

## Accuracy of machine learning for the automated detection of brain imaging abnormalities in dementia, stroke and pathological ageing: a systematic review

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### Review question

What machine learning approaches have been applied in studies investigating structural brain imaging in stroke, dementia, and pathological ageing populations?

What is the level of accuracy (sensitivity / specificity) that can currently be achieved by machine learning techniques in the automatic diagnosis of dementia?

What level of accuracy can be achieved in the automatic detection / segmentation of brain lesions associated with stroke, dementia and pathological ageing?

What types of features have been studied the most? Which features seem the most promising?

Have these techniques been tested in a clinical environment? Can they be generalized in the case of sets of images that were acquired with different scanners (different resolution/ scan parameters/ sequences, etc)?

### Searches

Databases:

PubMed/MEDLINE

Scopus

IEEE Xplore Digital Library

Science Direct

ACM Digital Library

Web of Science

Restrictions:

Year of publication  $\geq$  2006.

### Types of study to be included

There are no restrictions on the types of study design eligible for inclusion as far as the criteria on dataset size and quality are met.

### Condition or domain being studied

The diseases being studied are dementia (Alzheimer's, vascular, frontotemporal, Lewy bodies, etc.), stroke and brain lesions associated with pathological ageing (white matter lesions, cerebral microbleeds, enlarged perivascular spaces, etc.).

### Participants/population

Inclusion: adults with dementia, stroke, or brain lesions associated with pathological ageing (as diagnosed using any recognised diagnostic criteria). Structural MRI or CT scans have to be available for each participant.

### Intervention(s), exposure(s)

Not applicable.

## PROSPERO

### International prospective register of systematic reviews

#### Comparator(s)/control

Not applicable.

#### Context

#### Primary outcome(s)

Accuracy (sensitivity / specificity) of machine learning techniques for automated disease diagnosis, lesion detection or segmentation.

#### Secondary outcome(s)

Additional metrics on technique accuracy and / or correlation with clinical outcome, if available.

#### Data extraction (selection and coding)

#### Risk of bias (quality) assessment

Included studies will be graded by researchers according to the QUADAS-2 checklist (<http://www.bristol.ac.uk/media-library/sites/quadas/migrated/documents/quadas2.pdf>). The results will be reported in the review and in the discussion on the data synthesis.

#### Strategy for data synthesis

We will provide a narrative synthesis of the findings and the applicability of the included studies. Additionally, the studies will be divided in subgroups according to their main target (e.g., automatic diagnosis of dementia, automatic segmentation of stroke lesions, etc.). A quantitative meta-analysis (including forest plots) for summary estimates of sensitivity and specificity with 95% CIs of the different subgroups is planned to be carried out.

#### Analysis of subgroups or subsets

Included studies will be analysed separately according to their main target. Specifically, the subgroups are envisioned to be:

1. Studies on automatic classification of dementia vs healthy control. Additional subgroups, might involve classification of mild cognitive impairment progression and multi-class classification.
2. Studies on automatic detection and/or segmentation of stroke and related lesions.
3. Studies on detection and/or segmentation of brain lesions associated with pathological ageing.

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**Conflicts of interest**

None known

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English

**Country**

Scotland

**Stage of review**

Review\_Ongoing

**Subject index terms status**

Subject indexing assigned by CRD

**Subject index terms**

Aging; Dementia; Humans; Machine Learning; Neuroimaging; Stroke

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**Revision note for this version**

The QUADAS-2 checklist was chosen instead of the STARD one after further discussion among the research team as deemed more relevant.

**Details of any existing review of the same topic by the same authors**

**Stage of review at time of this submission**

<b>Stage</b>	<b>Started</b>	<b>Completed</b>
Preliminary searches	No	Yes
Piloting of the study selection process	No	No
Formal screening of search results against eligibility criteria	No	No
Data extraction	No	No
Risk of bias (quality) assessment	No	No
Data analysis	No	No

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## Versions

16 May 2016

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