

Transdiagnostic analysis of mental disorder symptoms associated with increased frequency of psychiatric hospitalization

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BACKGROUND

- Frequent utilisation of inpatient services is common among patients with psychiatric disorders¹, which contributes to high treatment costs and high economic burden².
- Psychotic illness has consistently been identified as a risk factor for hospitalisation.
- Other severe mental illnesses such as bipolar disorder and dementia, and a variety of sociodemographic, socioeconomic and health service factors have also contributed to higher rates of inpatient admissions^{3,4}.
- However, the aetiology and pathophysiology of mental disorders and their association with higher rates of hospitalisation remains unclear.

- Applying a transdiagnostic approach to investigating associations with clinical outcomes may help to increase our understanding as to which symptoms, regardless of diagnoses, may be more commonly associated with hospitalisations.

Objective: Using real-world data derived from natural language processing (NLP) of electronic health record (EHR) data, this study aims to examine the association between types and number of symptoms documented during Mental State Examination (MSE) with the frequency of hospitalisation in patients with mental disorders.

METHOD

Data source:

- Data were obtained from NeuroBlu (Figure 1), a trusted research environment that enables the analysis of de-identified, HIPAA-compliant real-world data from 25 U.S. healthcare providers that use the MindLinc EHR system.

Inclusion Criteria:

- Age 18 years and above at time of first visit
- First visit not as an inpatient or in an emergency room setting
- ≥ 2 distinct visits on different days, for the same mental disorder, with at least 12 months of follow-up data
- Health care centre with both inpatient and outpatient services

Index date: Date of first-recorded psychiatric diagnosis

Follow-up period: 1 year following index

Methodology:

- The cohort were categorised into 3 groups based on inpatient records found within the follow-up period: "no hospitalisation", "1-2 hospitalisations" and "3 or more hospitalisations".
- NLP was applied to generate a list of labels based on clinical features documented in the MSE
- MSE groups that were suggestive of transdiagnostic clinical features were selected, namely: Abnormal or Psychotic Thoughts, Mood, Cognition.
- The frequency of MSE symptoms from these 3 symptom groups (with a minimum patient frequency count of 100) was obtained +/- 30 days from the index date to ascertain symptoms recorded around date of first diagnosis.
- Multivariable multinomial logistic regression analysis was used to explore the relationship between the number of hospitalisations (categorical) and MSE symptoms documented at index, adjusted for age, sex, race, diagnosis and Clinical Global Impression-Severity (CGI-S) score.

