



Real-world applications of Artificial Intelligence in pre-dementia diagnostics and treatment administration



Esten H. Leonardsen

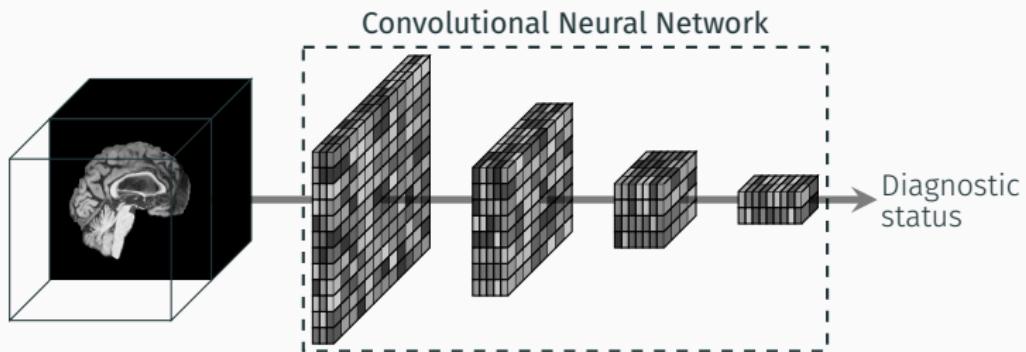
Chief Scientific Officer, baba.vision

Post-doc at the Department of
Psychology, Universitet i Oslo

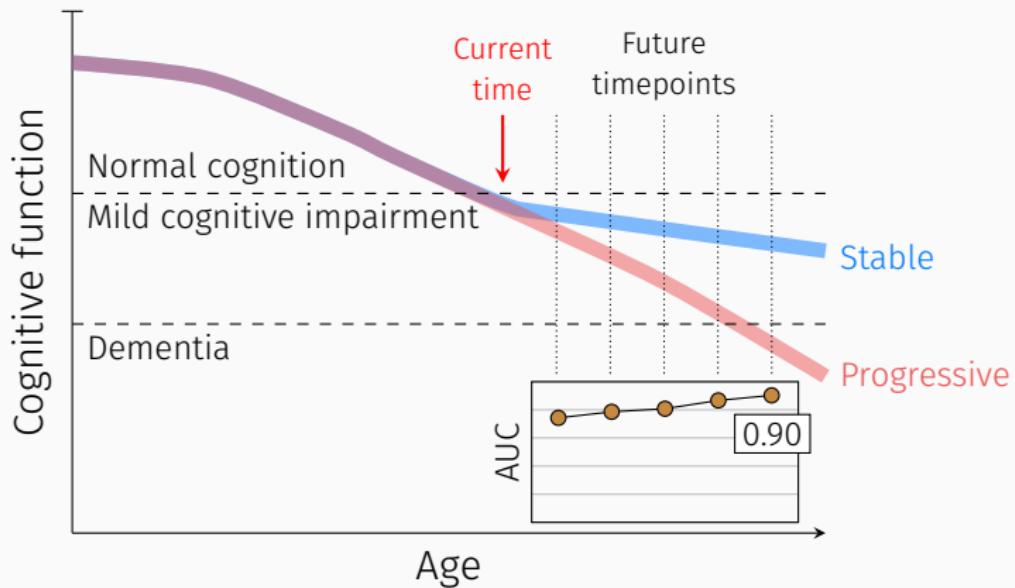


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Background



Background



Background

Deep neural networks learn general and clinically relevant representations of the ageing brain

Deep neural networks learn general and clinically relevant representations of the ageing brain, Leonardsen et al., 2022. *NeuroImage*, 256, 119210

linked to cognitive performance in multiple domains. While further validations in clinical contexts are needed, our XAI pipeline for dementia demonstrates how advanced predictive technology can be employed by clinicians to monitor and characterize disease development for individual patients.

