A CLINICAL EVALUATION OF A DECISION SUPPORT TOOL FOR DEMENTIA DIAGNOSIS USING HMPAO SPECT IMAGING
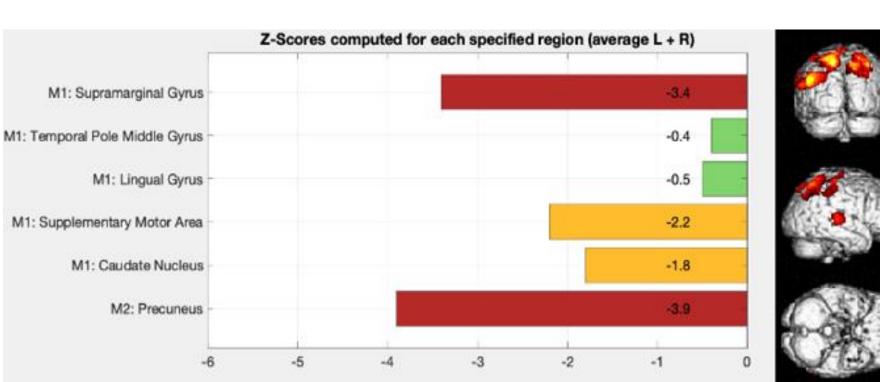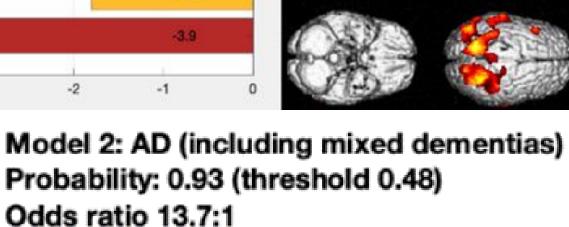
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PROJECT

Over 950,000 people currently live with dementia in the UK, rising to 1.4 million in 2040[1]. Early, accurate diagnosis remains a critical challenge. This project evaluates a novel, NIHR-funded, in-house machine learning tool developed to support the interpretation of brain HMPAO SPECT scans for dementia diagnosis. The tool comprises two logistic regression-based models: Model 1 classifies scans as normal versus abnormal, while Model 2 assesses the likelihood of Alzheimer's Disease (AD)/ Lewy Body Dementia (LBD). Both models generate a probability score and odds ratio to assist clinical decision-making.
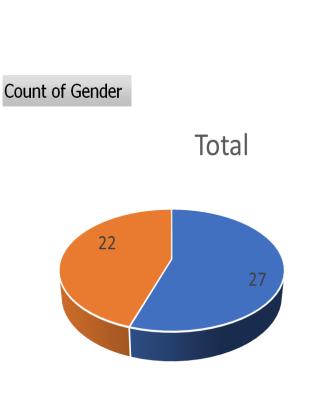

Z-Scores computed for each specified region (average L + R)

Region	Z-Score
M1: Supramarginal Gyrus	-3.4
M1: Temporal Pole Middle Gyrus	-0.4
M1: Lingual Gyrus	-0.5
M1: Supplementary Motor Area	-2.2
M1: Caudate Nucleus	-1.8
M2: Precuneus	-3.9

