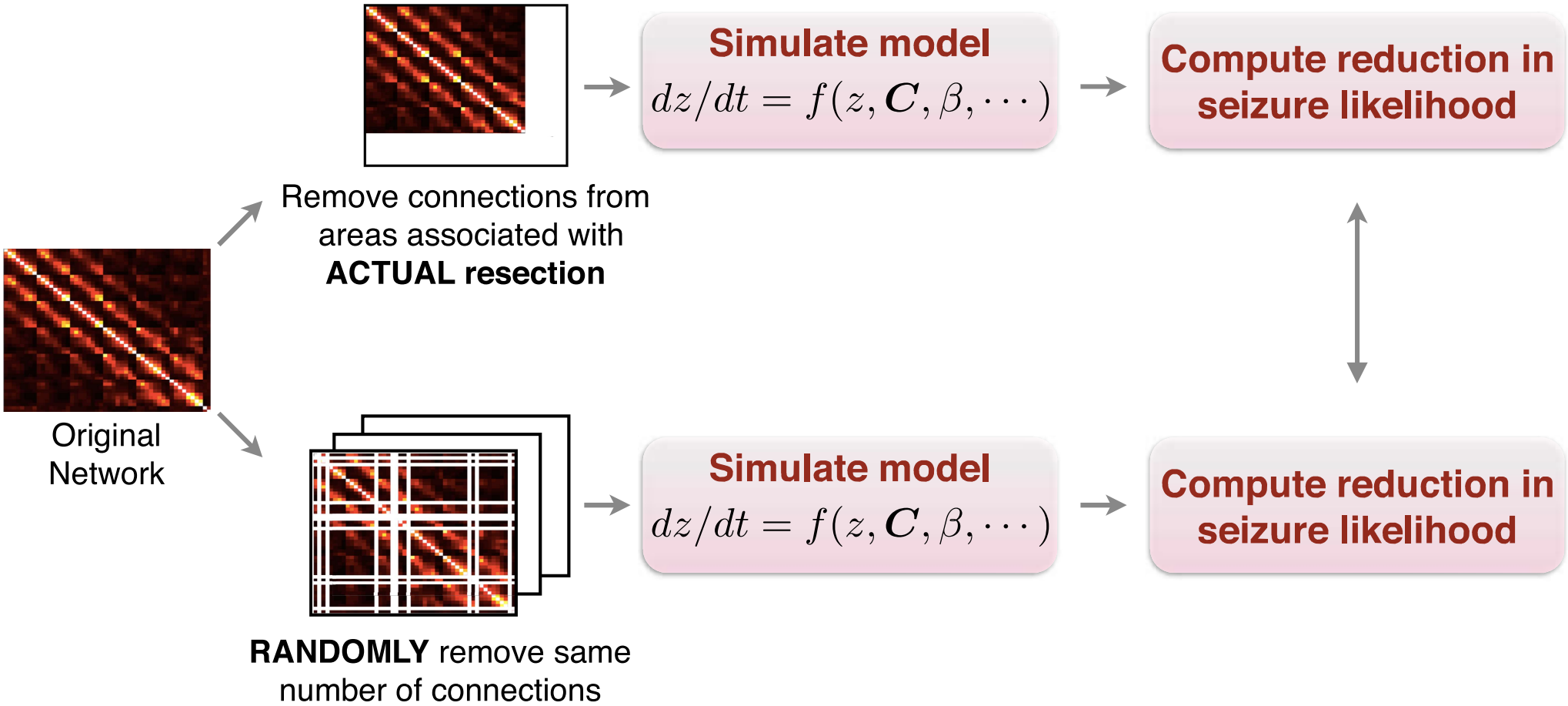
Method

Simulating surgical resection

- Compute if the seizure likelihood was substantially reduced in actual clinical resection.
- Baseline: Random resection of same number of connections in the network.
- Good outcome: **Escape time of actual resection > Escape time of random resection**