Constructing personalized characterizations of structural brain aberrations in patients with dementia using explainable artificial intelligence,
Leonardsen et al., 2024. *npj Digital Medicine*, 7(1), 110

Background

 estenhl Merge pull request #26 from estenhl/packaging ··· 7671d00 · 4 months ago 123 Commits

| | | | |
|---|------------------|---|---------------|
|  | citations | Finished READMEs for now | 9 months ago |
|  | docker | Updated docker containers, small linting fixes, fixed bug ... | 9 months ago |
|  | notebooks | Updated docker containers, small linting fixes, fixed bug ... | 9 months ago |
|  | preprocessing | Finished models, pre/postprocessing and example from ... | 10 months ago |
|  | pyment | Tried moving data folder (although I don't want to) | 5 months ago |
|  | scripts | Updated docker containers, small linting fixes, fixed bug ... | 9 months ago |
|  | tests | Removed redundant data folder | 5 months ago |
|  | .gitignore | More tests and comments, modified README | 9 months ago |
|  | CHANGELOG.md | More tests and comments, modified README | 9 months ago |
|  | LICENSE.md | Added license and citation | 2 years ago |
|  | README.md | Finished READMEs for now | 9 months ago |
|  | requirements.txt | Fixed docker containers | 10 months ago |
|  | setup.py | Tried moving data folder (although I don't want to) | 5 months ago |

 README  License

This is a repository containing pretrained models for neuroimaging data used in various scientific publications. The publications are listed [here](#), and all the models are listed [here](#). After version 3.0.0 the nature of this repo changed, a description of which can be found in the [changelog](#). The models posted here try to mimic the behaviour and interface of the [pretrained models in the Keras applications package](#). Besides the possibility of importing this library in Python and interacting with the models as Python-objects, we demonstrate three use cases for interaction here:

- [Jupyter notebooks](#)
- [Command-line scripts](#)
- [Docker containers](#)

No description, website, or topics provided.

 Readme
 View license
 Activity
 33 stars
 2 watching
 15 forks
Report repository

Releases 2

 v2.0.0 (Latest)
on Feb 17, 2023

+ 1 release

Packages

No packages published

Languages

 Jupyter Notebook 99.5%  Other 0.5%

<https://github.com/estenhl/pyment-public>

Background

1. Showcase the **general efficacy** of artificial intelligence for demonstrative clinical use-cases

Background

1. Showcase the **general efficacy** of artificial intelligence for demonstrative clinical use-cases
2. Build predictive models to solve specific **real-world clinical problems** using **commercially available data**
3. Ensure the **robustness and utility** of the models through extensive validation
4. Collaborate with clinicians to package the models in **user-friendly interfaces** integrating smoothly into **standardized clinical workflows**

