

AI in Lung Nodule Diagnosis: A Simulation-Based Clinical Pathway Analysis



England



Fellowship in Clinical AI

NHS Digital Academy Programme

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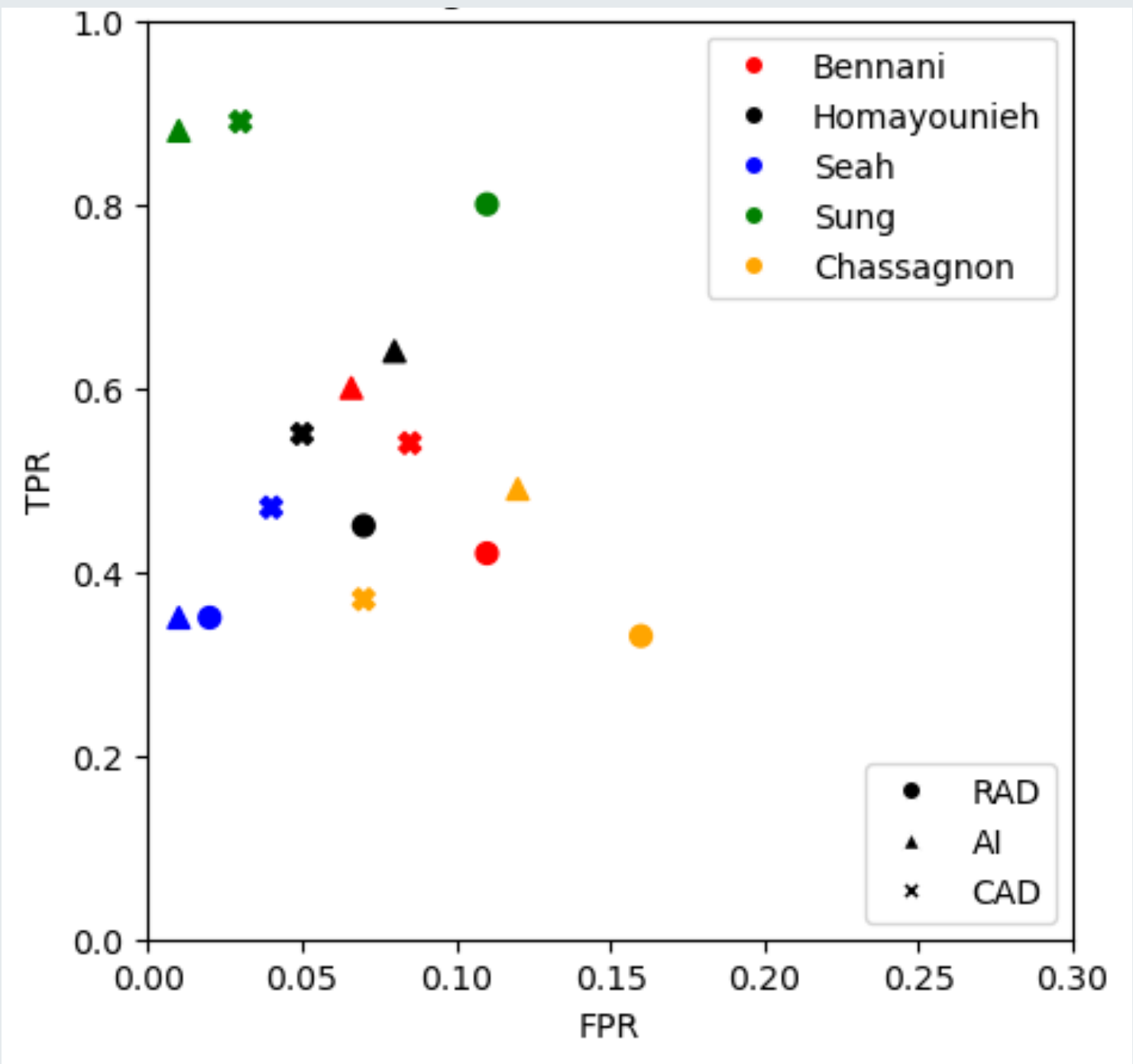
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Aim: to simulate the effect of chest X-ray AI systems on the lung nodule diagnostic pathway

For each technology, we simulated the the total clinical value, final diagnostic performance, CT scan utilisation, and the number of missed nodule cases.