NeuroBlu™ database

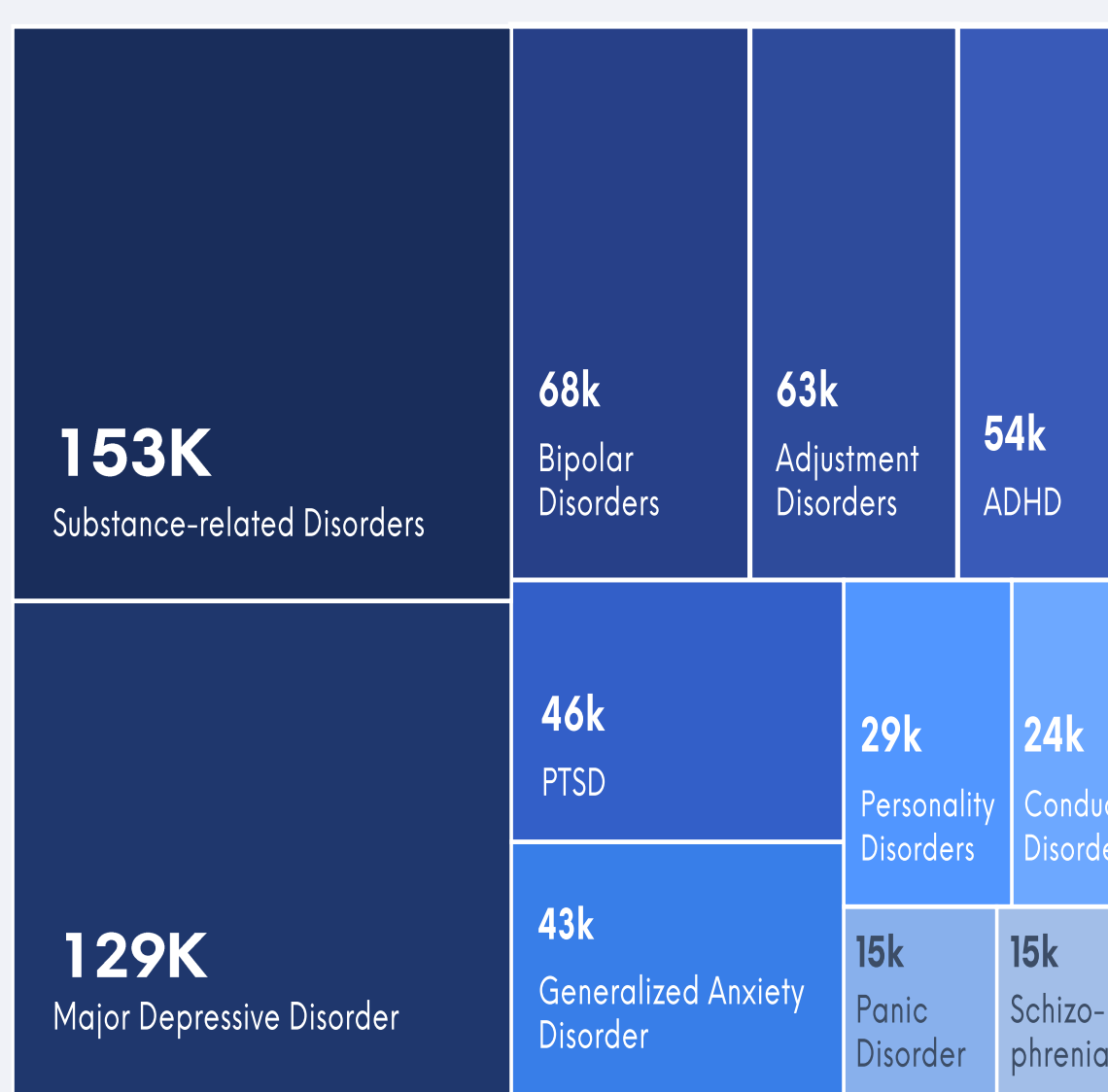


Figure 1. NeuroBlu Database overview

Structured Data

- Outcome Measures (e.g., CGI-S, GAF)
- Diagnosis Codes (ICD-9, ICD-10)
- Prescription Data
- Patient Demographics
- Emergency Department, inpatient & outpatient data across the same patients in 20 of 25 clinics

Unstructured Data

Mental Status Examination (MSE)

- A structured summary of observations of a patient's mental experiences and behaviour at a point in time.
- Holmusk developed >30 advanced Neural Network models to predict structured labels from MSE
- Created >300 psychiatry specific labels in collaboration with clinicians to track disease progression over time

External Stressors

- Social, relational and occupational events that may affect the patient's mental health

Data Source of US Health Facilities

De-identified EHR data were obtained from U.S. mental health services that use the MindLinc EHR system. The data were analysed in NeuroBlu, a secure Trusted Research Environment (TRE) that enables data assembly and analysis using an R/Python code engine.

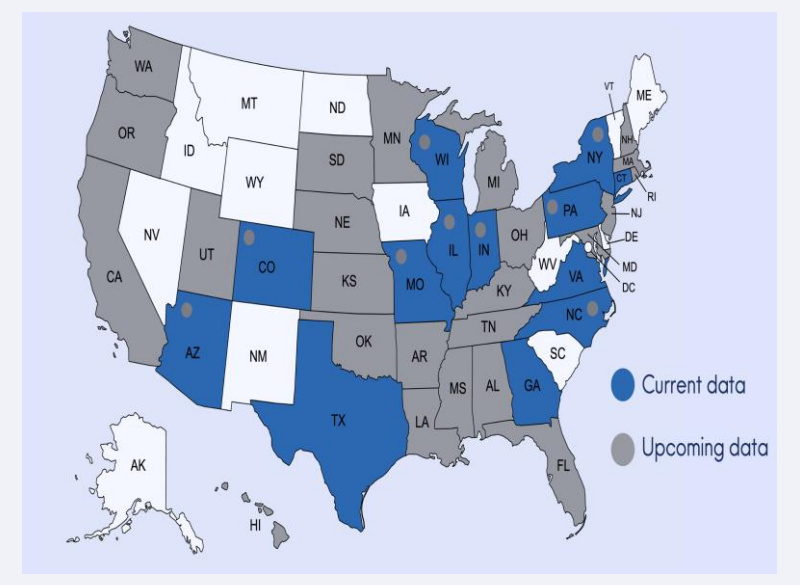


Figure 2. State specific data source for NeuroBlu

RESULTS

Table 1. Frequency of hospitalisations recorded in patients with mental health disorders stratified by those with MSE symptom labels recorded at diagnosis and the associations between no. of symptoms and hospitalisations analysed using multivariable logistic regression