Background



Per Wessel Nore
CEO baba.vision

Background

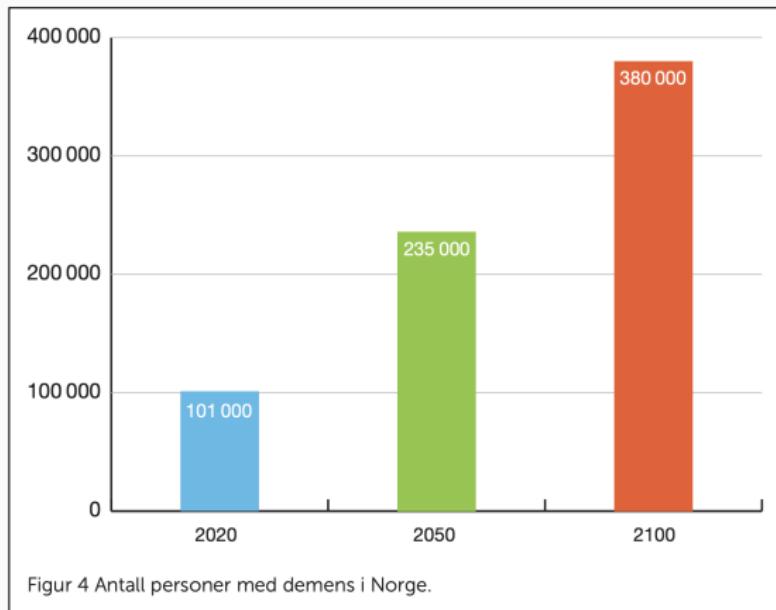


Per Wessel Nore
CEO babavision



Decision support for neuroradiological examinations in dementia pre-diagnosis

Neuroradiological decision support



Neuroradiological decision support



"However, in practice, this [referral for neuroimaging] concerns a very small number of patients, judiciously selected, as to not overwhelm the radiology services which was commented upon as being *exceptionally limited and often available off-site in another larger regional hospital!*"

Neuroradiological decision support

| | 1 | 2 | 3 | 4 | 5 |
|---|----|-----|-----|----|---|
| 1 | 38 | 273 | 17 | 4 | 0 |
| 2 | 0 | 92 | 144 | 12 | 0 |
| 3 | 0 | 6 | 89 | 31 | 2 |
| 4 | 0 | 0 | 3 | 19 | 5 |
| 5 | 0 | 0 | 0 | 0 | 5 |

Neuroradiological decision support

Subject: "Bibi"

MRI-Scans / 2024-09-16 MRI T1

Generate draft report with AI

Subject data

Age: 75
Sex: M

Image history

- MRI scan (T1, T2, PD) Today, 11:09 AM
- MRI scan (T1, T2, PD) Sep 4, 2024
- MRI scan (T1, T2, PD) Feb 2, 2024
- PET scan Feb 2, 2024

Overview

| | | | |
|-----------------------|-----------------------------|-----------------------------|--|
| Brain Age: 75 +11.01% | Dementia index: 7/10 -0.03% | Microhemorrhages: 5 +15.03% | Total volume change (ml): 2,318 +6.08% |
|-----------------------|-----------------------------|-----------------------------|--|

Score

| | | |
|----------------|--|--------------------------------------|
| MTA: ● ○ ○ | Differential diagnosis: Vascular dementia: ● ○ ○ | XAI Image highlights: Highlight 1: ● |
| CGA: ● ● ○ ○ | Ivy body dementia: ● ○ ○ | Highlight 2: ○ |
| Fazekas: ● ○ ○ | Alzheimer: ● ● ○ ○ | Highlight 3: ○ |
| PSMD: ● ● ○ ○ | Huntington: ● ○ ○ | |
| CAA: ● ○ ○ | ... | ... |

Navigator

- MRI-scans
- Reports
- Individuals

Images

- 2024-09-16 MRI T1
- 2024-09-16 MRI T2
- 2024-09-16 MRI PD

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2024-09-16 MRI T1

2024-09-16 MRI T2

2024-09-16 MRI PD

Deep learning

Score

| | |
|---------|-------|
| MTA | ● ● |
| CGA | ● ● ● |
| Fazekas | ● ● |
| PSMD | ● ● ● |
| CAA | ● ● |

Differential diagnosis

| | |
|--------------------|---------|
| Vascular dementia | ● ● |
| lewy body dementia | ● ● ● |
| Alzheimer | ● ● ● ● |
| Huntington | ● ● |
| ... | ... |

XAI Image highlights

- Highlight 1: ●
- Highlight 2: ●
- Highlight 3: ●

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Treatment response prediction and monitoring of patients on anti-amyloid therapies

Treatment response and monitoring

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Home > News > Leqembi recommended for treatment of early Alzheimer's disease



