

AI-based System Could Help Triage Brain MRIs

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At A Glance

- Researchers developed an AI-driven system for use as a triage tool in assessing brain MRIs.
- Researchers trained and validated the algorithm on data from more than 9,000 MRI exams.
- The model has the potential to further benefit outpatient care by identifying incidental findings.

OAK BROOK, Ill. (March 17, 2021) — An artificial intelligence-driven system that automatically combs through brain MRIs for abnormalities could speed care to those who need it most, according to a study published in *Radiology: Artificial Intelligence*.

MRI produces detailed images of the brain that help radiologists diagnose various diseases and damage from events like a stroke or head injury. Its increasing use has led to an image overload that presents an urgent need for improved radiologic workflow. Automatic identification of abnormal findings in medical images offers a potential solution, enabling improved patient care and accelerated patient discharge.

"There are an increasing number of MRIs that are performed, not only in the hospital but also for outpatients, so there is a real need to improve radiology workflow," said study co-lead author Romane Gauriau, Ph.D., former machine learning scientist at Massachusetts General Hospital and Brigham and Women's Hospital Center for Clinical Data Science in Boston. "One way of doing that is to automate some of the process and also help the radiologist prioritize the different exams."

Dr. Gauriau, along with co-lead author Bernardo C. Bizzo, M.D., Ph.D., and colleagues, and in partnership with Diagnosticos da America SA (DASA), a medical diagnostics company in Brazil, developed an automated system for classifying brain MRI scans as either "likely normal" or "likely abnormal." The approach relies on a convolutional neural network (CNN), a sophisticated type of AI that allows the model to learn directly from the images.

The researchers trained and validated the algorithm on three large datasets totaling more than 9,000 examinations collected from different institutions on two different continents.

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Romane Gauriau, Ph.D.

In preliminary testing, the model showed relatively good performance to differentiate likely normal or likely abnormal examinations. Testing on a validation dataset acquired at a different time period and from a different institution than the data used to train the algorithm highlighted the generalization capacity of the model. Such a system could be used as a triage tool, according to Dr. Gauriau, with the potential to improve radiology workflow.

"The problem we are trying to tackle is very, very complex because there are a huge variety of abnormalities on MRI," she said. "We showed that this model is promising enough to start evaluating if it can be used in a clinical environment."

Similar models have been shown to significantly improve turnaround time for the identification of abnormalities in head CTs and chest X-rays. The new model has the potential to further benefit outpatient care by identifying incidental findings. An incidental finding is an abnormality not related to the reason the physician ordered the test.

"Say you fell and hit your head, then went to the hospital and they ordered a brain MRI," Dr. Gauriau said. "This algorithm could detect if you have brain injury from the fall, but it may also detect an unexpected finding such as a brain tumor. Having that ability could really help improve patient care."

The work was the first of its kind to leverage a large and clinically relevant dataset and use full volume MRI data to detect overall brain abnormality. The next steps in the research include evaluating the model's clinical utility and potential value for radiologists. Researchers would also like to develop it beyond the binary outputs of "likely normal" or "likely abnormal."

"This way we could not only have binary results but maybe something to better characterize the types of findings, for instance, if the abnormality is more likely to be related to tumor or to inflammation," Dr. Gauriau said. "It could also be very useful for educational purposes."

Further evaluation is currently ongoing in a controlled clinical environment in Brazil with the research collaborators from DASA.

"A Deep Learning-Based Model for Detecting Abnormalities on Brain MRI for Triage: Preliminary Results from a Multi-Site Experience." Collaborating with Drs. Gauriau and Bizzo were Felipe C. Kitamura, M.D., Ph.D., Osvaldo Landi Junior, M.D., Suely F. Ferracioli, M.D., Fabiola B. C. Macruz, M.D., Ph.D., Tiago A. Sanchez, Ph.D., Marcio R. T. Garcia, M.D., Leonardo M. Vedolin, M.D., Ph.D., Romeu C. Domingues, M.D., Emerson L. Gasparetto, M.D., Ph.D., and Katherine P. Andriole, Ph.D.

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For information on brain MRI, visit [RadiologyInfo.org](https://radiologyinfo.org).

