



# Recognition of Early Covid-19 Chest X-Ray Findings Among Front-Line Physicians

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## Abstract

**Objective:** A novel Coronavirus disease (COVID 19) emerged from wet food markets of Wuhan China in late 2019, which caused severe respiratory symptoms. Frontline physicians face an immense task in identifying the Chest X-ray findings of this newly emerged pandemic. The purpose of this study is to evaluate the competency of frontline physicians in identifying subtle COVID 19 findings in Chest X-rays.

**Materials and methods:** In this questionnaire based study, frontline physicians were asked if they were directly involved in care of COVID 19 patients. The questionnaire included the queries about the specialty, grade/classification and experience of the physician. We included ten Chest X-rays in the series and physicians were asked if they suspected COVID or not in the corresponding image. The data collected was analyzed by SPSS ver 26.

**Results:** 236 physicians answered all the ten questions. The results were segregated into Subtle Covid, Clear Covid and Combined subtle and Clear Covid findings. Only 53.4 % of the participants correctly identified the subtle Covid findings whereas, 90.5% and 62.7% identified the clear Covid and combined subtle and clear Covid findings respectively. Physicians having more than 15 years of experience were most likely to correctly identify the Covid Chest X-Ray findings

**Conclusion:** Chest X-ray is an inexpensive and readily available imaging tool which frontline physicians use in course of illness. Physicians score poorly in identifying subtle changes in the images whereas, clear prominent findings are less likely to be missed.



## Introduction

A series of pneumonia resembling viral pneumonia emerged in Wuhan, China around December 2019 [1]. Deep sequencing analysis from lower respiratory tract samples indicated a novel coronavirus, which was named 2019 novel coronavirus (2019-nCoV). Coronaviruses are enveloped non-segmented positive-sense RNA viruses belonging to the family Coronaviridae and the order Nidovirales and broadly distributed in humans and other mammals [2]. Although most human coronavirus infections are mild, the epidemics of the two beta coronaviruses, severe acute respiratory syndrome coronavirus (SARS-CoV) and Middle East respiratory syndrome coronavirus (MERS-CoV) have caused more than 10,000 cumulative cases in the past two decades, with mortality rates of 10% for SARS-CoV and 37% for MERS-CoV [3-7]. COVID 19 caused pandemic and until now more than 35 million cases have been confirmed positive and there have been more than a million deaths worldwide [8]. The first confirmed case of COVID 19 in Saudi Arabia was reported on 02 March 2020 [9]. As of today there have been more than 340,000 cases who tested positive for COVID 19 with over 5000 deaths in the Kingdom [10]. Covid 19 posed a challenge even before leading economies, world leaders, hospital administrators and healthcare workers. Though all of the healthcare workers including doctors from different specialties geared up to tackle the pandemic, it were the frontline physicians (Emergency Medicine, Family Medicine, Critical Care and Internists) who were leading from the front. Patients who were suspected or confirmed of having COVID 19 visited family Medicine Clinics or Emergency Departments. Subsequently, they were managed by Internists or Critical care physicians. Majority of those patients had undergone Chest X-rays or Chest CT scans (Computed Tomography). Most common findings cited were patchy or diffuse reticular-nodular, ground glass opacities and consolidation, with basal, peripheral and bilateral predominance [11,12]. Adding to their woes in the pandemic, the already burnt out clinicians face challenges while interpreting those radiological images. In the present study, we focused on the ability of frontline physicians (Emergency Medicine, Critical Care Medicine, Anesthesia, Internal Medicine and Family Medicine) to recognize the early Chest X-ray changes reported in the course of the illness.

## Materials and methods

An electronic survey was carried out to evaluate the knowledge of frontline physicians of early chest X ray findings in COVID 19 patients from July 10 to Aug 25, 2020. Our study was closed ended (static) with multiple choice questions having a single response. A questionnaire was developed and piloted by sending it to 9 physicians. The questionnaire was modified according to the replies received to make it more efficient. The final modified questionnaire was sent to 308 frontline physicians in the Kingdom. The questionnaire consisted of 10 different clinical vignettes which included CXRs having single a pathology. We also included normal Chest X rays. Chest X rays with more than one finding, coexisting conditions and with more than one major differential diagnosis were excluded from the survey. The selected images were reviewed by three board certified senior radiologists, who based on their experience classified the images into clear or subtle (early) findings. Then in accordance with the literature of covid x-rays, images were carefully selected. The survey consisted of questions about the position ( resident, specialist or consultant), specialty (Anesthesia, Critical care, Family medicine, Internal medicine and Emergency medicine ), years of experience (0-5, 6-10, 11-15 or more than 15 ). Par-

ticipating physicians were asked If they were involved directly in taking care of suspected or confirmed COVID 19 cases. The questions directly asked if the corresponding Chest x ray image was suspected of having COVID 19 by selecting one of three options of "yes", "no", and "I don't know". Participants were also asked about the classical findings of COVID 19 in a Chest X ray. This study was approved by the institutional board review of our institution. The data collected from the responses was analyzed by using SPSS version 26. Analysis and findings were done by taking three groups for analysis: Clear COVID, Subtle (early) and the combination of Clear COVID and Subtle. Responses have been analyzed through 'multiple responses analysis' tools in SPSS to gather the responses according to the three groups. Group frequencies was obtained to test the differences in the responses according to the participants specialty, position and years of experience. Comparisons were made using pearson-chi square tests and P- values of less than 0.05 were considered significant.

