

World first for AI and machine learning to treat COVID-19 patients worldwide

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Addenbrooke's Hospital in Cambridge and 20 other hospitals from across the world and healthcare technology leader NVIDIA have used artificial intelligence (AI) to predict COVID patients' oxygen needs on a

global scale.

The research was sparked by the pandemic and set out to build an AI tool to predict how much extra oxygen a COVID-19 patient might need in the first days of hospital care, using data from across four continents.

The technique, known as federated learning, used an algorithm to analyze chest X-rays and electronic health data from [hospital patients](#) with COVID symptoms.

To maintain strict patient confidentiality, the patient data was fully anonymized and an algorithm was sent to each hospital so no data was shared or left its location.

Once the algorithm had "learned" from the data, the analysis was brought together to build an AI tool which could predict the oxygen needs of hospital COVID patients anywhere in the world.

Published today in *Nature Medicine*, the study dubbed EXAM (for EMR CXR AI Model), is one of the largest, most diverse clinical federated learning studies to date.

To check the accuracy of EXAM, it was tested out in a number of hospitals across five continents, including Addenbrooke's Hospital. The results showed it predicted the oxygen needed within 24 hours of a patient's arrival in the emergency department, with a sensitivity of 95 percent and a specificity of over 88 percent.

"Federated learning has transformative power to bring AI innovation to the clinical workflow," said Professor Fiona Gilbert, who led the study in Cambridge and is honorary consultant radiologist at Addenbrooke's Hospital and chair of radiology at the University of Cambridge School of Clinical Medicine.

"Our continued work with EXAM demonstrates that these kinds of global collaborations are repeatable and more efficient, so that we can meet clinicians' needs to tackle complex health challenges and future epidemics."

First author on the study Dr. Ittai Dayan, from Mass General Brigham in the U.S., where the EXAM algorithm was developed, said, "Usually in AI development, when you create an algorithm on one hospital's data, it doesn't work well at any other [hospital](#). By developing the EXAM model using federated learning and objective, multimodal data from different continents, we were able to build a generalizable model that can help frontline physicians worldwide."

Bringing together collaborators across North and South America, Europe and Asia, the EXAM study took just two weeks of AI "learning" to achieve high-quality predictions.

"Federated Learning allowed researchers to collaborate and set a new standard for what we can do globally, using the power of AI," said Dr. Mona G. Flores, Global Head for Medical AI at NVIDIA. "This will advance AI not just for healthcare but across all industries looking to build robust models without sacrificing privacy."

The outcomes of around 10,000 COVID patients from across the world were analyzed in the study, including 250 who came to Addenbrooke's Hospital in the first wave of the pandemic in March/April 2020.

The research was supported by the National Institute for Health Research (NIHR) Cambridge Biomedical Research Centre (BRC).

Work on the EXAM model has continued. Mass General Brigham and the NIHR Cambridge BRC are working with NVIDIA Inception startup Rhino Health, cofounded by Dr. Dayan, to run prospective studies using

EXAM.

Professor Gilbert added, "Creating software to match the performance of our best radiologists is complex, but a truly transformative aspiration. The more we can securely integrate data from different sources using federated learning and collaboration, and have the space needed to innovate, the faster academics can make those transformative goals a reality."

More information: Ittai Dayan et al, Federated learning for predicting clinical outcomes in patients with COVID-19, *Nature Medicine* (2021).

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