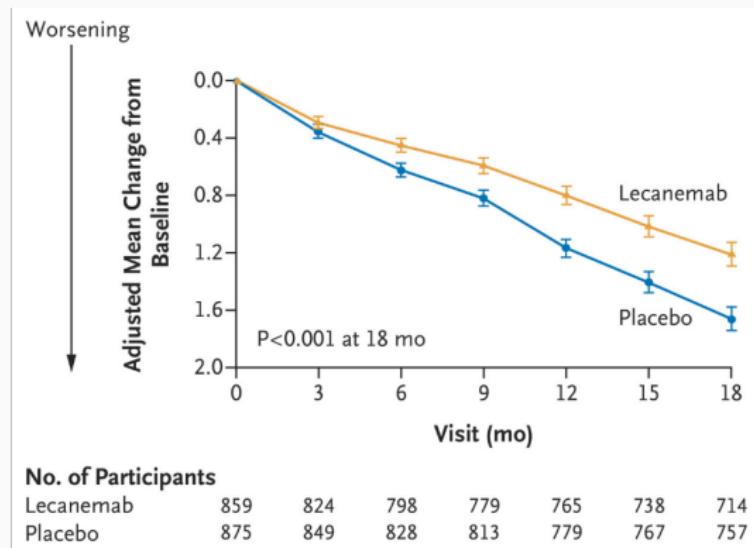
Leqembi recommended for treatment of early Alzheimer's disease

14 November 2024

Re-examination concludes that benefits outweigh risks in a restricted patient population

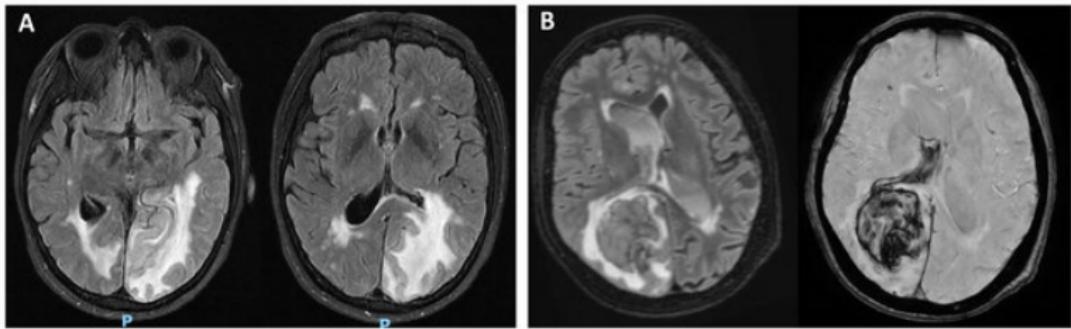
[News](#) [Human](#) [Medicines](#)

Treatment response and monitoring



Van Dyck, C. H., Swanson, C. J., Aisen, P., Bateman, R. J., Chen, C., Gee, M., ... & Iwatsubo, T. (2023). Lecanemab in early Alzheimer's disease. *New England Journal of Medicine*, 388(1), 9-21.

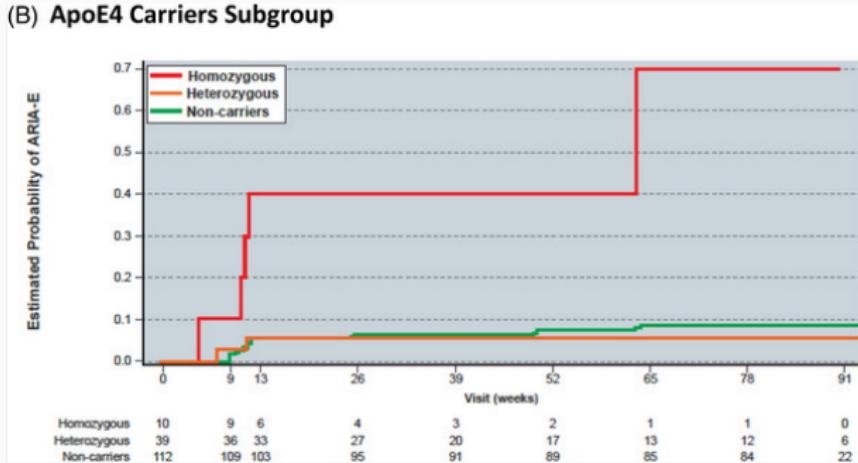
Treatment response and monitoring



Villain, N., Planche, V., & Levy, R. (2022). High-clearance anti-amyloid immunotherapies in Alzheimer's disease. Part 1: Meta-analysis and review of efficacy and safety data, and medico-economical aspects. *Revue neurologique*, 178(10), 1011-1030.

