess or empyema.</p>

<p>ACR Recommendations for the use of Chest Radiography and Computed Tomography (CT) for Suspected COVID-19 Infection (updated 22 Mar 2020)</p>	<p>Country: USA.</p> <p>CT should not be used to screen for or as a first-line test to diagnose COVID-19. CT should be used sparingly and reserved for hospitalised, symptomatic patients with specific clinical indications for CT. Appropriate infection control procedures should be followed before scanning subsequent patients.</p> <p>Facilities may consider deploying portable radiography units in ambulatory care facilities for use when chest radiographs are considered medically necessary. The surfaces of these machines can be easily cleaned, avoiding the need to bring patients into radiography rooms.</p> <p>Radiologists should familiarise themselves with the CT appearance of COVID-19 infection in order to be able to identify findings consistent with infection in patients imaged for other reasons.</p> <p>(Updated 22 March 2020) As an interim measure, until more widespread COVID-19 testing is available, some medical practices are requesting chest CT to inform decisions on whether to test a patient for COVID-19, admit a patient or provide other treatment. The American College of Radiology strongly urges caution in taking this approach. A normal chest CT does not mean a person does not have COVID-19 infection and an abnormal CT is not specific for COVID-19 diagnosis. A normal CT should not dissuade a patient from being quarantined or provided other clinically indicated treatment when otherwise medically appropriate. Clearly, locally constrained resources may be a factor in such decision making.</p>
<p>Recommendations on COVID-19 Management in Imaging Departments 25 March 2020.</p>	<p>Country: Canada.</p> <p>The Centers for Disease Control (CDC) does not currently recommend chest radiograph (CXR) or CT to diagnose COVID-19. Viral testing remains the only specific method of diagnosis. Confirmation with the viral test is required, even if radiologic findings are suggestive of COVID-19 on CXR or CT.</p> <p>Generally, the findings on chest imaging in COVID-19 are not specific and overlap with other infections. Imaging should only be conducted for those COVID-19 patients where imaging will impact management of the condition.</p> <p>A normal chest CT does not mean a person does not have COVID-19 infection and an abnormal CT is not specific for diagnosis. A normal CT should not dissuade a patient from being quarantined when otherwise medically appropriate. Clearly, locally constrained resources may be a factor in such decision making.</p> <p>If chest CT is performed, a non-contrast full dose diagnostic CT is recommended. A contrast-enhanced CT would be useful to detect complications such as empyema and/or lung abscess.</p>
<p>Interim guidelines for clinical management of SARS-CoV-2 infection (5th edition)</p>	<p>Country: Taiwan (ROC).</p> <p>Chest imaging (including CT) may be used to identify pulmonary complications for people with COVID-19 with severe pneumonia and also for acute respiratory distress syndrome (ARDS).</p>

<p>Taiwan Government, 2020</p>	
<p>UK surgical Royal Colleges, Intercollegiate General Surgery Guidance on COVID-19 UPDATE, 27 March 2020.</p>	<p>Country: UK. The UK surgical Royal Colleges have produced advice and guidelines on COVID-19. The use of additional chest CT to assess for the presence of likely COVID-19 infection may have a role in stratifying risk in patients presenting acutely and requiring a CT abdomen, particularly those needing emergency surgery. In the absence of rapid access to other forms of COVID-19 testing, this is appropriate if it will change the management of the patient. However, a negative scan would not exclude COVID-19 infection. As with all other advice at the moment, this may change. Bodies represented are:</p> <ul style="list-style-type: none"> • Association of Surgeons of Great Britain and Ireland • Association of Coloproctology of Great Britain and Ireland • Association of Upper Gastrointestinal Surgeons • Royal College of Surgeons of Edinburgh • Royal College of Surgeons of England • Royal College of Physicians and Surgeons of Glasgow • Royal College of Surgeons in Ireland
<p>Clinical management of patients with moderate to severe COVID-19 - Interim guidance</p> <p>Canadian Government, Canadian Critical Care Society, Association of Medical Microbiology and Infectious Disease Canada, 2020</p>	<p>Country: Canada. Chest imaging (including CT) may be used to identify pulmonary complications for people with COVID-19 with severe pneumonia and also for acute respiratory distress syndrome (ARDS).</p>
<p>Guidance from the International Society of Heart and Lung Transplantation regarding the SARS CoV-2 pandemic</p> <p>International Society for Heart and Lung Transplantation, 2020</p>	<p>Country: International. For testing in symptomatic patients: computed tomography (CT) findings may assist in diagnosis and repeat viral testing may be considered on an individual basis. A thoracic CT scan may show signs of SARS-CoV-2 infection even before development of symptoms or positive PCR and thus should be considered for donor and candidate assessment. This is based on availability of adequate personal protective equipment and other resources. If CT imaging is suggestive of a viral pneumonitis, we recommend foregoing transplant.</p>
<p>Guidelines for CT Chest and Chest Radiograph reporting in patients with suspected COVID-19 infection</p>	<p>Country: Australia and New Zealand. These guidelines were produced based on the available medical literature (at 28 March 2020), and after careful consideration of guidelines issued by the Radiological Society of North America and the British Society of Thoracic Imaging (BSTI). While screening for COVID-19 infection with chest CT is not</p>

