



BMJ Open is committed to open peer review. As part of this commitment we make the peer review history of every article we publish publicly available.

When an article is published we post the peer reviewers' comments and the authors' responses online. We also post the versions of the paper that were used during peer review. These are the versions that the peer review comments apply to.

The versions of the paper that follow are the versions that were submitted during the peer review process. They are not the versions of record or the final published versions. They should not be cited or distributed as the published version of this manuscript.

BMJ Open is an open access journal and the full, final, typeset and author-corrected version of record of the manuscript is available on our site with no access controls, subscription charges or pay-per-view fees (<http://bmjopen.bmj.com>).

If you have any questions on BMJ Open's open peer review process please email info.bmjopen@bmj.com

BMJ Open

Emergency department presentation and readmission after index psychiatric admission: a data linkage study

Journal:	<i>BMJ Open</i>
Manuscript ID	bmjopen-2017-018613
Article Type:	Research
Date Submitted by the Author:	10-Jul-2017
Complete List of Authors:	Li, Xue; UNSW Australia, Department of Developmental Disability Neuropsychiatry Srasuebkul, Preeyaporn; UNSW Australia, Department of Developmental Disability Neuropsychiatry Reppermund, Simone; UNSW Australia, Department of Developmental Disability Neuropsychiatry Trollor, Julian; University of New South Wales, Department of Developmental Disability Neuropsychiatry
Primary Subject Heading:	Health services research
Secondary Subject Heading:	Mental health
Keywords:	Psychiatric admission, readmission, emergency department presentation, mental health service, data linkage

SCHOLARONE™
Manuscripts

Only

TITLE:

Emergency department presentation and readmission after index psychiatric admission:
a data linkage study

RUNNING TITLE:

Acute care re-presentations following index mental health admission

AUTHORS

Xue Li¹, Preeyaporn Srasuebkul¹, Simone Reppermund ^{1,2}, Julian N Trollor ^{1,2}

¹ Department of Developmental Disability Neuropsychiatry, School of Psychiatry,
UNSW Sydney, Australia

² Centre for Healthy Brain Ageing, School of Psychiatry, UNSW Sydney, Australia

CORRESPONDING AUTHOR:

Professor Julian Trollor, Department of Developmental Disability Neuropsychiatry,
School of Psychiatry, 34 Botany Street, UNSW Sydney, Sydney NSW 2052, Australia.
Email: j.trollor@unsw.edu.au

Abstract

Objective: Using linked administrative datasets to assess factors associated with Emergency Department (ED) presentation and psychiatric readmission in three distinctive time intervals after the index psychiatric admission.

Design: A retrospective data-linkage study.

Setting: Population-based study using four linked government minimum datasets including acute hospital care from July 2005 to June 2012 in New South Wales, Australia.

Participants: People aged ≥ 18 years on 01 July 2005 who had their index admission to a psychiatric ward from 01 July 2007 to 30 June 2010.

Outcome measures: Odds ratios of factors associated with psychiatric admission and ED presentation were calculated for three intervals: 0-1 month, 2-5 months, and 6-24 months after the separation from the index admission.

Results:

Index admission was identified in 35,056 individuals (51% males) with a median age of 42 years. Of 16,281 (45%) individuals with at least one ED presentation after the index admission, 3,734 (23%) presented within 0-1 month, 6,439 (40%) within 2-5 months and 10,436 (64%) within 6-24 months after index admission. Of 14,523 (45%) individuals with at least one psychiatric readmission, 8,110 (56%) were admitted within 0-1 month, 6,539 (45%) within 2-5 months and 7,740 (53%) within 6-24 months after index admission. Principle diagnoses at index admission, sociodemographic factors, comorbidity and other inpatient service utilisation were significantly associated with ED presentations and psychiatric readmissions. In particular, drug and alcohol comorbidity was associated with increased psychiatric readmissions in the last two intervals and

intellectual disability with increased ED presentations and psychiatric readmissions across all intervals.

Conclusion:

Social determinants of service utilisation, early drug and alcohol intervention and addressing the unmet needs of individuals with intellectual disability and mental illness are key areas for investment to improve trajectories after index admission. Innovative approaches to support people with complex comorbidities in and beyond inpatient settings are needed.

Keywords

Psychiatric admission, readmission, emergency department presentation, mental health service, data linkage

Strengths and limitations

- This study identifies factors associated with psychiatric readmissions and ED presentations following index admission after controlling for potential confounding factors in a large population based dataset.
- The only population study internationally that has examined Emergency Department presentation and psychiatric readmission at multiple time intervals after index separation.
- The major limitation of this study is the use of administrative data, which lacks potentially important clinical information

Introduction

Mental illness is one of the leading causes of disability in most developed countries^{1 2}. Building a mental health system that cohesively supports individuals with severe mental illness is a challenge for mental health services in many countries. Despite enhancements in community psychiatric supports, demand for acute services for people with mental ill health remains high, as evidenced by escalating use of Emergency Departments (ED)³ and high demand for acute psychiatric inpatient services⁴⁻⁶. Most acute psychiatric episodes of care are by repeat users^{7 8}. Thus, the development of a clear understanding of the drivers of ED utilisation and psychiatric readmission for those with mental illness is of potential benefit to mental health consumers, service providers and health service administrators.