Treatment response and monitoring

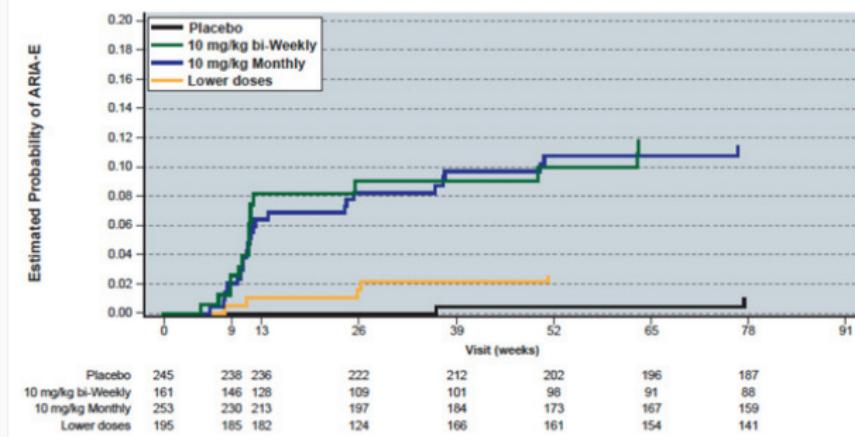
(B) ApoE4 Carriers Subgroup



Honig, L. S., Barakos, J., Dhadda, S., Kanekiyo, M., Reyderman, L., Irizarry, M., ... & Sabbagh, M. (2023). ARIA in patients treated with lecanemab (BAN2401) in a phase 2 study in early Alzheimer's disease. *Alzheimer's & Dementia: Translational Research & Clinical Interventions*, 9(1), e12377.

Treatment response and monitoring

(A) Overall Population

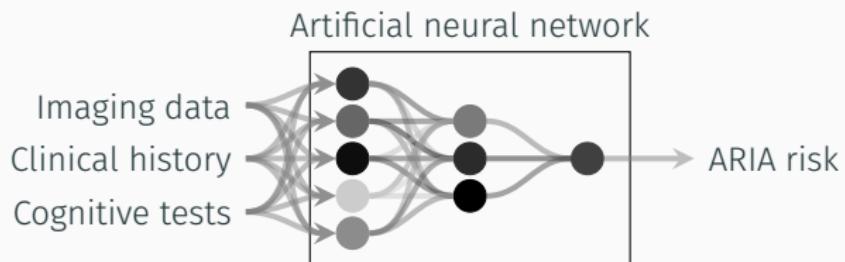


Honig, L. S., Barakos, J., Dhadda, S., Kanekiyo, M., Reyderman, L., Irizarry, M., ... & Sabbagh, M. (2023). ARIA in patients treated with lecanemab (BAN2401) in a phase 2 study in early Alzheimer's disease. *Alzheimer's & Dementia: Translational Research & Clinical Interventions*, 9(1), e12377.