Model 1: Abnormal Scan
Probability: 0.99 (threshold 0.85)
Odds ratio 107.0:1

Model 2: AD (including mixed dementias)
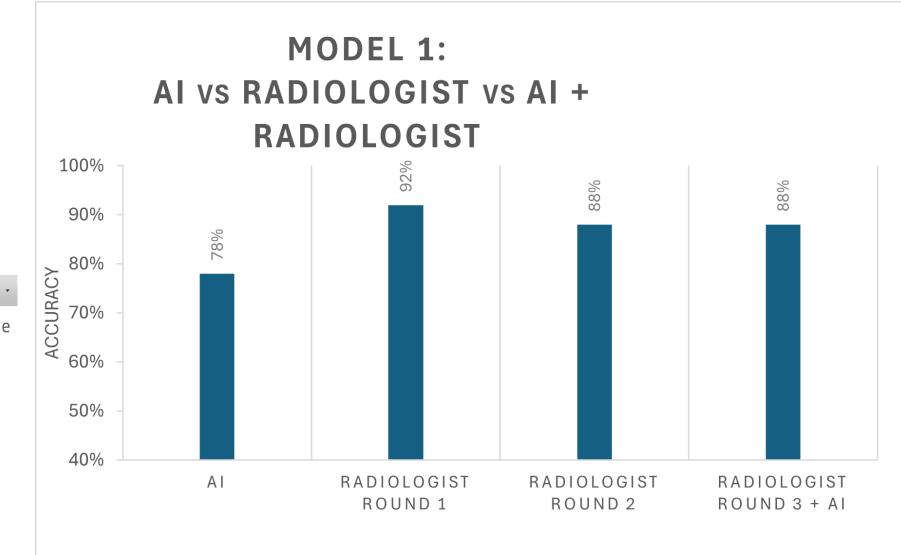Probability: 0.93 (threshold 0.48)
Odds ratio 13.7:1

METHODS

The evaluation was conducted by a Clinical AI Fellow, also a radiology trainee, who received structured training in HMPAO scan interpretation under the guidance of a Professor of Neurology. The AI outputs were embedded on the perfusion to diagnosis reports, providing a holistic view of the scan. The Radiologist independently assessed 49 patient scans acquired in September 2024, across three phases: an initial review (Round 1), a reassessment following further training (Round 2), and a final assessment incorporating the AI model's output (Round 3). Each scan was rated on two dimensions—normal vs abnormal and AD/LBD present vs absent—alongside a five-point diagnostic confidence score (ranging from very low [Level 1] to very high [Level 5])
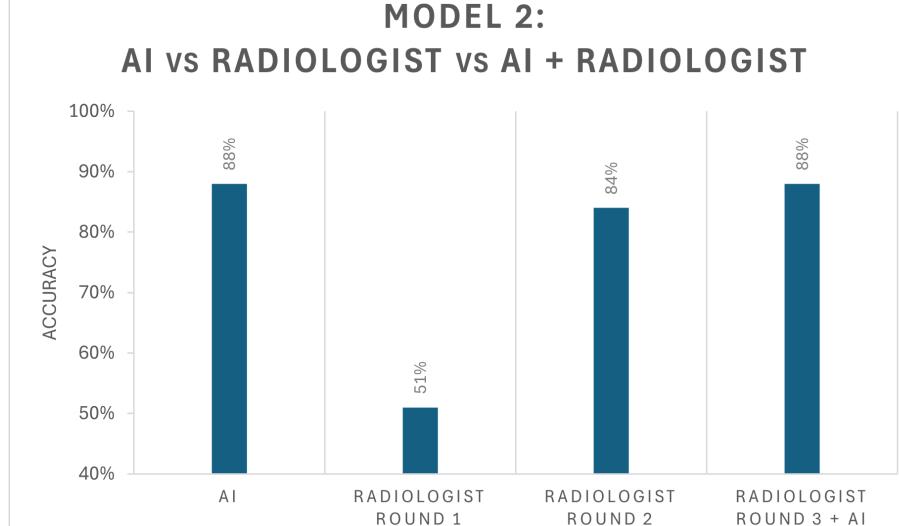