RANZCR, 2020	recommended at this time, the number of chest CT examinations performed for clinical assessment of patients with proven or suspected infection is increasing as the prevalence of disease within the Australia and New Zealand communities increases. Chest radiographs performed throughout the course of COVID-19 infection, particularly in hospitalised patients, are used to identify the typical and atypical features of COVID-19 infection, monitor the extent of lung involvement, inform management decisions and may identify other processes.
Statement on use of CT chest to screen for COVID-19 in pre-operative patients The Royal College of Radiologists, 2020	Country: UK. The RCR supports the agreed intercollegiate statements from the Surgical Royal Colleges. CT screening for COVID-19 in asymptomatic COVID-19 positive patients has a low pick up rate and a 20% false negative rate in symptomatic patients. The guidance was drafted in light of the acknowledged low sensitivity and specificity of chest CT for the diagnosis of COVID-19.
Clinical Practice Guidelines: COVID-19 Paediatric Improvement Collaborative, The Royal Children’s Hospital Melbourne, 2020	Country: Australia. CT has been used for diagnosis in adults; this is not recommended in children.

Table 3: Systematic Reviews on CT for COVID-19 In Progress (From The PROSPERO Database)

Title	Summary
The accuracy of chest X-ray, CT and ultrasound for the diagnosis of patients with suspected COVID-19 in a hospital setting: a systematic review and meta-analysis , PROSPERO Verkooijen, et al. 2020	Protocol of a systematic review asking, ‘How accurate are chest X-rays, CT and ultrasound for the diagnosis of patients with suspected COVID-19 in hospital setting?’ Publication date TBC.
The performance of Chest CT and its imaging features for diagnosing Coronavirus Disease 2019: a meta-analysis , PROSPERO Zhang, et al. 2020	Protocol of a systematic review asking, ‘The diagnostic performance of chest CT chest CT and its imaging features compared to initial RT-PCR for patients suspected with COVID-19.’ Publication date TBC.

