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.

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Optical techniques, computed tomography and deep learning role in the diagnosis of COVID-19 pandemic towards increasing the survival rate of vulnerable populations

The COVID-19 was declared pandemic on March 11, 2020 as it has affected the people of more than 192 countries on the globe. This havoc has spread from China to other world countries and does not seem to be as deadly as SARS and MERS [1]. It has been further announced by WHO that more than 80 % of COVID-19 patients have mild symptoms but mortality rate is above 6% in reported cases. Testing of COVID-19 is problematic due to scarcity of diagnostic resources. Early diagnosis and social distancing are essential to reduce the chances of it's spread to other healthy humans. The casualities death toll to date is 320,181 with 4,894,220 reported cases. COVID-19 belongs to the family of SARS (civet origin), MERS (camel origin) viruses and differs due to its source (penguin origin) and the additional protein (s–spike) found on it. Effective treatments for the lung obstruction of COVID-19 are not available to most defenseless populations except oxygen therapy, which may help somewhat. Ultrasound has recently been proposed as a diagnostic method for COVID-19 infection [2], however, diagnostic and therapeutic protocols are still not well established due to the insufficient COVID-19 affected patient research data, space and medical equipment in hospitals. This makes it difficult to detect lung problems early and, as a consequence, COVID-19 infection can be fatal to people who are at risk. Early detection can be achieved with optical methods (transmittance, reflectance and fluorescence) which allows critical molecular-sensitive detection of real-time analysis of biological tissues [3–5].

It has been found that it takes 14 days at the most before the actual symptoms appear. The challenge is that it is neither flu nor typical pneumonia. Unlike pneumonia, it affects both lungs and infact, various parts of each lung resulting a diffused damage to the patient. There is a dire need of reaching the rapid changes in lung images as well for prompt accurate diagnostics [6]. This letter to the editor aims to propose optically monitored transmission tomography in general and ultra low dose computed tomography as a special method for reliable diagnosis of inidividuals subjected to the pandemic that has been paced to a seemingly lower level with drastic percuationary measures. In addition to this, the need is there to adopt computer aided optical diagnostic techniques as a second opinion with expert advice.

Currently, there are two alternatives which are considered authentic for medical community: clinical tests and symptomatic lung scans, i.e., RT-PCR (gold standard for diagnosis of COVID-19 by WHO) and CT imaging. The former has varying turnaround times and is relatively less sensitive. The sensitivity of CT scans (88 %) has been found high as compared to the clinical approach (59 %) for diagnosing suspected patients [7,5]. In other words, the ratio of finding the true positives with CT is higher than RT-PCR. Two important things, therefore, can be highlighted: the use of ultra low CT methods and the automated analysis system. This may help to save time for treatment monitoring and give an extra flexibility in their decisions through automated support systems built on deep learning-based strategies. The objective should be to develop confidence of medical community in these systems. Moreover, since the symptoms (which are detectable through CT images) appear after the molecular level changes occurred due to the penetration of the COVID-19 virus through cell membrane and completion of replication process of its RNA, therefore, optically monitored CT imaging along with deep learning is the best solution for authentic diagnosis at early stage of the diseases. So, optical methods like Raman spectroscopy, transmission/reflectance spectroscopy of (blood, plasma, nasopharyngeal swab sample) [8] along with CT images on which the most important findings concerning to lungs' CT have been found to be grounding glass opacities, patchy consolidation or crazy paving pattern and pleural effusion in lower sections of both lungs [9,10]. In future, it is suggested that ultra-low dose CT [11] techniques should be preferred to acquire sequential CTs progression for rapidly varying findings with history through cytokine storms in severe patients along with optical diagnostics methods to boost authentic diagnostic capability and a correlation can be established between them for early diagnostic of disease. It is caused by abnormal immune response to the infection rather than by the virus itself and results in cells death in the lungs starving of blood oxygen [12]. According to our opinion, the limited number of views and sparse sampling for reconstruction of cross-sectional scans should be used in this case for releaving the patients of deadly radiation dose hazards from progressive viewing of lungs. We have already proved that viewing of lungs can be achived through ten fold decrease in CT dose. Radiation dose should be under safe margins to assure the prevention from increased risk of cancer by viewing radiations exposure that may again be problematic in coming days. As for the other option in this letter, it is important to extract COVID-19 features from the reconstructed images and provide a computer based automated solution thus reducing disease control time. The accurate and fast computer-aided system for timely diagnosis using deep learning strategies is suggested as a helping diagnostic method and classifying the diseased subjects with a confidence level of 87 % with reduced false negatives [13,14].

The use of robust deep learning strategy should be considered as a monitoring tool especially during the pandemic to discriminate the community acquired pneumonia from COVID-19 patients [15] in both optical signature and CT images. This partly ensures the experts using knowledge base from their previous experiences and helps healthcare workers in gradual record updating of patients along with signature databank to diagnose through deep learning.

Ultrasonography can also be used to monitor and treat patients without any destructive effects. It is based on the special patterns to be examined for diagnostic purposes. The texture shape in the pattern indicates the seriousness of the lungs disease. The strategies highlighted

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so far can act as a support to control the COVID-19 spread especially for elderly and young patients. Numerous researchers are working constantly to help the health care personnel to develop low dose scanning methodologies in collaboration with research institutions and medical industry. The need is there as well to adopt the sophisticated and automated decision support systems with confidence especially in these days of need.

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