What if artificial intelligence in medical imaging could accelerate Covid-19 treatment?

Artificial intelligence (AI) solutions can help radiologists with the triage, quantification and trend analysis of patient data. AI-powered medical imaging is already used to detect critical diseases, and medical imaging has played a significant role in the fight against Covid-19, easing the pressure on healthcare systems. Although AI imaging as a diagnostic tool is still surrounded by various challenges and uncertainties, its use in the context of Covid-19 has assisted clinicians with its faster image-processing times – as little as 10 seconds compared with up to 15 minutes for a manual reading of a computerised tomography (CT) scan.

Medical imaging has always been one of the most advanced areas of AI application showing remarkable accuracy and sensitivity in the identification of imaging abnormalities. In the context of Covid-19, medical imaging has facilitated incidental diagnosis, offering supporting evidence in clinical situations where false negative RT-PCR tests are suspected and helping evaluate treatment outcomes, disease progression and anticipated prognosis.

AI-empowered image processing can automate searches through large databases and deliver more precise demarcation of infections in X-ray and CT images, facilitating fast evaluation of CT scans and identification of Covid-19 findings. Clinicians and radiologists can use machine learning (ML) algorithms to examine information contained in medical scans or images as these provide better tools for localisation and quantification of disease features. The result can be better early detection, diagnostic performance and prognostic value while also easing the burden on laboratory testing. Could these AI systems, with their several advantages, replace human (medical) judgement in the context of the Covid-19 pandemic?

Potential impacts and developments

AI-supported medical imaging can be vital in the fast detection and classification of Covid-19, as it can immediately flag chest CT scans showing suspected Covid-19 allowing the patients concerned to be tested promptly. Image recognition algorithms can bring together and analyse chest CT scan findings, clinical symptoms, exposure patterns and other forms of testing, thus providing clinicians and clinical decision-making systems in general with essential information.

Using well-curated medical imaging data, AI algorithms can be developed, trained and validated so as to anticipate possible clinical deterioration or improvement. These evidence-based predictions could in effect help hospitals plan workflow in an emergency context such as the current one. They would provide consistent, quantifiable information to evaluate precisely the gravity of a patient's illness, enabling medical personnel to effectively triage patients and thus alleviate the ever-growing patient backlog.

Recently, a new algorithm has been developed combining CT images of patients' lungs with non-imaging data to identify Covid-19-positive patients who require immediate intervention; another, meanwhile, offers an automated tool for rapid identification of patients with suspicious chest imaging for isolation and further testing.

AI can reduce the time taken in the medical imaging process by examining thousands of images from a chest CT scan. It can also increase patient safety by improving X-ray exposure parameters and producing low-dose CT scans. AI-empowered visual sensors can meanwhile accelerate scanning, automate risk stratification and, in effect, reduce unnecessary radiation exposure in the clinical setting.

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AI medical imaging models have been deployed in a number of hospitals around the world. The US Food and Drug Administration (FDA) has authorised the use of AI algorithms that detect Covid-19 in partially imaged lungs as an incidental finding, whereas the EU is funding the Imaging Covid-19 AI initiative, a multi-centre European project, to enhance the use of CT in the diagnosis of Covid-19 by using AI. Last but not least, a group of Belgian hospitals have recently developed the first CE-marked AI solution for CT that offers fast quantification of lung pathology on chest CT scans in Covid-19 patients. Are these initiatives sufficient to cope with the current needs for safe and accurate AI-powered diagnostic tools? Or are more multicentre and multidisciplinary clinical studies needed to address the current knowledge gaps?

Anticipatory policy-making

Along with great benefits, the introduction of AI to medical imaging also raises a significant number of legal questions and ethical considerations. The deployment of AI in the context of the current pandemic is also subject to numerous challenges that could undermine the accuracy and usefulness of its eventual clinical findings. These relate to the overall gap in knowledge of the long-term effects of Covid-19 and the lack of historical data to enable training on large-scale prognosis data. The result is the over-use of small incomprehensive public datasets and a combined lack of robustness and interpretability of AI models in clinical practice. One additional important diagnostic challenge lies with the non-specificity of Covid-19 patterns and their differentiation from non-Covid-19 viral pneumonia or asymptomatic patients with unaffected lungs.

The primary challenge in this context is that of accessing large volumes of data for AI development and the lack of representative data to train and validate algorithms. As the effectiveness of AI-supported devices relies on the accuracy of training data, grounding modelling and clinical decisions on sub-optimal data may compromise accuracy and reliability and result in deficient medical diagnoses. In fact, the accelerating development of AI-based diagnostic tools in response to the current pandemic has brought to the fore the absence of standardised protocols for training and validating ML algorithms in this domain and the lack of large and diverse image datasets from a variety of certified sources, as required to train the algorithm.

The training, testing and eventual validation of AI-based algorithms for use in the current public health crisis requires access to large and curated datasets developed in accordance with existing privacy norms and data protection rules. The absence of such large datasets means AI-supported medical scans may be biased by technical factors owing to subtle differences in data from different scanning techniques or ill-curated data that train algorithms and deep networks on Covid-19. The integration of AI techniques in radiology in this particular context also raises questions about the ethics of the procedures and protocols followed for collecting and processing this medical data, including issues of informed consent, privacy and data ownership.

Under the General Data Protection Regulation, patients must give prior informed explicit consent for the use of their medical scans and imaging data in developing an AI algorithm, and this must be renewed before the design and training of each new version. Is that plausible given the time pressure to deliver fast clinical findings and solutions? The grounding of diagnostic decisions on AI-powered processing also raises liability questions: who should be held liable for an ineffective medical diagnosis? The doctor or the software developer?

Under the EU Medical Devices Regulation, a radiologist could be held liable if they depart from the AI-powered diagnostic medical imaging equipment's diagnosis. However, the question is whether or not these AI algorithms have been subject to the same rigorous pre-market authorisation and auditing standards followed for the assessment and eventual deployment of other medical devices? Or have these regulatory procedures been fast-tracked owing to the urgent demand for Covid-19 related diagnostic solutions?

Beyond the issue of the availability, quality and representativeness of the datasets used to train algorithms, the majority of hospitals lack the technological infrastructure, manpower and knowhow to manage these complex AI systems effectively, since most of them use outdated computer-assisted diagnostics tools or only perform visual checks on medical scans.

Uptake of image recognition AI in medical diagnostics currently sits between 1 and 20 % depending on the disease area. Consequently, the use of AI-powered imaging in resource-limited settings remains a major technological and policy challenge that must be addressed as a matter of urgency, not least because of its

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potential benefits in boosting public health systems' capacity to cope with the current extraordinary global health crisis.

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