Symptom Group	Symptom Label	Total N (%)	Hospitalisations				
			0	1-2	≥3		
Abnormal or psychotic thoughts	experiencing delusions/abnormal thoughts (grandeur)	207 (0.4)	120 (0.3)	61 (0.6)	26 (1.3)		
	experiencing hallucinations (auditory)	1817 (3.8)	1231 (3.5)	467 (4.4)	119 (5.8)		
	experiencing hallucinations (visual)	1396 (2.9)	872 (2.5)	394 (3.7)	130 (6.3)		
	experiencing delusions (not specified)	2253 (4.7)	1276 (3.7)	757 (7.1)	220 (10.7)		
	experiencing delusions/abnormal thoughts (paranoia)	2105 (4.4)	1113 (3.2)	762 (7.1)	230 (11.2)		
	responding to internal stimuli	1372 (2.9)	756 (2.2)	463 (4.3)	153 (7.4)		
Mood	anxious, tense	9862 (20.7)	6127 (17.6)	3086 (28.8)	649 (31.5)		
	depressed, sad, despondent	12784 (26.9)	8692 (25.0)	3436 (32.0)	656 (31.8)		
	irritable, angry	3399 (7.1)	1888 (5.4)	1192 (11.1)	319 (15.5)		
	elevated, manic	723 (1.5)	357 (1.0)	270 (2.5)	96 (4.7)		
	labile	313 (0.7)	225 (0.6)	77 (0.7)	11 (0.5)		
	misc. issues	1354 (2.8)	925 (2.7)	337 (3.1)	92 (4.5)		
Cognition	general issues with attention and concentration	1836 (3.9)	962 (2.8)	745 (6.9)	129 (6.3)		
	varying issues with attention and concentration	604 (1.3)	286 (0.8)	261 (2.4)	57 (2.8)		
	issues with concentration	729 (1.5)	471 (1.4)	206 (1.9)	52 (2.5)		
	issues with attention	960 (2.0)	655 (1.9)	255 (2.4)	50 (2.4)		
	general issues	914 (1.9)	627 (1.8)	240 (2.2)	47 (2.3)		
	executive functioning (some impairment)	549 (1.2)	235 (0.7)	226 (2.1)	88 (4.3)		
Covariate			1-2 hospitalisations		≥ 3 hospitalisations		
		aOR	95% C.I.	p	aOR	95% C.I.	p
No. of MSE symptoms		1.19	1.14 - 1.24	<.001	1.30	1.21 - 1.40	<.001

- Of the 47,545 patients included in the cohort, 73.1% (n=34,760) had no recorded hospitalisations, 22.6% (n=10,723) had 1-2 recorded hospitalisations and 4.3% (n=2,062) had ≥3 hospitalisations within a 12-month period.

- Controlling for demographic factors, psychiatric diagnoses, and CGI-S, multinomial logistic regression analyses found that the number of MSE symptoms was significantly associated with hospitalisations, where a greater number of symptoms was related to higher odds of being hospitalised (see Table 1 for adjusted odds ratio).