## Results

A total of 236 participants answered all the 10 questions.

### Subtle COVID

Overall 53.4% of the total participants could correctly identify the subtle Chest X-ray findings of COVID 19; Whereas a significant 38.1% failed to identify the findings. Another 8.5% responded that they do not have any idea (Table 1). The percentage of responses in identifying subtle-covid findings is low. The highest correct responses recorded from participants were of Internal Medicine (59.7%) followed by Critical Care (57.7%), Anesthesia (53.5%), Emergency Medicine (52.9) and Family Medicine (44.4%) (Table 2). Regarding Physician classification, the highest correct responses came from the Specialists (57.1%) followed by Consultants (55.6%) and Residents (50.7%). The difference in the responses between Specialists and Residents has not been found to be statistically significant, ( $P = 0.146$ ) (Figure 1). With respect to the experience, participants having more than 15 years of experience have identified the X-rays more correctly and the lowest percentage was attributed to those with less than 5 years of experiences. However, this difference was not found to be significant ( $P = 0.053$ ).

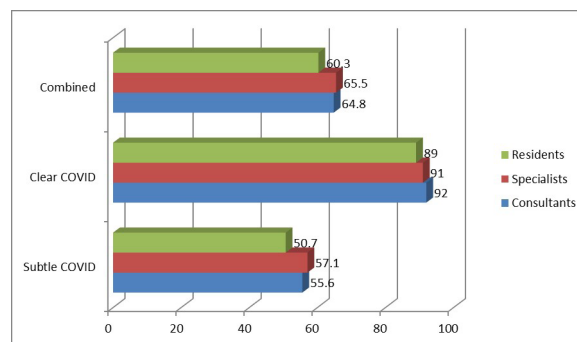
### Clear COVID

90.5% of the total participants correctly identified the Chest X-rays with prominent COVID 19 findings (Table 1). 5.4% could not identify the clear findings and 4.1% responded as 'do not know'. Specialty wise Critical Care physicians identified the prominent Chest X -rays more than others (96.4%) followed by Internists (93.3%), Emergency Medicine (92.5%), Anesthesia (87.8%) and Family Medicine (77.8%). The difference in detection between the family medicine and critical care physicians, and between the Emergency physicians and critical care was not found to be statistically significant ( $P = 0.203$ ,  $P = 0.508$  respectively ). (Table 2). 92% of the Consultants correctly identified clear COVID 19 chest X -ray findings followed by Specialists (91%) and the Residents (89%). The difference in response between the Consultants and Residents was not found to be statistically significant ( $p = 0.970$ ) (Figure 1). The highest percentage of correct responses have been received from the participants with more than 15 years of working experiences (92.7%) and lowest from those with working experience of 5 years and less (89.4%). The difference between the participants in identifying clear COVID 19 X-ray findings with less than 5 years of experi-

ences and more than 10 years and above of experience are not statistically significant, ( $p= 0.970$ ).

### Clear and subtle COVID combined

Taking the total number of responses into consideration, our study reveals that overall about 62.7% have identified the clear and subtle COVID findings correctly whereas, 29.9% of the respondents failed to identify the findings. Another 7.4% replied 'do not know' about the findings in the X-rays (Table 1). Participants from Internal Medicine have the highest correct responses (68.1%) in identifying both the clear and subtle COVID X-ray findings closely followed by Critical Care (67.3%), Emergency Medicine (62.8%), Anesthesia (62.1%) and Family Medicine (52.8%) (Table 2). With respect to the position of the participants, Specialists were the most competent group in identifying the clear and subtle X-ray findings together (65.5%), followed by Consultants (64.8%) and Residents (60.3%) (Figure 1). The difference however, between residents and specialists is not statistically significant ( $p= 0.286$ ). 67.4% of participants who have more than 15 years of experience have identified the findings whereas, only 59.8% of the participants with less than 5 years of experience could reply correctly. Participants with more years of experiences have identified the findings more successfully than the participants with less working experiences. However, this difference is not statistically significant ( $p= 0.08$ ). For specialty, between participants of critical care and emergency, the difference in responses is not significant, ( $p= 0.950$ ).