Count of Gender — Total — Female 27, Male 22

MODEL 1: AI vs RADIOLOGIST vs AI + RADIOLOGIST

	Accuracy
AI	78%
RADIOLOGIST ROUND 1	92%
RADIOLOGIST ROUND 2	88%
RADIOLOGIST ROUND 3 + AI	88%

MODEL 2: AI vs RADIOLOGIST vs AI + RADIOLOGIST

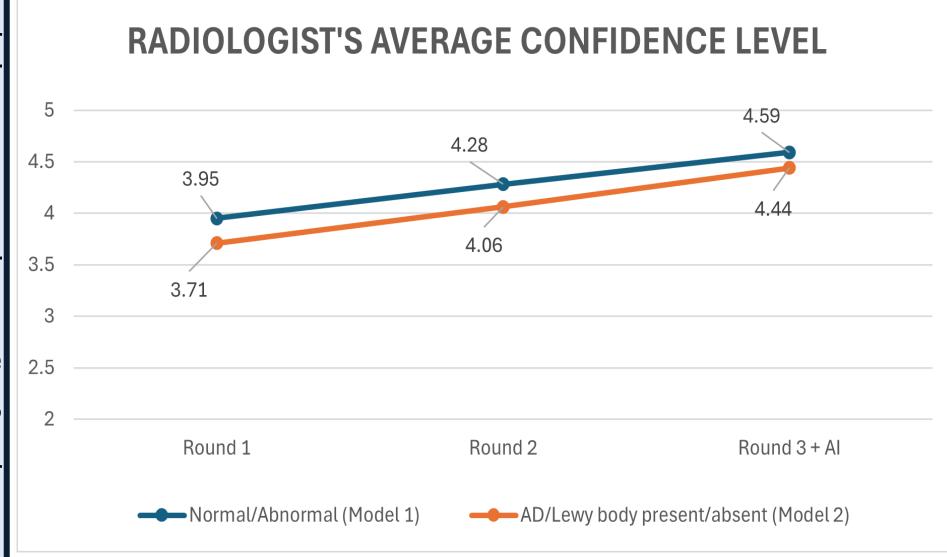|	Accuracy
AI	88%
RADIOLOGIST ROUND 1	51%
RADIOLOGIST ROUND 2	84%
RADIOLOGIST ROUND 3 + AI	88%

RESULTS

Model 1 demonstrated 78% concordance with expert opinion, while Model 2 achieved 88%. The Fellow's accuracy in classifying scans as normal or abnormal was 92% in Round 1, decreasing slightly to 88% in Rounds 2 and 3. In contrast, accuracy in detecting AD/LBD improved markedly—from 51% in Round 1 to 84% in Round 2, rising to 88% in Round 3 with AI support. Diagnostic confidence also increased over time: for normal/abnormal classification, it rose from 3.95 to 4.28 in Round 2, and further to 4.59 in Round 3 with AI support; for AD/LBD assessment, the scores rose from 3.71 to 4.06 in Round 2 and reaching 4.44 in Round 3 with AI support. Importantly, analysis of eight "borderline" cases in Model 1, which showed a mean probability score of 0.73 and odds ratio >1, suggests that lowering the probability threshold from 0.85 to 0.73 in Model 1 could improve model sensitivity.

RADIOLOGIST'S AVERAGE CONFIDENCE LEVEL

	Round 1	Round 2	Round 3 + AI
Normal/Abnormal (Model 1)	3.95	4.28	4.59
AD/Lewy body present/absent (Model 2)	3.71	4.06	4.44

CONCLUSION

This evaluation study demonstrates that incorporating AI model output significantly improved a trainee's performance in diagnosing AD/LBD and enhanced diagnostic confidence. These findings highlight the potential of AI tools to support more accurate dementia diagnosis and to facilitate learning and confidence-building among junior clinicians.

NEXT STEPS

- *Fine tuning the Model 1 output performance by reducing the Threshold for improving diagnostic sensitivity.*
- *Model 1 retraining and further evaluation of the re-trained model.*
- *Further evaluation of both Model 1 and 2 with multiple readers.*
- *Regulatory approval.*
- *Deployment and Monitoring.*

REFERENCES

The Economic Impact of Dementia (https://www.alzheimers.org.uk/sites/default/files/2024-05/the-annual-costs-of-dementia.pdf)