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# A fully automatic deep learning system for COVID-19 diagnostic and prognostic analysis

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A fully automatic deep learning system provides a convenient method for COVID-19 diagnostic and prognostic analysis, which can help COVID-19 screening and finding potential high-risk patients with worse prognosis <https://bit.ly/3bRaxGw>

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**ABSTRACT** Coronavirus disease 2019 (COVID-19) has spread globally, and medical resources become insufficient in many regions. Fast diagnosis of COVID-19 and finding high-risk patients with worse prognosis for early prevention and medical resource optimisation is important. Here, we proposed a fully automatic deep learning system for COVID-19 diagnostic and prognostic analysis by routinely used computed tomography.

We retrospectively collected 5372 patients with computed tomography images from seven cities or provinces. Firstly, 4106 patients with computed tomography images were used to pre-train the deep learning system, making it learn lung features. Following this, 1266 patients (924 with COVID-19 (471 had follow-up for >5 days) and 342 with other pneumonia) from six cities or provinces were enrolled to train and externally validate the performance of the deep learning system.

In the four external validation sets, the deep learning system achieved good performance in identifying COVID-19 from other pneumonia (AUC 0.87 and 0.88, respectively) and viral pneumonia (AUC 0.86). Moreover, the deep learning system succeeded to stratify patients into high- and low-risk groups whose hospital-stay time had significant difference ( $p=0.013$  and  $p=0.014$ , respectively). Without human

assistance, the deep learning system automatically focused on abnormal areas that showed consistent characteristics with reported radiological findings.

Deep learning provides a convenient tool for fast screening of COVID-19 and identifying potential high-risk patients, which may be helpful for medical resource optimisation and early prevention before patients show severe symptoms.