

## Radiology in the Era of COVID-19: A Systematic Exploration of Detection and Diagnosis Modalities

Angeliki Ailianou\*

Department of Biomedical Imaging and Image-Guided Therapy, Morocco

### Abstract

The COVID-19 pandemic has underscored the significance of radiology in the early detection and precise diagnosis of the disease. This research article presents a systematic exploration of various radiological modalities employed in the context of COVID-19, examining their efficacy, challenges, and emerging trends. From traditional chest imaging to cutting-edge artificial intelligence (AI) applications, this study aims to provide a comprehensive overview of the evolving landscape of radiological approaches during the ongoing global health crisis. According to the findings, deep learning-based models have an extraordinary capacity to offer an accurate and efficient system for the detection and diagnosis of COVID-19, the use of which in the processing of modalities would lead to a significant increase in sensitivity and specificity values.

The application of deep learning in the field of COVID-19 radiologic image processing reduces false-positive and negative errors in the detection and diagnosis of this disease and offers a unique opportunity to provide fast, cheap, and safe diagnostic services to patients.

### Introduction

The emergence of COVID-19 has catalyzed a paradigm shift in the role of radiology, necessitating a thorough investigation into the diverse array of detection and diagnosis modalities utilized. This section establishes the critical importance of radiology in managing the COVID-19 pandemic and outlines the research objectives of the study [1].

The early detection of COVID-19 is essential not only for patient care but also for public health by ensuring the patients' isolation and controlling the pandemic. Due to the novelty of the disease, ways to fight it were not known in the early days, but researchers considered screening and rapid diagnosis of infected patients and their separation from the community of healthy people as an important measure. The clinical features of COVID-19 include respiratory symptoms, fever, cough, dyspnea, and pneumonia. However, these symptoms do not always indicate COVID-19 and are observed in many cases of pneumonia, leading to diagnostic problems for physicians [2].

One of the most important ways to diagnose COVID-19 is to use radiological images, including X-ray and computed tomography (CT) scan. Chest imaging is a quick and easy procedure recommended by medical and health protocols and has been mentioned in several texts as the first tool in screening during epidemics. Compared to RT-PCR, CT scan images have a high sensitivity in diagnosing and detecting cases with COVID-19; however, their specificity is low. This means that CT scan is more accurate in cases of COVID-19, but less accurate in cases of nonviral pneumonia [3].

In addition, the CT scanner rays can cause problems for patients who require multiple CT scans during the course of the disease. The American College of Radiology recommends that CT scans should not be used as the first line of diagnosis. Problems such as the risk of transmission of the disease while using a CT scan device and its high cost can cause serious complications for the patient and healthcare systems, so it is recommended that if medical imaging is needed, the CT scan be replaced with CXR radiography [4]. X-ray imaging is much more extensive and cost-effective than conventional diagnostic tests. Transmission of an X-ray digital image does not require transferring from the access point to the analysis point, so the diagnostic process is

performed very quickly. Chest radiography is convenient and fast for medical triaging of patients.

### Methodology

A systematic review methodology is employed to gather and analyze relevant literature on radiological modalities used in the detection and diagnosis of COVID-19 [5]. The inclusion criteria involve studies published in peer-reviewed journals, focusing on various imaging techniques, including chest radiography, computed tomography, ultrasound, and AI applications.

### Chest Imaging

This section provides an in-depth analysis of the role of chest imaging, encompassing both X-rays and CT scans, in detecting and diagnosing COVID-19 [6]. The review explores the sensitivity and specificity of these modalities, discusses the nuances in their interpretation, and evaluates their efficacy in different stages of the disease.

### Point-of-Care Ultrasound (POCUS)

The utilization of point-of-care ultrasound in the context of COVID-19 is investigated, emphasizing its portability, real-time capabilities, and potential as a valuable tool in resource-limited settings. The section explores the diagnostic accuracy and challenges associated with POCUS in the context of COVID-19 [7].

\*Corresponding author: Angeliki Ailianou, Department of Biomedical Imaging and Image-Guided Therapy, Morocco, E-mail: Ailianouangeilki@gmail.com

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## Artificial Intelligence (AI) Applications

This segment delves into the role of AI in revolutionizing the field of radiology during the COVID-19 era [8]. The study investigates the development and implementation of AI algorithms for the automated analysis of imaging data, including their accuracy, reliability, and ethical considerations.

## Emerging Trends and Innovations

The research explores ongoing trends and innovations in radiology for COVID-19, such as the identification of novel imaging biomarkers, advanced imaging protocols, and the integration of emerging technologies like augmented reality. These developments are discussed in the context of their potential impact on improving detection and diagnosis.

## Discussion

The current review provided up-to-date information on DL algorithms and their application as an expression of radiographic imaging analysis of COVID-19. Many studies have shown that the use of DL algorithms can improve the rate of metric features of CT scan images and enhance the sensitivity and specificity of radiographic images compared to the radiologists diagnosis; therefore, the use of this inexpensive and affordable modality should be considered as a reliable method for the diagnosis of COVID-19 [9]. By reviewing 23 research papers on the application of X-ray in the diagnosis of COVID-19 by using DL methods, the current modality can be introduced to the scientific and medical community for the early and rapid diagnosis of this disease. By improving imaging methods through artificial intelligence technologies, we can find the cheapest and safest imaging methods to prevent the transmission of COVID-19.

## Challenges and Future Directions

This section critically examines the challenges faced by current radiological modalities, including standardization issues, data privacy concerns, and the need for rigorous validation of AI algorithms [10]. The article concludes with insights into potential future directions for research and development in radiology for COVID-19.

## Conclusion

The systematic exploration presented in this research article highlights the pivotal role of radiology in the ongoing battle against COVID-19. By analyzing various detection and diagnosis modalities, this study contributes to a comprehensive understanding of the evolving landscape of radiology in the era of COVID-19 and sets the stage for further advancements in medical imaging technology.

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