Images (JPG, TIF):

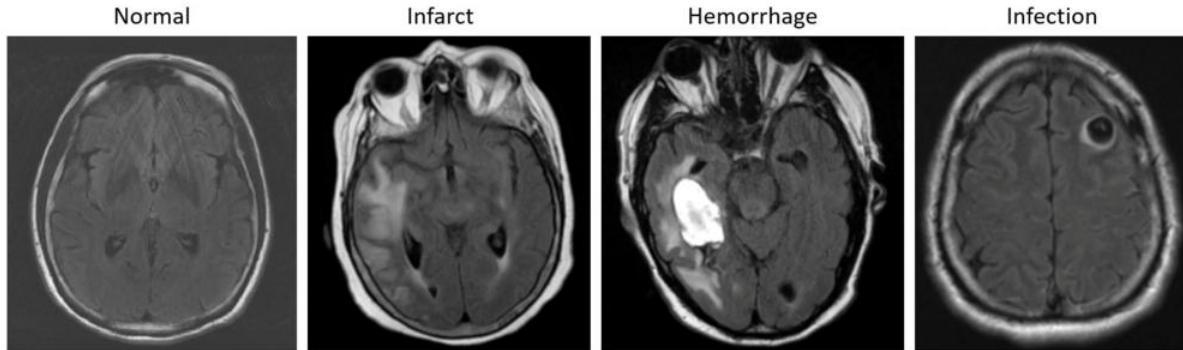


Figure 1. Examples of axial FLAIR sequences from studies within dataset A. From left to right: a patient with a 'likely normal' brain; a patient presenting an intraparenchymal hemorrhage within the right temporal lobe; a patient presenting an acute infarct of the inferior division of the right middle cerebral artery; and a patient with known neurocysticercosis presenting a rounded cystic lesion in the left middle frontal gyrus.

[High-res \(TIF\) version](#)

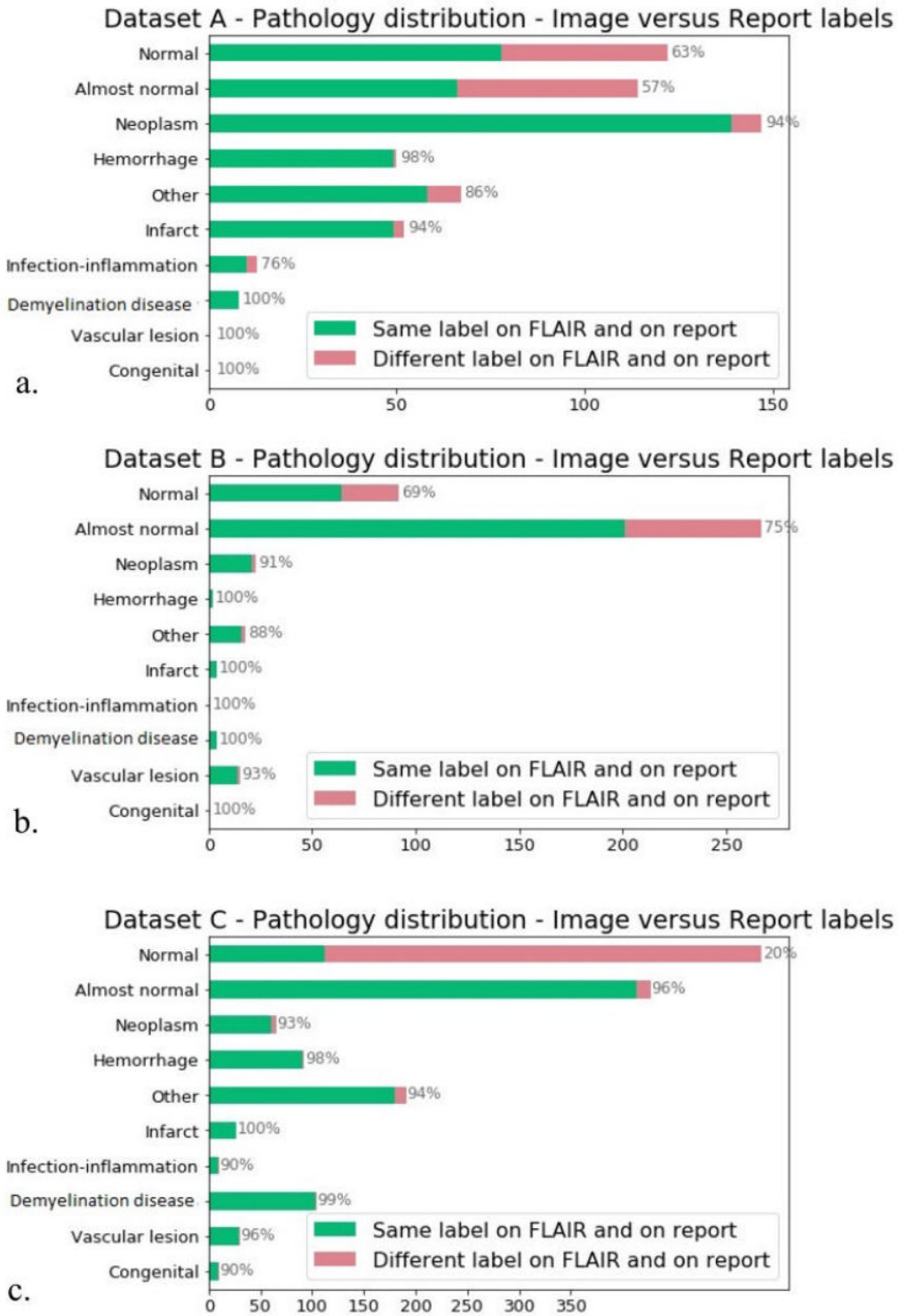


Figure 2. Pathology distribution on (a) dataset A, (b) dataset B, and (c) dataset C using annotations from the report. Reported in green are the percentage of annotations in which labels derived from the fluid attenuated inversion recover MR image alone matched the report labels. Note on imaging 'almost normal' and other pathologies are classified as likely abnormal. [High-res \(TIF\) version](#)