Title	Summary
<p>The diagnostic performance of chest CT and its key signs for COVID-19: a systematic review and meta-analysis, PROSPERO Wu, et al. 2020</p>	<p>Protocol of a systematic review asking, 'What is the performance of CT for diagnosis of COVID-19, as compared with RT-PCR, in original articles?' Publication date TBC.</p>
<p>Comparing RT-PCR and CT as Diagnostic Tools for COVID-19: a systematic review, PROSPERO Waller, et al. 2020</p>	<p>Protocol of a systematic review asking, 'Do studies of the sensitivity of RT-PCR and/or CT in screening COVID-19 have appropriate methodologies?' Publication date TBC.</p>
<p>Computed tomography scan findings in COVID-19 patients: a systematic review and meta-analysis, PROSPERO Azami, et al. 2020</p>	<p>Protocol of a systematic review summarising a number of CT imaging presentation findings in COVID-19. Publication date TBC.</p>
<p>CT imaging features of the 2019 Corona Virus Disease (COVID-19) by disease severity and time course: a system review and meta-analysis, PROSPERO Fu, et al. 2020</p>	<p>Protocol of a systematic review. Although typical radiological findings in COVID-19 patients have been recently described in detail in many studies, the sample size of individual study and the CT abnormalities as a function of clinical severity and time course are still limited. Therefore, these issues were assessed in a meta-analysis and literature was systematically reviewed for a comprehensive understanding and reliable evidence of radiological features. Publication date TBC.</p>
<p>CT and MR imaging findings in COVID-19 patients with neurological symptoms: a systematic review and meta-analysis, PROSPERO Bisdas, et al. 2020</p>	<p>Protocol of a systematic review asking, 'What is the prevalence and the CT/MRI findings in Coronavirus Disease 2019 (COVID-19) patients with neurological symptoms?' Publication date TBC.</p>
<p>Chest CT findings in COVID-19 in adults: A systematic review of the current literature, PROSPERO Ojha, et al. 2020</p>	<p>Protocol of a systematic review evaluating the imaging manifestations of COVID -19 on chest CT in adults. Publication date TBC.</p>
<p>Performance of chest CT compared to RT-PCR for COVID-19: a systematic review and meta-analysis of diagnostic tests, PROSPERO Al-Rifai, et al. 2020</p>	<p>Protocol of a systematic review asking:</p> <ul style="list-style-type: none"> • Which is more sensitive for COVID-19, Chest CT or RT-PCR? • Which is more specific for COVID-19, Chest CT or RT-PCR? • What is the positive predictive value Chest CT compared to RT-PCR? • What is the negative predictive value Chest CT compared to RT-PCR? <p>Publication date TBC.</p>

Title	Summary
<p>Radiological and hybrid imaging in SARS, MERS, and COVID-19 outbreaks, PROSPERO Fichera, et al. 2020</p>	<p>The main aim of this systematic review was to evaluate the role of radiological and hybrid imaging (PET/CT) for diagnosing and monitoring pulmonary infections due to the SARS and MERS epidemic and to the COVID-19 pandemic outbreaks. Organisational and structural aspects of the radiological units will also be taken into account.</p>

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Appendix

Search Terms

Population / condition search terms:

("COVID-19"[All Fields] OR "COVID-2019"[All Fields] OR "severe acute respiratory syndrome coronavirus 2"[Supplementary Concept] OR "severe acute respiratory syndrome coronavirus 2"[All Fields] OR "2019-nCoV"[All Fields] OR "SARS-CoV-2"[All Fields] OR "2019nCoV"[All Fields] OR (("Wuhan"[All Fields] AND ("coronavirus"[MeSH Terms] OR "coronavirus"[All Fields])) AND (2019/12[PDAT] OR 2020[PDAT])))

Intervention terms:

CT OR computer tomography

Searched Resources

Databases: PubMed; TRIP Database; Cochrane Library

General search: Google.

Australian Sources:

- National COVID-19 Clinical Evidence Taskforce
- Australian Commission on Quality and Safety in Healthcare
- Australian Government Therapeutic Goods Administration
- Australian Government Department of Health, including MSAC
- Royal Australian and New Zealand College of Radiologists

Other Sources (e.g. regulators, peak bodies, and organisations):

- North America:
 - Centers for Disease Control and Prevention
 - Food and Drug Administration
 - Environmental Protection Agency
 - American College of Radiology
 - CADTH
- Europe:
 - UK Medicines and Healthcare Products Regulatory Agency
 - European Centre for Disease Prevention and Control
 - Public Health England
 - Italian Society of Medical and Interventional Radiology / Italian College of Paediatric Radiology
 - UK NICE
 - ECRI
- International
 - World Health Organisation

Search Results

108 relevant studies, guidelines, guidance, and position statements were found. Of these, 10 with grey literature guidelines, position statements, and guidance, 5 were published in peer reviewed journals, and 5 were published systematic reviews. All other 88 publications were either observational studies reporting on CT findings, studies reporting on the use of AI with CT, reports about management of CT machines during the pandemic, or narrative reviews. Reference list for remaining 88 publications are available upon request. The earliest journal publication was on 24th February. An additional 10 systematic review protocols were found from the PROSPERO database.

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