

## Introduction

A subset of patients presenting with psychosis have an **underlying medical cause** – these have been described as **secondary ('organic') psychoses**<sup>1</sup>. A range of disorders have been implicated, including epilepsy, autoimmune and neurodegenerative conditions.

Early identification of these patients is essential to tailor treatment towards the underlying aetiology. However, on first presentation, **distinguishing between primary and secondary psychoses can be clinically challenging**.

Improved understanding of the **psychopathological features of secondary psychotic disorders** might facilitate better **detection of cases**, and help prioritise patients for confirmatory investigations.

## Aim

Using a **large and representative retrospective dataset** of patients diagnosed with psychosis disorders, we aimed to develop a **classification-based diagnostic prediction model** to identify cases of secondary psychosis using psychopathological features.

## References

1. Keshavan MS, Kaneko Y. Secondary psychoses: an update. *World Psychiatry*. Feb 2013;12(1):4-15
2. Misselbrook T, Patel R, Nicholson T, Cullen A, Pollak T. 15 Organic psychosis: using electronic patient records to investigate demographics, aetiology and outcome. *Journal of Neurology, Neurosurgery & Psychiatry*. 2017;88(8):A8.
3. Blackman G, Dadwal AK, Teixeira-Dias M, Ffytche D. The association between visual hallucinations and secondary psychosis: a systematic review and meta-analysis. *Cogn Neuropsychiatry*. Nov 3 2023:1-15.
4. Al-Diwani A, Handel A, Townsend L, et al. The psychopathology of NMDAR-antibody encephalitis in adults: a systematic review and phenotypic analysis of individual patient data. *The Lancet Psychiatry*. Mar 2019;6(3):235-246.

## Method

Utilising **electronic health records** from the largest mental health provider in the UK (South London and Maudsley NHS Foundation Trust), we identified patients with a **clinical diagnosis of primary 'non-organic' or secondary 'organic' psychosis** between 2007 and 2022.

Validated natural language processing (NLP)-based **feature extraction tools** were used to ascertain the presence or absence of 61 psychopathological symptoms in the 1-month period prior to diagnosis.

A **weighted regularised logistic regression** model was then trained to predict whether a patient ultimately received a diagnosis of a primary 'non-organic' or secondary 'organic' psychotic disorder and evaluated using 10-fold cross-validation.

Classifier performance was based on balanced accuracy and area under the ROC curve. The importance of individual features in the classification model was also explored.

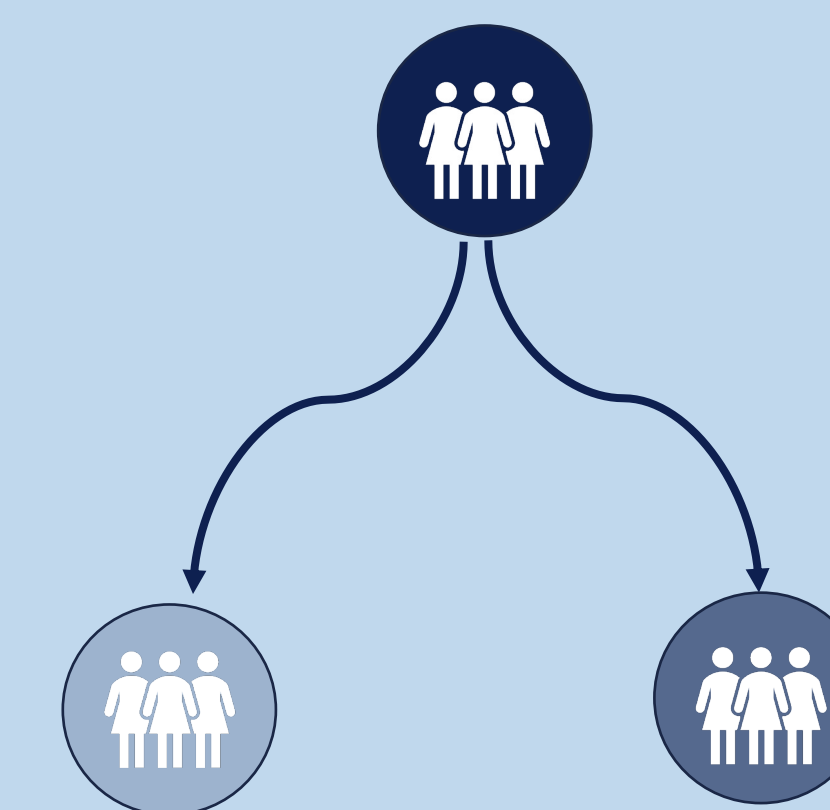
## Results

We identified 27,252 patients diagnosed with psychotic disorders of whom 4% (n=1,050) were assigned a diagnosis of a secondary 'organic' psychosis. Demographic characteristics of the groups are reported in Figure 1.

Overall, the most common symptoms were drowsiness, paranoia, hallucination, delusion and disturbed sleep (see figure 2).

A weighted regularised logistic regression classifier achieved a **balanced accuracy of 69% and an area under the ROC curve of 0.79** (see figure 2).

Based on the machine learning classifier, the most important features associated with secondary 'organic' psychosis were **waxy flexibility, visual hallucinations and concrete thinking**. In contrast, the most important variables associated with primary 'non-organic' psychosis were **negative symptoms, paranoia, social withdrawal, and formal thought disorder**.