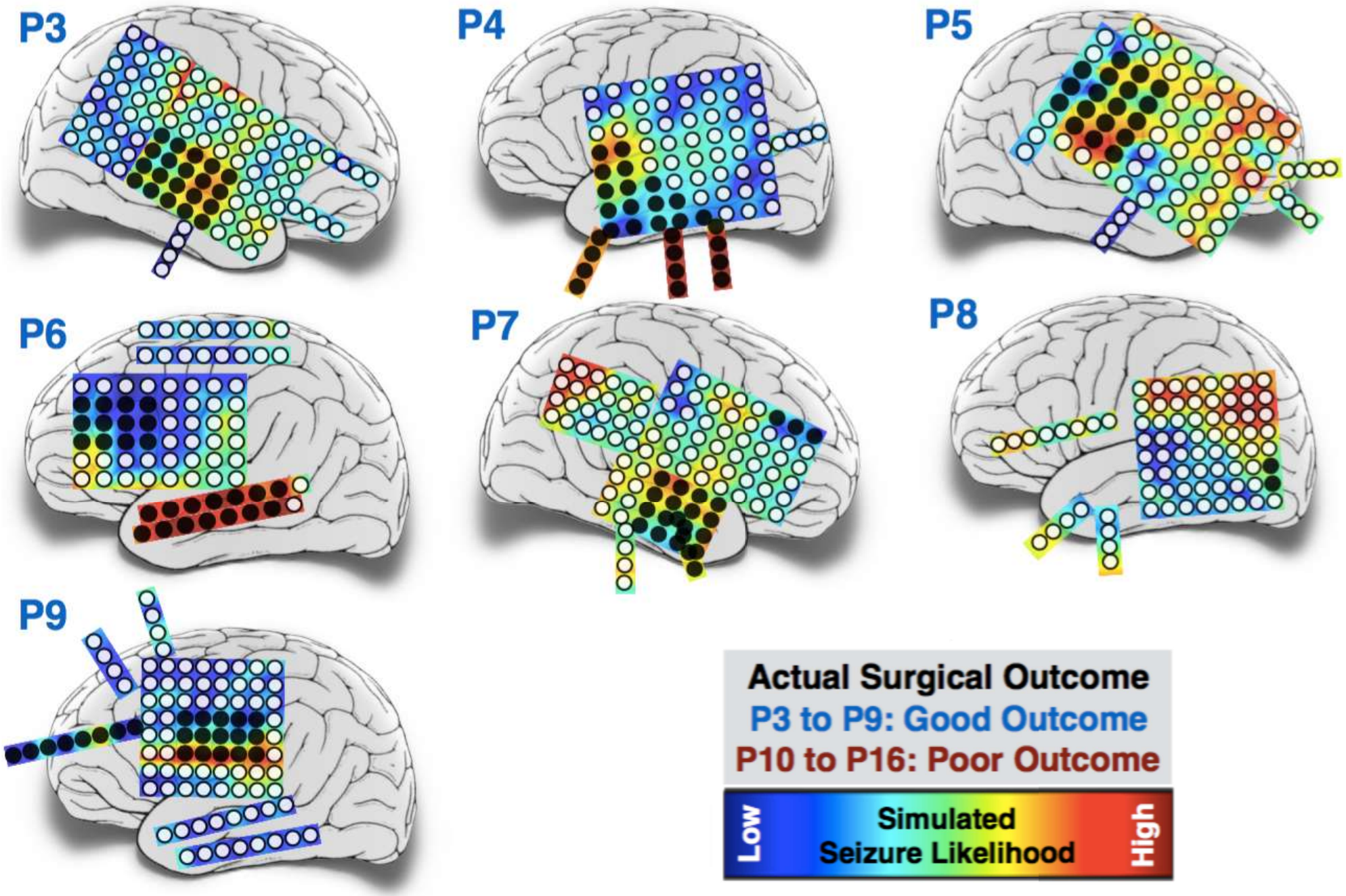
Result: Patient information

Table 1 Patient information, actual surgical outcomes

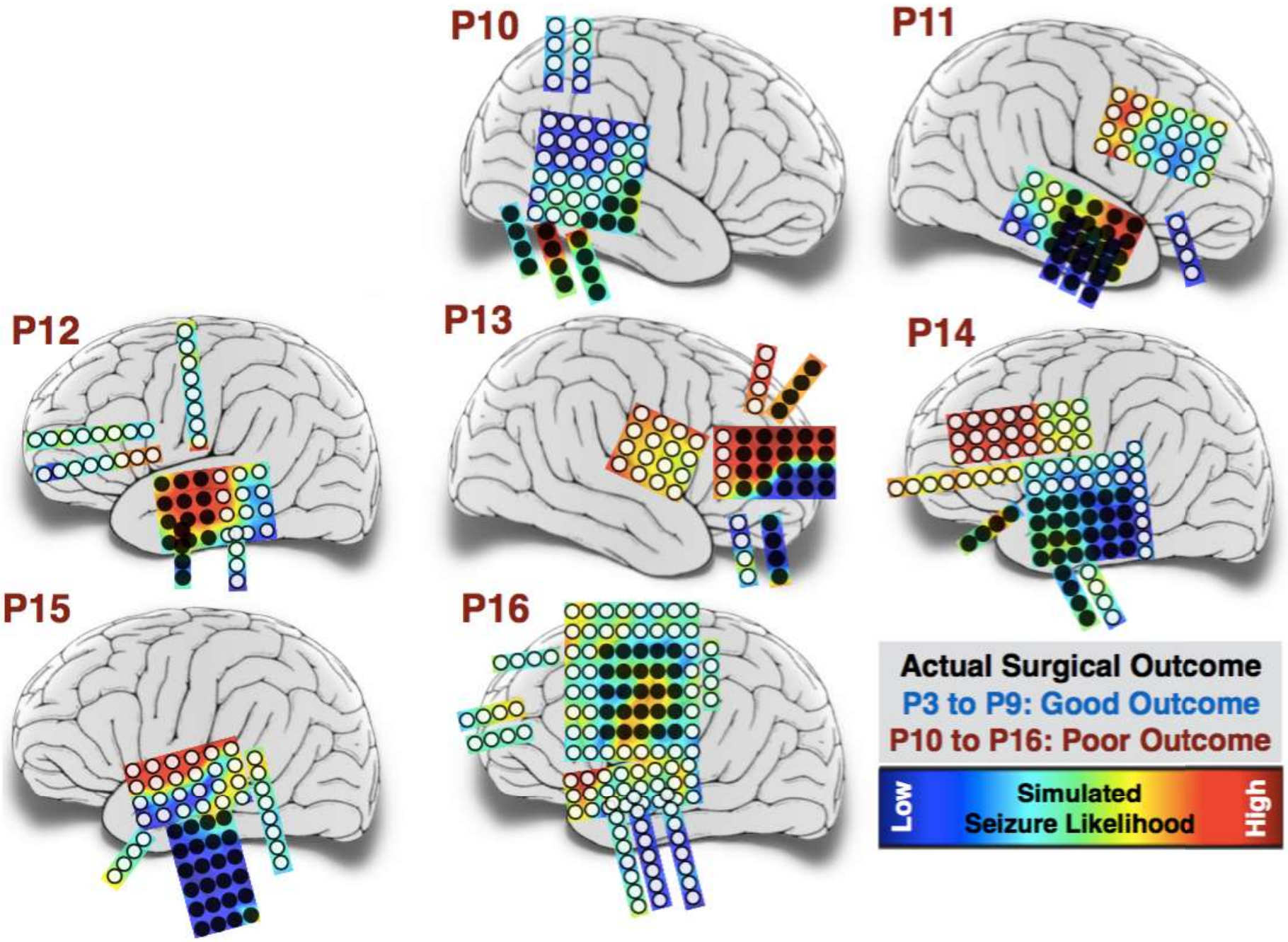
Patient ID	Sex	Age[a] onset	Age[a] at surgery	Location of surgery	Surgical outcome (ILAE Class)
P1	F	11–20	21–30	Temporal lobectomy	Seizure free (II)
P2[b]	M	1–10	1–10	Parietal corticectomy	Not seizure free (IV)
P3	F	11–20	41–50	Posterior temporal lesionectomy	Seizure free (I)
P4	F	1–10	50–60	Temporal lobectomy	Seizure free (I)
P5	M	1–10	11–20	Parietal corticectomy	Seizure free (I)
P6[b]	M	51–60	51–60	Medial frontal lobectomy; amygdalohippocampectomy	Seizure free (I)
P7[b]	M	11–20	11–20	Temporal lobectomy; amygdalohippocampectomy	Seizure free (I)
P8[b]	M	1–10	11–20	Occipital lobectomy	Seizure free (I)
P9[b]	M	1–10	1–10	Frontal corticectomy	Seizure free (I)
P10[b]	F	11–20	21–30	Temporo-occipital lobectomy	Not seizure Free (IV)
P11[b]	F	1–10	31–40	Temporal lobectomy	Not seizure free (IV)
P12[b]	F	11–20	21–30	Temporal lobectomy; amygdalohippocampectomy	Not seizure free (V)
P13[b]	M	1–10	1–10	Frontal lobectomy	Not seizure free (IV)
P14[b]	M	31–40	31–40	Temporal lobectomy	Not seizure free (V)
P15[b]	F	11–20	21–30	Temporal lobectomy	Not seizure free (V)
P16[b]	M	1–10	1–10	Frontal lesionectomy	Not seizure free (V)