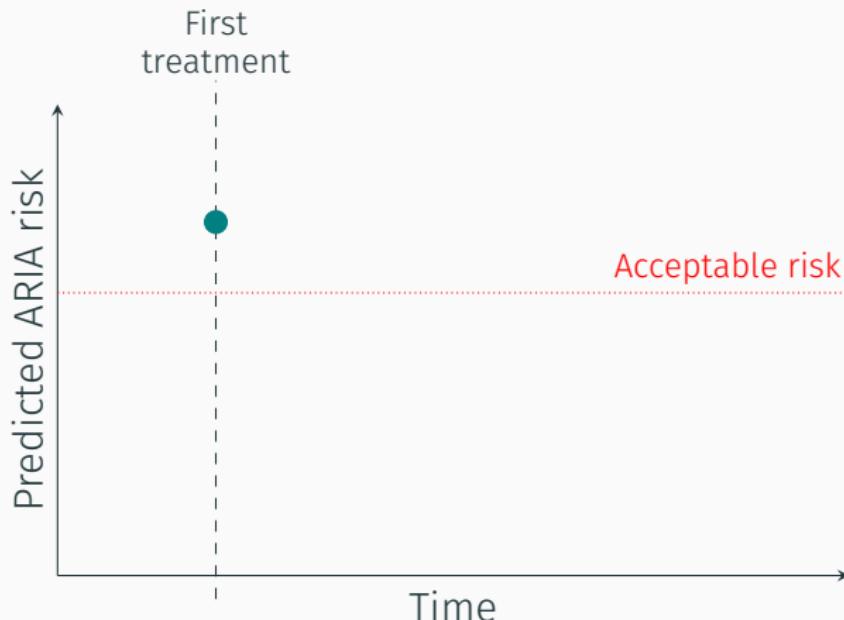
Treatment response and monitoring

"MRI-based exclusion criteria of the lecanemab phase 3 (CLARITY AD) study included a history of any CNS macrohemorrhage >10 mm in diameter, more than 4 microhemorrhages (<10 mm in diameter), evidence of superficial siderosis, evidence of brain vasogenic edema, significant white matter hyperintensities, multiple lacunar strokes, or any cerebral strokes involving a major vascular territory. Evidence of cerebral contusion, encephalomalacia, brain aneurysms or other vascular malformations, central nervous system (CNS) infection, and brain tumors other than meningioma or arachnoid cysts excluded patients from phase 3 trial participation. **These same restrictions should apply when considering patients for treatment with lecanemab.** MRI evidence of underlying CAA-ri/ABRA or other conditions placing patients at risk for ARIA as well as more serious forms of ARIA should exclude patients as treatment candidates."

Treatment response and monitoring



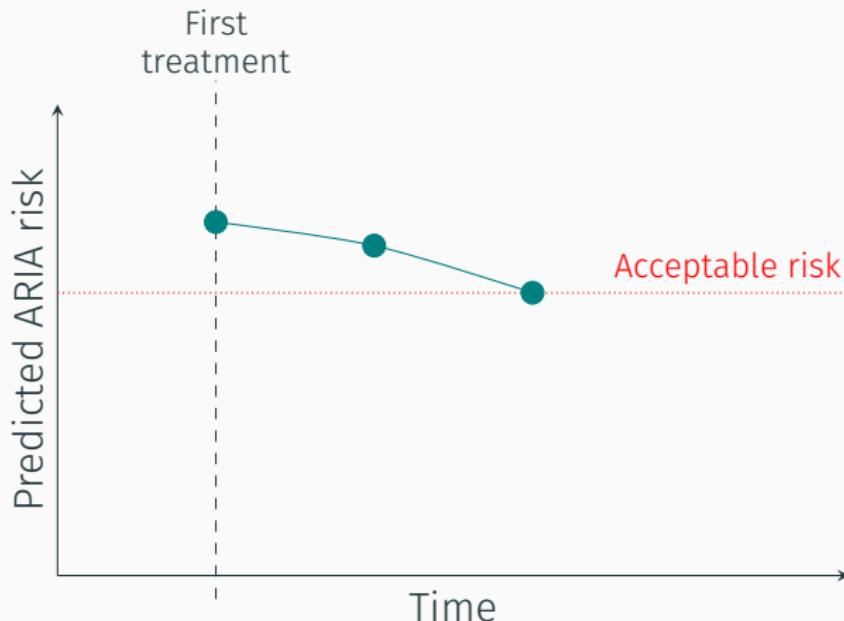
Treatment response and monitoring



Treatment response and monitoring

"We recommend obtaining MRIs after the **5th, 7th, and 14th infusions** as outlined in the PI. We recommend an additional week 52 (i.e., before the 26th infusion) MRI scan, especially for APOE4 carriers and those with evidence of ARIA on earlier MRIs."