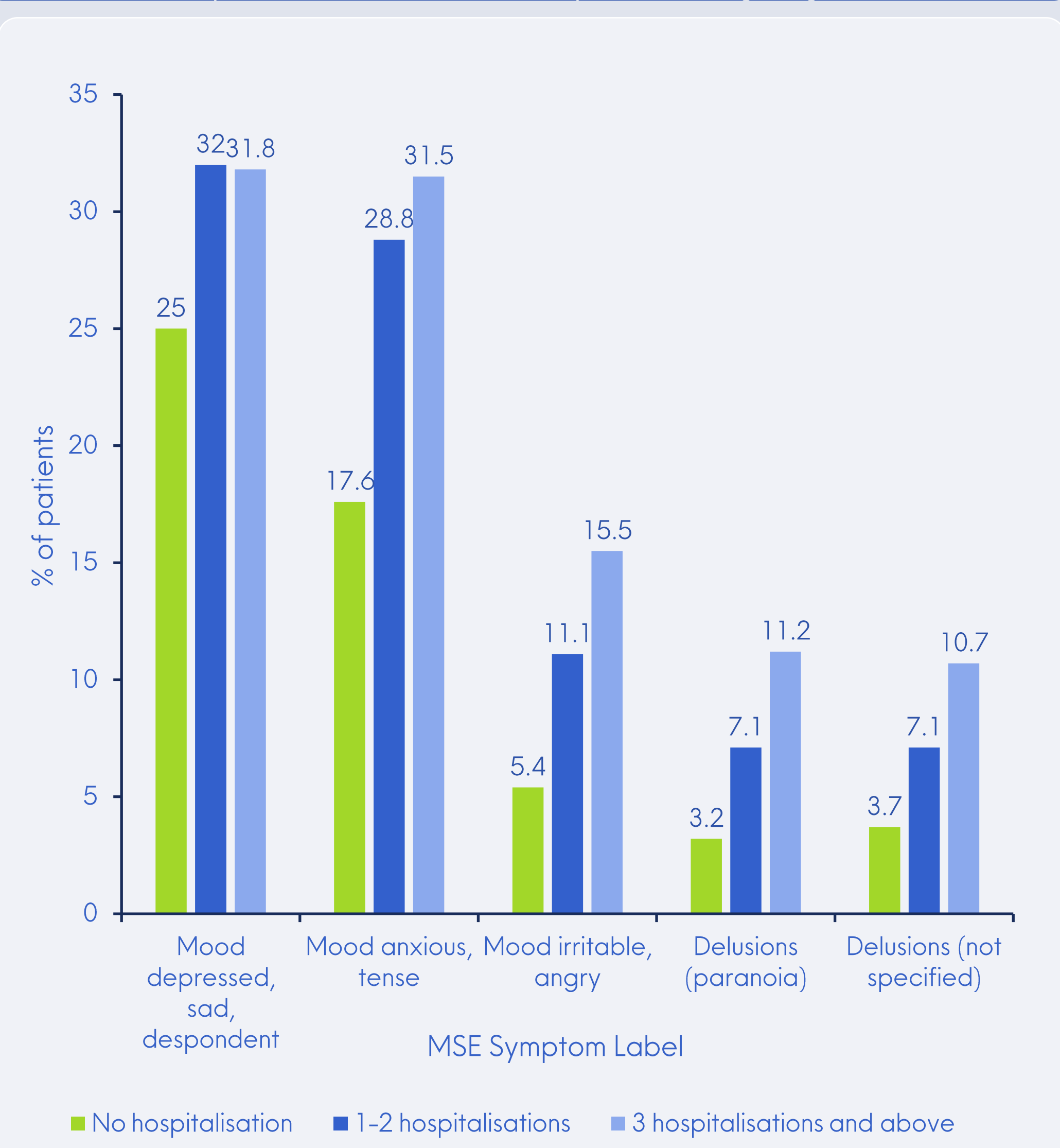
- Table 1 presents the MSE symptoms that were present in more than 100 patients (i.e., n ≥ 100), while Figure 3 presents the top 5 most prevalent MSE symptoms.

- The top 3 most frequently documented were those related to mood, where 26.9% of patients within the cohort were identified as having "depressed mood", 20.7% with "anxious mood", and 7.1% with "angry mood".

- Patients who had at least 1 hospitalisation within the study period had a higher frequency of these symptoms at the point of first-recorded diagnosis (index date)

- Patients with ≥ 3 hospitalisations had a 3-fold proportional increase in documented MSE symptoms of delusion, irritability, elevated mood and impaired executive function compared to those with no hospitalisation.

Figure 3. Top 5 most prevalent MSE symptom labels recorded at the time of diagnosis for patients with mental health disorders (n=47,545) by the number of hospitalisations recorded in the year following diagnosis.



DISCUSSION

- Our findings suggest that transdiagnostic features affecting mood and cognition are common across all patients in our cohort irrespective of psychiatric diagnosis, where a higher number of such symptoms is related to a higher frequency of hospitalization. Irritable mood and delusions are particularly associated with a relative increase in number of hospitalisations.

- This is aligned with past research that has considered a 'C factor' (cognitive dysfunction) and emotion dysregulation as transdiagnostic features present across major psychiatric disorders.^{5,6}

- Analysing big data generated from EHR produces robust findings that reflect real-world practice, which may better inform innovative treatment strategies to address unmet needs in the patient population.

- In conclusion, these results support utilizing a transdiagnostic approach to psychiatric treatment in targeting specific symptoms, which may lead to a reduction in rates of hospitalization, instead of a disorder-specific approach.⁷

Limitations

- The MSE symptoms examined were captured at the index date and thus may not accurately reflect the illness trajectory over the 12 months.

- It was not possible to consistently capture all relevant clinical and non-clinical factors that could have contributed to the risk of hospitalisation.

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Conflicts of Interest: All authors report current employment with Holmusk Technologies, Inc. RP reports equity ownership in Holmusk Technologies, Inc