	"Organic" Psychosis (n=1,050)	Non "organic" psychosis (n= 26,202)
<b>Diagnoses</b>	<ul style="list-style-type: none"> <li>F06.0 mental disorders due to physiological condition</li> </ul>	<ul style="list-style-type: none"> <li>F2x Schizophrenia</li> <li>F31.5 BPAD</li> <li>F32.3/F33.3 Depression with psychosis</li> </ul>
<b>Mean age (SD)</b>	59 (22) years	44 (18) years
<b>Sex (% female)</b>	517 (48%)	11,123 (42%)
<b>Ethnicity (%)</b>		
White	552 (52%)	10,667 (40%)
Black	258 (35%)	9,308 (24%)
Other	255 (24%)	6,425 (24%)

Figure 1 Sample demographics

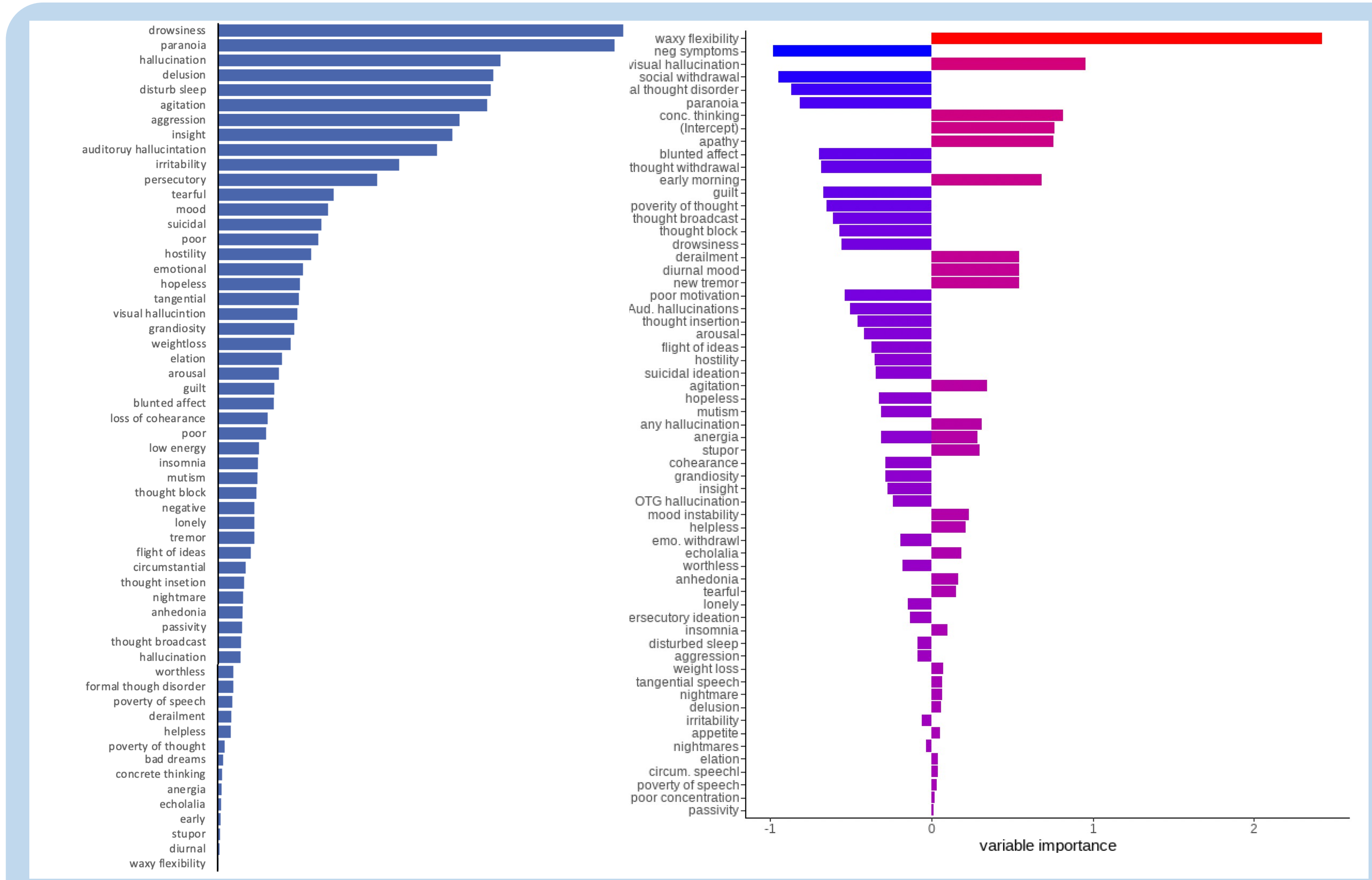


Figure 2 Proportion of sample exhibiting psychiatric symptoms during 1 month period prior to index diagnosis.

Figure 3 Ranked feature importance in distinguishing 'organic' and 'non-organic' psychosis status. Positive values indicate association with 'organic' status and negative values indicate association with 'non-organic' status.

## Conclusions

Preliminary findings from a large and a representative sample of patients presenting with psychosis, suggest that there may be psychopathological features that can distinguish cases of secondary 'organic' from primary 'non-organic' psychoses.

Machine learning may be informative in deriving individualised prediction estimates that could be used to identify patients at high risk of having a secondary 'organic' psychosis and who should be prioritised for further investigation.

Future steps include expansion of features to enhance predictive accuracy and external validation in separate populations to determine generalisability.

## Acknowledgements

With thanks to Prof Rob Stewart and Jyoti Sanyal. This work has been supported by the NIHR Oxford Health Biomedical Research Centre and the NIHR Maudsley Biomedical Research Centre.