Since January 2020 Elsevier has created a COVID-19 resource centre with free information in English and Mandarin on the novel coronavirus COVID-19. The COVID-19 resource centre is hosted on Elsevier Connect, the company's public news and information website.

What is the Diagnostic Accuracy of Chest Radiography, Ultrasound, and Computed Tomography for COVID-19?

TAKE-HOME MESSAGE

Chest radiography is a reasonable initial test for COVID-19 due to its moderate sensitivity and specificity. Chest computed tomography (CT) and lung ultrasound have greater sensitivity and can be considered when the initial chest radiograph is nondiagnostic.

METHODS

DATA SOURCES

The authors searched PubMed, Embase, the CDC Library on COVID-19 research articles database, and preprints indexed in bioRxiv and medRxiv through September 30, 2020. The authors also searched ClinicalTrials.gov and the World Health Organization International Clinical Trials Registry Platform.

STUDY SELECTION

Two authors independently screened articles for inclusion, with discrepancies resolved by consensus with a third reviewer. With the exception of case-control studies, the authors included all study designs that reported on the test accuracy of chest radiography, lung ultrasound, or chest CT. Study participants included individuals suspected of having COVID-19 regardless of age. The reference standard was a positive reverse transcriptase–polymerase chain reaction (RT-PCR) COVID-19 result (from any manufacturer and using any sample type), positive WHO criteria for COVID-19, positive China CDC criteria for

EBEM Commentators
Michael Gottlieb, MD
Alexander Jay, DO
Benjamin Mogni, MD
Department of Emergency Medicine
Rush University Medical Center
Chicago, IL

Jestin N. Carlson, MD, MS, Alan Jones, MD, and Michael Gottlieb, MD, serve as editors of the SRS series.

Editor's Note: This is a clinical synopsis, a regular feature of the *Annals'* Systematic Review Snapshot (SRS) series. The source for this systematic review snapshot is: **Islam N, Ebrahimzadeh S, Salameh JP, et al. Thoracic imaging tests for the diagnosis of COVID-19. Cochrane Database Syst Rev. 2021;3:CD013639.**

Results

Accuracy of Different Imaging Modalities for COVID-19

Outcome	No. of Studies (No. of Participants)	No. of COVID-19 Cases (%)	Sensitivity (95% CI)	Specificity (95% CI)
Chest radiograph	9 (3,694)	2,111 (57.1%)	80.6% (69.1% to 88.6%)	71.5% (59.8% to 80.8%)
Lung ultrasound	5 (446)	211 (47.3%)	86.4% (72.7% to 93.9%)	54.6% (35.3% to 72.6%)
Chest CT	41 (16,133)	8,110 (50.3%)	87.9% (84.6% to 90.6%)	80.0% (74.9% to 84.3%)

CI, confidence interval; *CT*, computed tomography.

The researchers identified a total of 4,734 studies, with 51 studies (n=19,755) selected for inclusion. Out of the total cohort of studied patients, 10,155 (51.4%) had a final diagnosis of COVID-19. All the studies used RT-PCR as the reference standard. The images were read by attending radiologists in 39 studies, radiology residents in 2 studies, and both the radiology attending and residents in 1 study. Eight studies did not report the level of training for the party responsible for reading the images. The majority of the studies

COVID-19, positive serology for SARS-CoV-2 antibodies with concurrent symptoms, or positive findings using study-specific criteria. There were no language restrictions.

DATA EXTRACTION AND SYNTHESIS

Two review authors independently extracted data and assessed methodological quality, with discrepancies resolved by consensus with a third reviewer. The risk of bias and applicability concerns were assessed using the QUADAS-2 domain list.[1] Data were analyzed using a bivariate model to account for within- and between-study variance as well as the correlation between sensitivity and specificity across studies. Heterogeneity was investigated through visual inspection of forest plots and summary receiver operating characteristics plots. The authors did not assess for publication bias.

were conducted in Europe (n=33), with the remainder conducted in Asia (n=13), North America (n=3), and South America (n=2). Chest CT and lung ultrasound both had moderate sensitivity which was higher than that of chest radiography (Table). Chest CT had the highest specificity, while lung ultrasound had the lowest specificity.

Commentary

As of April 2021, there have been more than 138 million confirmed cases of COVID-19, with nearly 3 million deaths worldwide.[2] Symptoms can vary significantly across patients infected with COVID-19, and rapid testing has not been universally available.[3,4] RT-PCR typically has a longer turnaround time thus limiting the ability to use the information rapidly in real time. Therefore, imaging offers an alternative for diagnosing COVID-19 pulmonary involvement in the acute care setting.

This systematic review found that chest radiography, lung ultrasound, and chest CT all had moderate sensitivity, with lower sensitivity for chest radiography and lower specificity for ultrasound.[5] The authors also highlight the importance of considering the pretest probability and prevalence of COVID-19 when interpreting these findings. With a prevalence of 5%, the false negative rate would be 0.6% for CT, 0.7% for ultrasound, and 1% for radiography, whereas with a prevalence of 50%, the false negative rate would increase to 6% for CT, 7% for ultrasound, and 10% for radiography.

This review has several limitations. First, the study populations were clinically heterogeneous, including a mix of pediatric and adult patients as well as varying severities of illness and comorbidities (eg, heart failure, end-stage renal disease). The study prevalence also varied significantly, ranging from 5% to 90%. The gold standard was RT-PCR in all studies, but the specific test, sample fluid, and frequency (ie, repeat testing if negative) varied across studies. There were also differences in the type of chest radiograph (eg, single view versus two views) and type of CT (eg, resolution, use of contrast). Moreover, there were differences in the imaging criteria used and the personnel who performed the interpretations (eg, resident vs attending physician, specialty). The ultrasound data were substantially more limited, with only a few studies and small sample sizes. In fact, more recent data have suggested that ultrasound may be more accurate than RT-PCR.[6] Finally, there was limited description of the sonographer's training or experience, which is critical given the operator-dependent nature of this imaging tool.

Dr. Carlson was the supervising editor on this article. Dr. Gottlieb did not participate in the editorial review or decision to publish this article.

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