[a]Actual age has been changed to age groups to maintain the anonymity of patients.
[b]Diagnosed at Mayo Clinic. More details available in Supplementary Table 7.

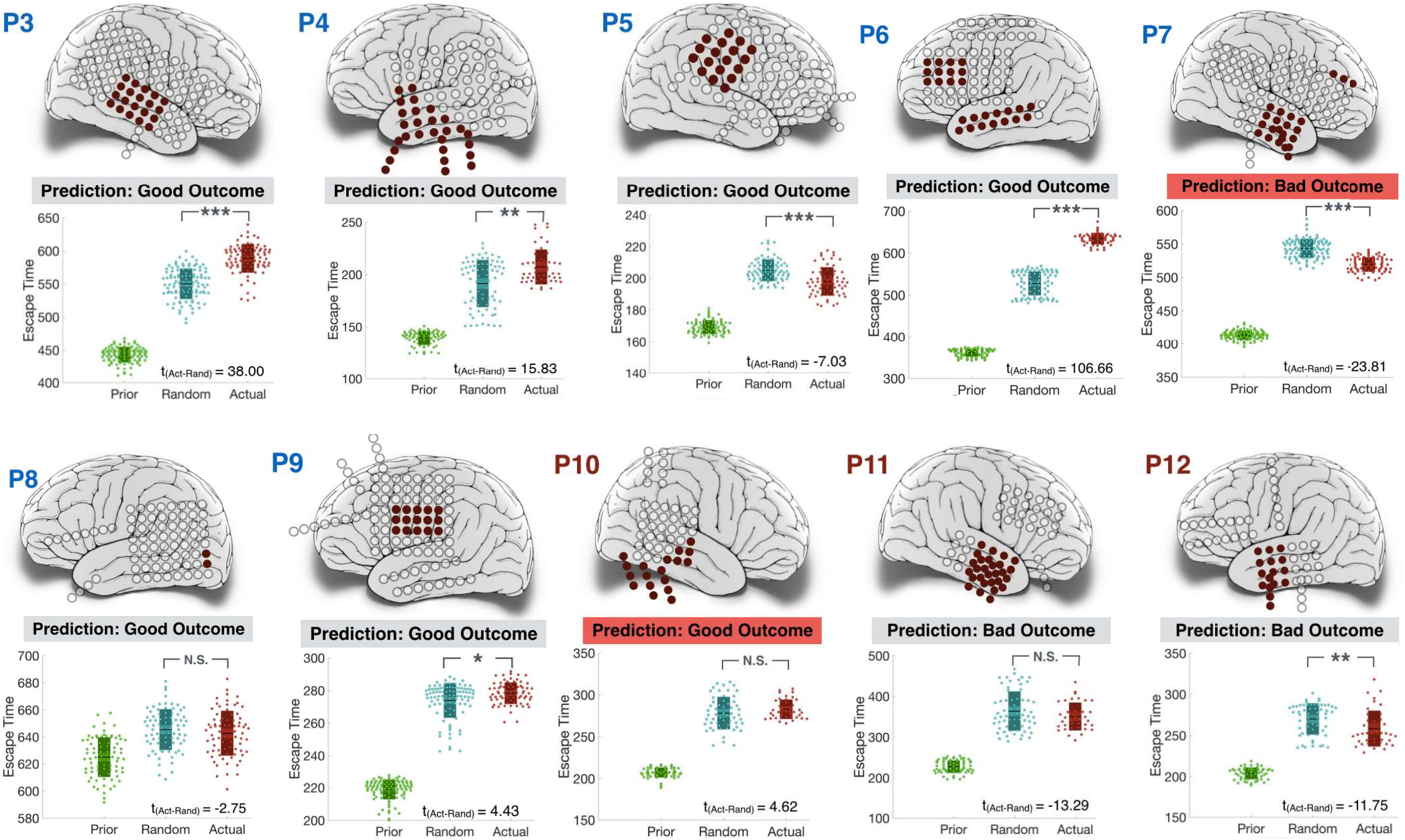
Result: Predicting location of epileptogenic tissues



