Artifical intelligence approach may help detect Alzheimer's disease from routine brain imaging tests

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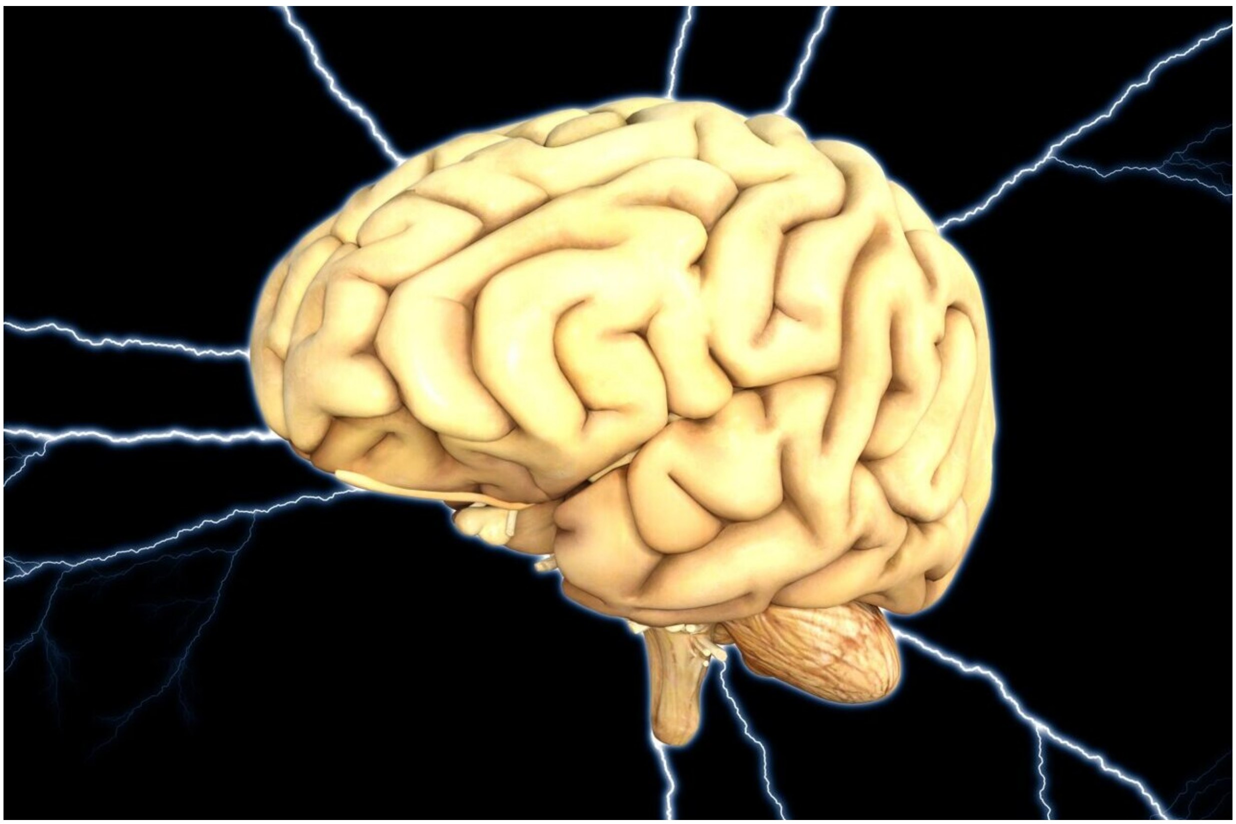

Credit: Pixabay/Pete Linforth.

Although investigators have made strides in detecting signs of Alzheimer's disease using high-quality brain imaging tests collected as part of research studies, a team at Massachusetts General Hospital (MGH) recently developed an accurate method for detection that relies on routinely collected clinical brain images. The advance could lead to more accurate diagnoses.

For the study, which is published in *PLOS ONE*, Matthew Leming, Ph.D., a research fellow at MGH's Center for Systems Biology and an investigator at the Massachusetts Alzheimer's Disease Research Center, and his colleagues used deep learning—a type of machine learning and artificial intelligence that uses large amounts of data and complex algorithms to train models.

In this case, the scientists developed a model for Alzheimer's disease detection based on data from brain magnetic resonance images (MRIs) collected from patients with and without Alzheimer's disease who were seen at MGH before 2019.

Next, the group tested the model across five datasets—MGH post-2019, Brigham and Women's Hospital pre- and post-2019, and outside systems pre- and post-2019—to see if it could accurately detect Alzheimer's disease based on real-world clinical data, regardless of hospital and time.

Overall, the research involved 11,103 images from 2,348 patients at risk for Alzheimer's disease and 26,892 images from 8,456 patients without Alzheimer's disease. Across all five datasets, the model detected Alzheimer's disease risk with 90.2% accuracy.

Among the main innovations of the work were its ability to detect Alzheimer's disease regardless of other variables, such as age. "Alzheimer's disease typically occurs in older adults, and so deep learning models often have difficulty in detecting the rarer early-onset cases," says Leming. "We addressed this by making the deep learning model 'blind' to features of the brain that it finds to be overly associated with the patient's listed age."

Leming notes that another common challenge in disease detection, especially in real-world settings, is dealing with data that are very different from the training set. For instance, a deep learning model trained on MRIs from a scanner manufactured by General Electric may fail to recognize MRIs collected on a scanner manufactured by Siemens.

The model used an uncertainty metric to determine whether patient data were too different from what it had been trained on for it to be able to make a successful prediction.

"This is one of the only studies that used routinely collected brain MRIs to attempt to detect dementia. While a large number of deep learning studies for Alzheimer's detection from brain MRIs have been conducted, this study made substantial steps towards actually performing this in real-world clinical settings as opposed to perfect laboratory settings," said Leming. "Our results—with cross-site, cross-time, and cross-population generalizability—make a strong case for clinical use of this diagnostic technology."

More information: Matthew Leming et al, Adversarial confound regression and uncertainty measurements to classify heterogeneous clinical MRI in Mass General Brigham, *PLOS ONE* (2023). DOI: 10.1371/journal.pone.0277572

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