**Figure 1:** Percentage of participants by position having correct responses to each category.

**Table 1:** Percentage of total number of participants responding to each Chest X ray category.

Category	Suspect ( yes)	Do not suspect (No)	Do not know
Subtle COVID	53.4%	38.1%	8.5%
Clear COVID	90.5%	5.4%	4.1%
Combined	62.7%	29.9%	7.4%

**Table 2:** Percentage of participants from each specialty having correct responses to Chest X-ray from each category.

Category	Anesthesia	Critical care	Emergency medicine	Family medicine	Internal medicine
Subtle COVID	53.5%	57.7%	52.9%	44.4%	59.7%
Clear COVID	87.8%	96.4%	92.5%	77.8%	93.3%
Combined	62.1%	67.3%	62.8%	52.8%	68.1%

### Discussion

Fever, cough, and dyspnea consistent with the manifestation of lower respiratory tract infections are amongst the most common symptoms in patients with COVID-19 pneumonia [9,12]. Henceforth, a chest imaging modality becomes necessary in the due course for these patients. Chest X-ray remains the most common, readily available and cost effective imaging modality for detecting chest infections. Chest X-rays are usually used as 'point of care' by the frontline physicians to act immediately and are interpreted with full details later by the radiologist according to the institution protocols. There have been a few studies, which tried to assess the competency of practitioners in interpreting Chest X-rays. In a study conducted in 2010 to evaluate the competency of senior medical students in Brazil to interpret Tuberculosis Chest X-rays, it was observed that the students performed better when the disease was extensive rather than mild or moderate [13]. In the present study we found that more than ninety percent of the physicians were able to identify the prominent COVID findings whereas, only half of the physicians (53.4%) could identify the X-rays with the subtle findings. These results are in concordance with the above stated study. There have been studies in which interns, residents and fellows faced difficulty in interpreting normal Chest X-rays [14]. In a study by Mehdipoor, most of the participants failed to interpret acute diagnostic Chest X-rays [15]. In the same study about eighty five percent had difficulty in identifying normal Chest x-rays. Mehrotra et al. compared Chest X-ray competency of clinicians from

medicine, Accident and Emergency (A&E), anesthetics, Intensive Therapy Unit (ITU), surgery and radiology. Consultants and registrars attained significantly higher scores than junior doctors [16]. One more study confirmed the statistical difference between junior and senior doctors in interpreting the Chest X-rays [17]. In the present study though the senior physician's competency in interpretation of COVID Chest X-rays was higher however, it was not found to be statistically significant. A possible explanation might be that COVID pandemic is new for all classes. Though Corona viruses have been described earlier too but their clinical significance has become relevant recently. The previous studies in identifying the Chest X-rays were the classic well known pathologies. However, COVID 19 presents with a varied vague scenarios and findings. In a large observational study of 636 COVID 19 patients in an ambulatory setting, majority of the patients (73.6%) showed no identifiable findings on the chest imaging [18]. Interestingly, when the images were re-read with the knowledge that patients has COVID 19, 20% of the reports were changed to abnormal. This may be attributed to the difficulty in perceiving subtle findings in early course of illness. In order to rationalize the chest imaging in COVID patients, Fleischner Society issued a multinational consensus guidelines [19]. In patients with mild clinical features, imaging is indicated after a positive viral test if the patient has risk factors for disease progression. In a patient with moderate to severe clinical features, imaging is indicated after a positive viral

test if the patient is at risk for worsening of pulmonary status. If testing for COVID-19 is unavailable, imaging can determine if an alternative diagnosis is present or if the findings suspicious for COVID-19 are revealed, can guide further workup. In the present study the difference between various frontline specialties in identifying the Chest X-rays is evident. This can be attributed to two main reasons. Specialties like Critical care, Emergency medicine and Internal medicine treat more sick patients with extensive and clear COVID imaging findings whereas stable patients with minimal symptoms and subtle findings usually present to Family medicine centers. Secondly, many of the usual acute emergencies which are treated by Emergency medicine, Critical care and Internists had a significant downfall during the pandemic [20,21]. These visits declined staggering even upto more than 40% of the usual. As a result the physicians had a very low threshold in identifying the findings on Chest X-rays which otherwise might have been overlooked in the usual busy times or would have attracted multiple differential diagnosis. Chest X-ray is an important reproducible tool for assessing COVID 19 to predict early mortality and need for the ventilator support [22]. However even after six months of COVID pandemic, our findings of poor diagnostic competency is highly concerning. To improve the competency of physicians in identifying Chest X-rays and to improve the quality of care of our patients various recommendations have been made previously. Increasing the number of credits of radiology during the medical school, continuous medical education of in-service physicians and increasing the number of on-site radiologists or tele-radiology in interpreting all Chest X-rays immediately [13-15]. Weatherburn et al. argued that Picture archiving and Communication System (PACS) improves the identification in comparison to the standard radiological films [23]. However, our institution uses PACS and the competency unfortunately is still disappointing. Chest X-ray remains a widely used and quintessential tool in the management of COVID 19. However, with more than forty million cases and over a million deaths worldwide the competency of physicians in identifying subtle COVID 19 findings in Chest X-rays is staggeringly low. Physicians should keep a low threshold in identifying these signs and continuous medical education should be provided wherever necessary with the latest updates.

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