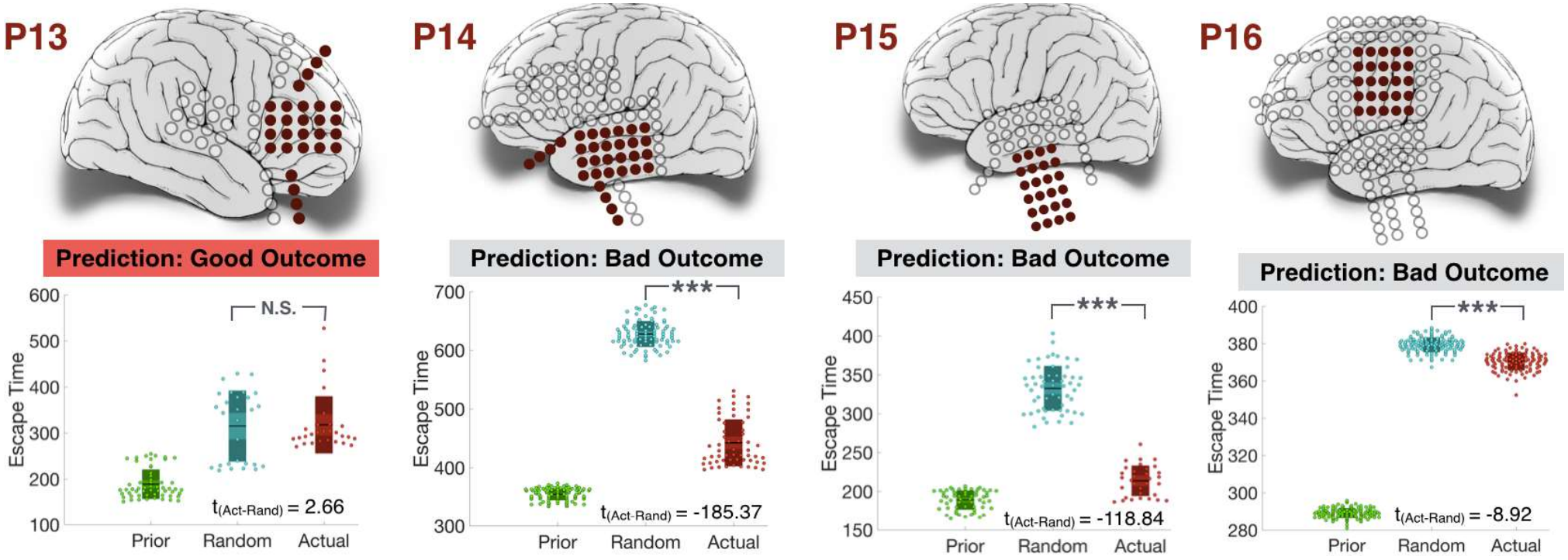
Result: Predicting location of epileptogenic tissues