Five multi-reader clinical studies were included

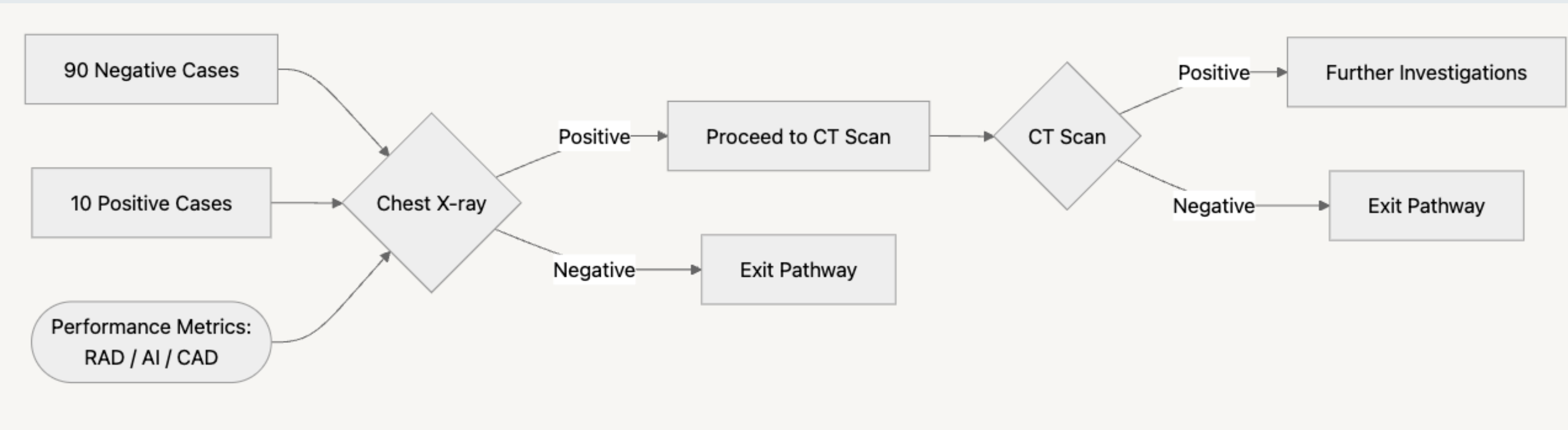
First Author	Year	Technology	Study Design	Readers (n)	Dataset (n)
Bennani	2023	ChestView	Multi Reader	12	500
Chassagnon	2023	ChestView	Multi Reader	8	500
Homayounieh	2021	AI Rad Companion	Multi Reader	9	100
Seah	2021	Annalise.ai	Multi Reader	20	2568
Sung	2021	VUNO Med-Chest	Multi Reader	20	228



Diagnostic performance metrics

Five clinical investigations were included. Diagnostic performance metrics were extracted. “RAD”: radiologist alone, “AI”: AI alone, “CAD”: computer-aided diagnosis (radiologist assisted by AI).

The lung nodule diagnostic pathway was simulated



Clinical Pathway Outcome	Value
False Negative CXR	-100
True Negative CXR	5
True Positive CXR & CT	50
False Positive CXR & CT	-10
True Positive CXR & False Negative CT	-100
False Positive CXR & True Negative CT	-5