Treatment response and monitoring



Treatment response and monitoring

SAMPLE
ARIA-H Report

icobrain aria
by comatrix

NAME: icobrain aria DATE OF BIRTH: 1952-01-01 STUDY DATES: 2018-02-06 - 2018-11-21 ID: IOC ID:

STATUS: Intermediate REMARKS: Not for clinical use.

2018-02-06 2018-11-21 2018-11-21

Microhemorrhages

| NEW COUNT | EVALUATED SEVERITY |
|-----------|--------------------|
| 6 | Moderate |

| | Left (count) | Right (count) |
|----------------|--------------|---------------|
| Frontal Lobe | 0 | 0 |
| Parietal Lobe | 0 | 0 |
| Occipital Lobe | 0 | 0 |
| Temporal Lobe | 0 + 6 | 0 |
| Total (count) | 0 | 0 |
| Cerebellum | 0 | 0 |
| Other | 0 | 0 |
| Whole Brain | 0 + 6 | 0 |

Superficial Siderosis

| NEW COUNT | EVALUATED SEVERITY |
|-----------|--------------------|
| 0 | None |

| | Left (count) | Right (count) |
|----------------|--------------|---------------|
| Frontal Lobe | 0 | 0 |
| Parietal Lobe | 0 | 0 |
| Occipital Lobe | 0 | 0 |
| Temporal Lobe | 0 | 0 |
| Total (count) | 0 | 0 |
| Cerebellum | 0 | 0 |
| Other | 0 | 0 |
| Whole Brain | 0 | 0 |

Note: In benchmark mode, automated measurements for patients with estimated MILD or SEVERE Microhemorrhages. Severity test, an average, the following severity levels are used: 0 = no microhemorrhages, and 1 = 1 or more positive new microhemorrhages.

Severity

- No new incidents
- Less than 5 new incidents
- 5 to 9 new incidents
- 10 or more new incidents
- New incidents

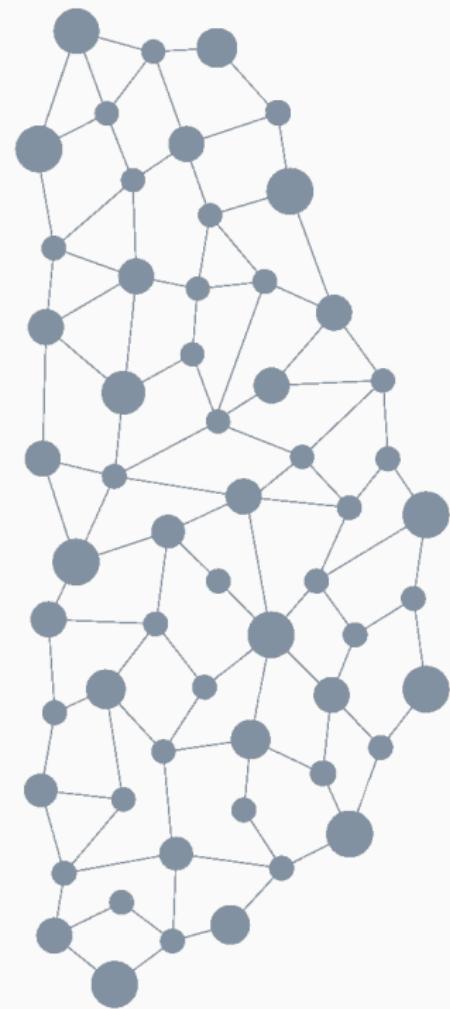
Note: In benchmark mode, automated measurements for patients with estimated ICONE Superficial Siderosis. Severity test, an average, the following severity levels are used: 0 = no positive new superficial siderosis sites, 1 = 1 or more positive new superficial siderosis sites.

Severity

- No new areas
- 1 new area
- 2 new areas
- More than 2 new areas
- New areas

To be used only with a radiological report. Please consult the HCP manual for additional guidance.
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Thank you for your attention!
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