Result: Predicting surgical outcome



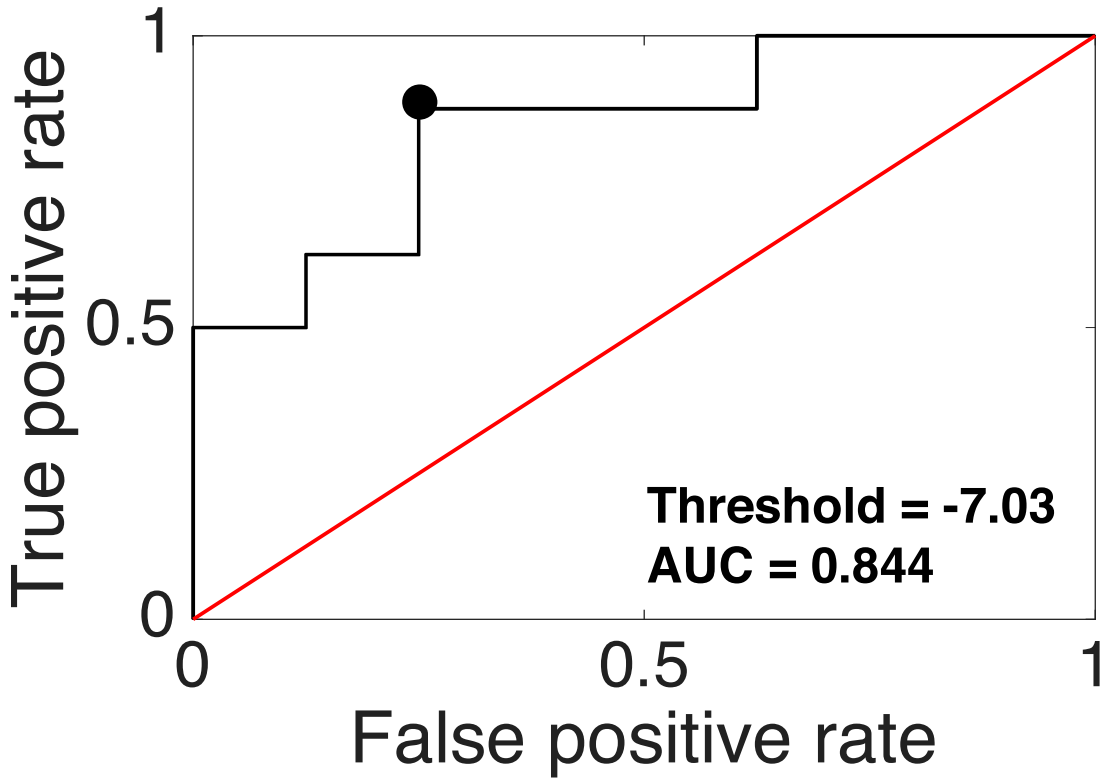
Result: Predicting surgical outcome



Summary of all results

Table 2 Confusion matrix indicating performance of algorithm in predicting surgical outcomes using $t_{actual:rand}$

		Actual surgical outcome	
		Seizure free = 8	**Not seizure free = 8**
Predicted outcome	**Seizure free = 9**	True positive = 7	False positive = 2 (type I error)
	Not seizure free = 7	False negative = 1 (type II error)	True negative = 6
	Accuracy = 0.813	True positive rate, or sensitivity = 0.875	False positive rate, or fall-out = 0.25
		False negative rate, or miss rate = 0.125	True negative rate, or specificity = 0.75