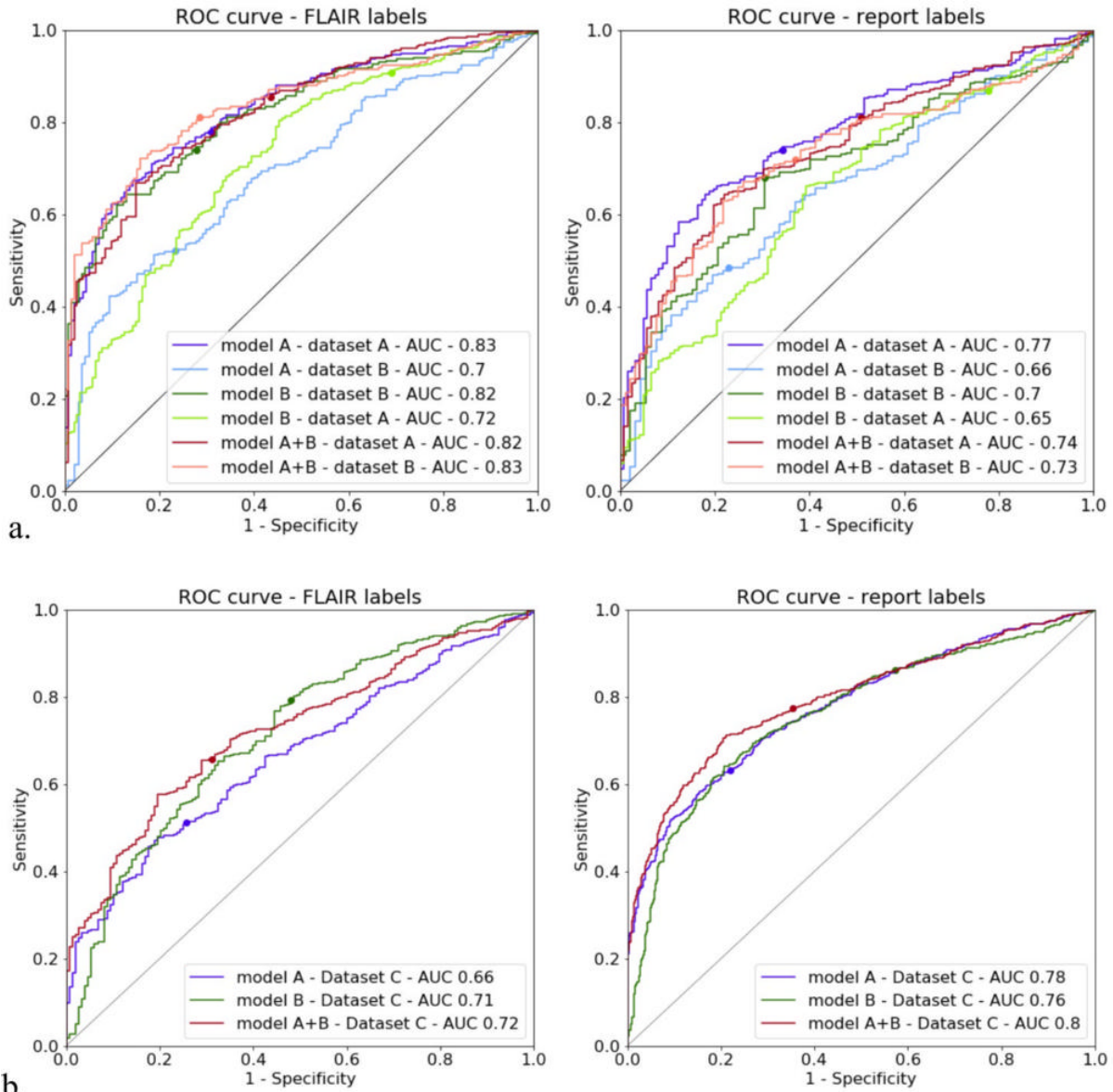


Figure 3. Receiver operating characteristic curves for models A, B, and A+B on (a) TestA and TestB, as well as on (b) TestC. Annotation labels from FLAIR (left) and radiology report annotation labels (right) were used as ground truth. The dots show the values corresponding to a threshold of 0.5. [High-res \(TIF\) version](#)

Resources:

[Study abstract](#)