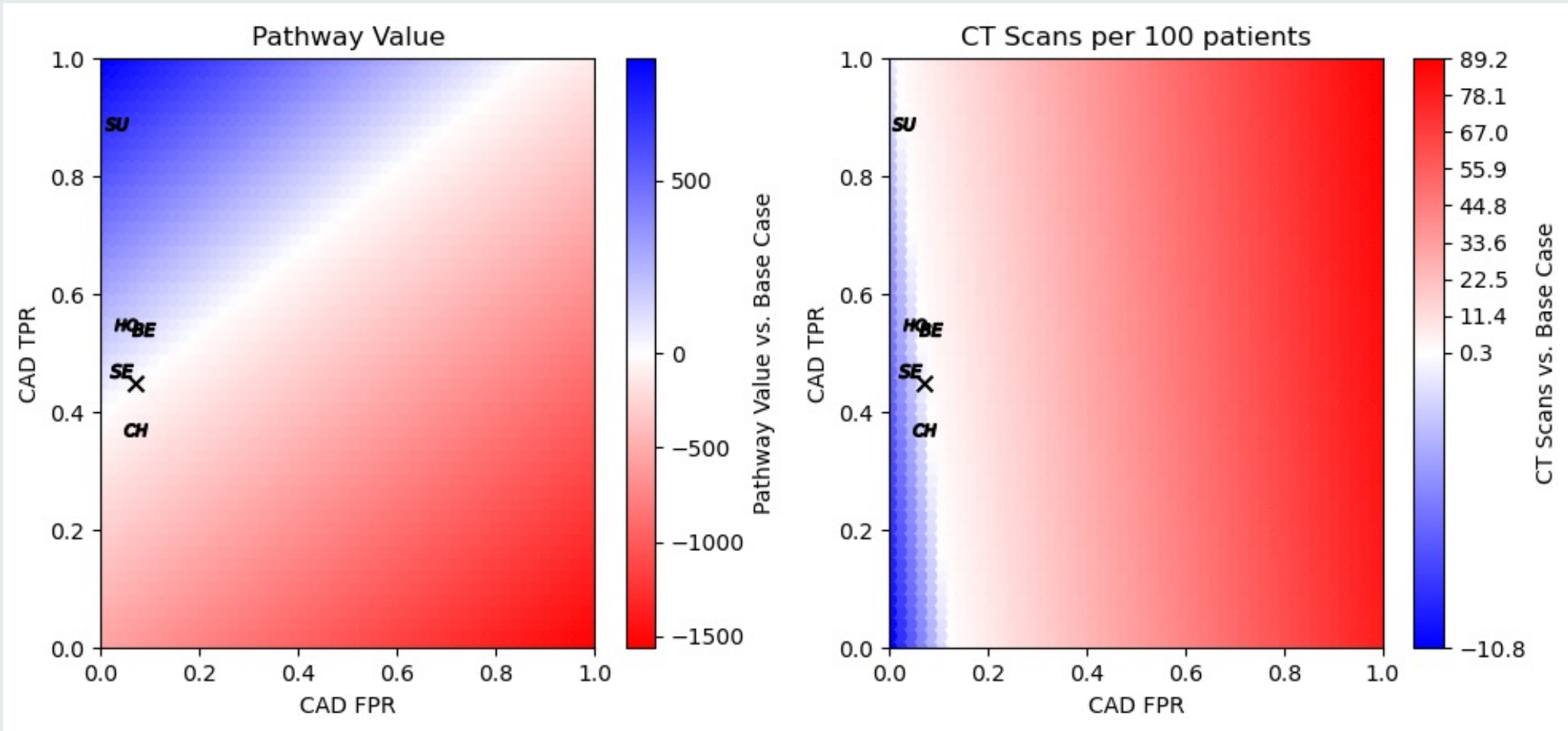
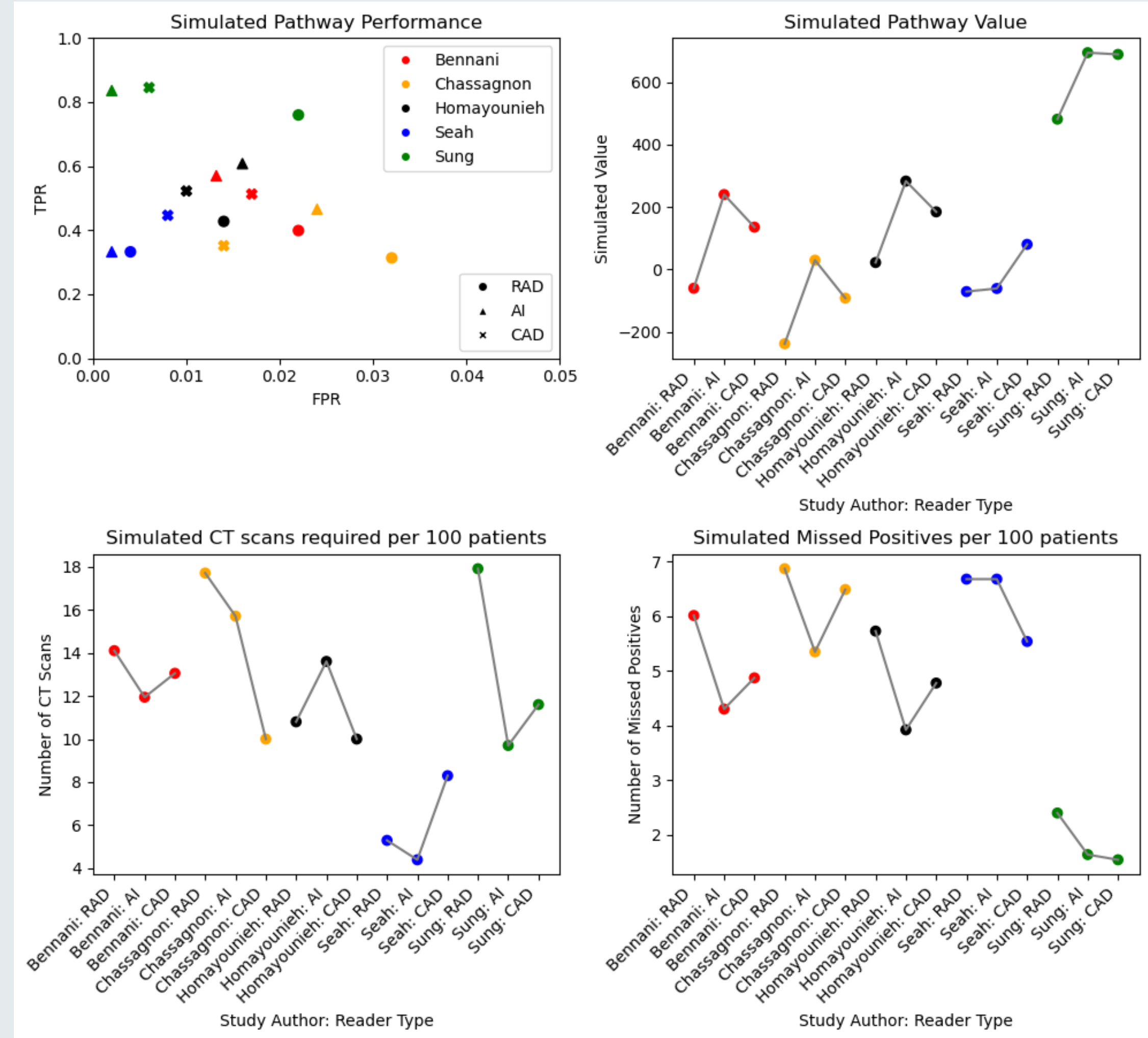
Relative clinical values were assigned to possible pathway outcomes

Clinical pathway simulation

In simulation, VUNO Med-Chest (Sung et al.) demonstrated the highest value and lowest missed positives. Annalise.ai (Seah et al.) showed the lowest CT scan utilisation and was the only system where “Computer aided diagnosis” performed better than “AI” alone.

Clinical pathway value & CT scan utilisation vs. base case

There was a narrow diagnostic performance window which yields higher clinical value without higher CT scan utilisation vs. base case (Homayounieh et al. unassisted radiologist)



BE: Bennani, CH: Chassagnon, HO: Homayounieh, SE: Seah, SU: Sung

- Chest X-ray AI clinical investigations report performance metrics but not the effects on the clinical pathway.
- Clinical pathway simulation can be used to estimate value, missed positive cases, and CT scan utilisation.
- Most AI systems performed best “AI-alone”.
- One system performed best as “Computer Aided Diagnosis”, trading off lower FPR (specificity) for higher TPR (sensitivity).