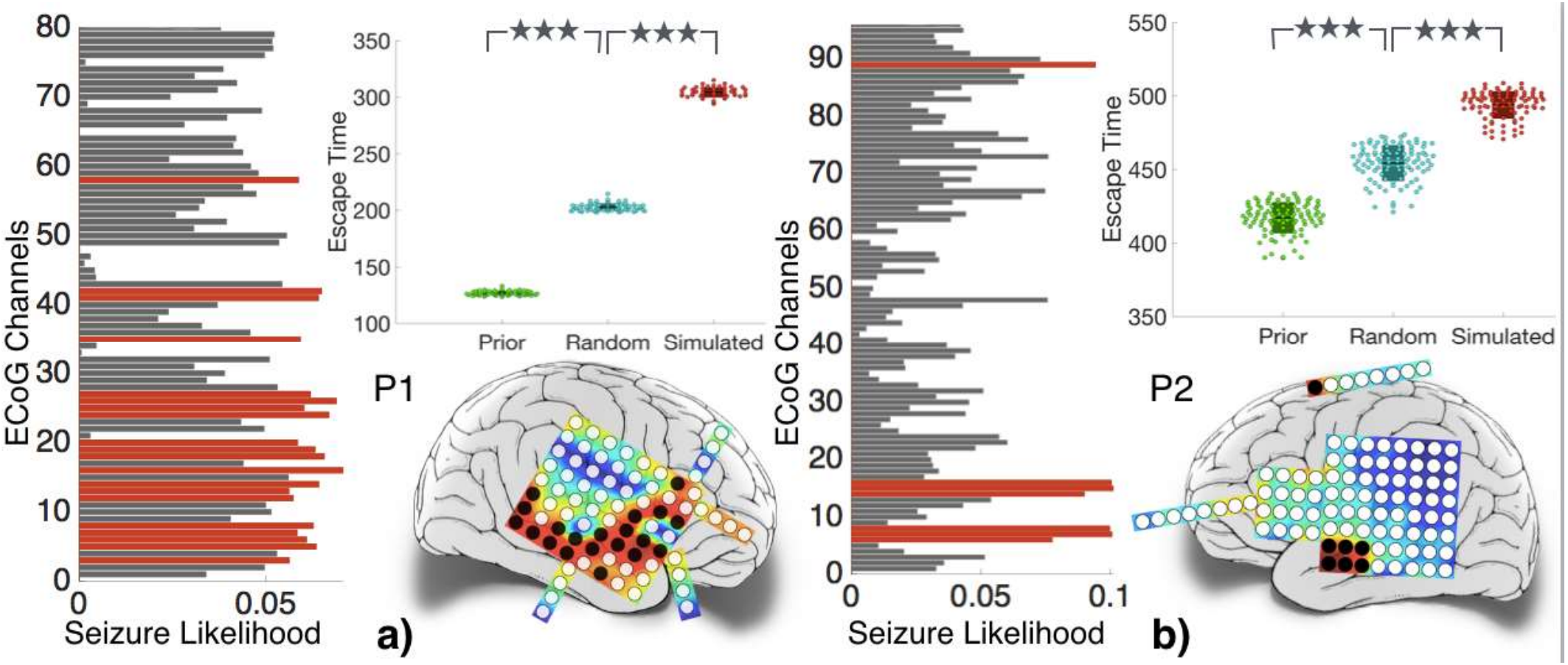
Summary

- Sensitivity = 87.5%
- Specificity = 75%
- Accuracy = 81.3%

Predicted correct outcome for 13 out of 16 patients.

A step further: Prediction of alternative resection strategies

- Key question remains: **Which areas should be removed, if any, to result in a better chance of a positive outcome?**
- Predict cortical areas which may lead to better outcomes.



Conclusion

In this retrospective study we have demonstrated:

- **Computational models** when **combined with physiological data**, can improve the understanding of brain (dys)function, particularly in case of epilepsy.
- Computational modelling can be used to make **patient specific, clinically relevant predictions.**
- Predicting epileptogenic tissues using non-seizure data, surgical outcomes for a planned resection, and alternative resection locations can potentially add **complementary value** during the pre-surgical evaluation in focal epilepsy.

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Predicting neurosurgical outcomes in focal epilepsy patients using computational modelling

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THANK YOU!

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