Administrative data can provide substantial insights to the factors associated with mental health service use. Factors such as prior service contacts, sociodemographic factors, specific psychiatric conditions, and comorbidities all have significant impacts on mental health related service use⁹⁻¹². For example, the 2010 Australian National Survey of Psychosis¹³ revealed that being younger, having high severity of psychotic symptoms, and poor social functioning were positively correlated with mental health service use. Another US study found psychiatric conditions such as schizophrenia and affective disorders not only increase the likelihood of psychiatric readmission, they were also found to be predictors of ED presentations¹². Other strong predictors with a robust and reciprocal impact on both ED use and psychiatric service use are comorbid conditions including physical and psychiatric comorbidity, cognitive and psychiatric comorbidity and drug and alcohol comorbid conditions^{14 15}. Research relating to

specific factors associated with acute mental health service use and ED use after index psychiatric admission has yet to be undertaken.

Rising demand for acute healthcare services and the substantial costs associated with repeat acute healthcare emphasize the importance of cohesive mental health supports and early intervention¹⁶. Within the mental health context, the first psychotic episode is well recognised as a key opportunity for intervention with early engagement in recovery oriented support resulting in demonstrated improvements in outcome¹⁷, however this concept has broader relevance for a range of mental disorders. For many individuals, index admission represents a sentinel opportunity for mobilisation of first episode supports, yet little is known about service system trajectories after the first admission. Understanding drivers of re-presentation to acute psychiatric services will help to develop services appropriate to the needs at index admission, will enable potential strategies to improve service efficiency^{18 19}, and will potentially improve outcomes for affected individuals.

To date, emphasis has been placed on early readmission rates such as readmission within 28 days or 30 days as indicators of acute care service efficiency²⁰. However, predictors of readmission can be different at different time intervals following discharge²¹. It is likely that sociodemographic and physical and mental health comorbidities may interact to produce increasing complexity over time, with associated increases in the likelihood of re-presentation to acute services. Thus, examination of the factors associated with acute mental health service use over several intervals, and for a substantial time period, is an important step in developing a comprehensive understanding of the drivers of service use.

Population health administrative records in Australia provide an opportunity to examine acute health services use and their determinants. The current study aims to identify the factors associated with acute care service use following index psychiatric admission. Doing so will provide an opportunity to understand drivers of acute service use in this context, and to better plan services and policy responses which underpin recovery from an initial mental health episode. To understand the dynamics of acute service use we examined the factors associated with psychiatric readmissions and ED presentation in three distinctive time intervals: from discharge to 1 month, from 2 to 5 months, and from 6 to 24 months after the index admission. We hypothesised that the principle psychiatric diagnoses at index admission, sociodemographic factors, comorbid conditions and non-psychiatric admissions would have a significant association with ED presentations and psychiatric readmissions and that predictors may vary over time.

Methods

Datasets and record linkage

Four linked datasets were used to define the cohort and/or exposure in this study. De-identified linkage was performed by the New South Wales²² Centre for Health Record Linkage (CHeReL) based on a statistical linkage key (SLK581). In accordance with best practice privacy preserving protocols, the linked unit record data was provided to the researchers after removal of personal identifiers. The databases contained data collected from 1 July 2005 to 30 June 2012 in NSW. The databases used in this analysis were the following:

The Admitted Patient Data Collection (APDC) contains information on all admissions to public and private hospitals in NSW including psychiatric facilities. It

also contains information on psychiatric and intellectual disability diagnoses. Diagnoses in this data collection were coded in the International Statistical Classification of Diseases and Related Health Problems, Tenth Revision, Australian Modification (ICD-10-AM) ²³.

The Emergency Department Data Collection (EDDC) contains information on emergency department (ED) presentations at NSW public hospitals.

The Disability Services Minimum Dataset (DS MDS) is a state service data collection scheme that is collected by a disability administrator in each Australian jurisdiction. It contains information on intellectual disability diagnosis, which was used to identify this factor.

The Registry of Birth Death and Marriage (RBDM) contain registration of death information, which was used to determine the period of exposure for this study.

Study population

We included people who were alive and aged ≥ 18 years on 01 July 2005 and who had their first admission to a psychiatric ward within the period of 01 July 2007 to 30 June 2010. Information regarding admission to and a separation from a psychiatric ward was obtained from the APDC record.

Data on admissions to a psychiatric ward was available from 2005-2012. However, to capture an approximation of the first psychiatric admission, we defined the index admission as being the first psychiatric admission of an individual between 01 July 2007 and 30 June 2010, following exclusion of those individuals who had their first admissions prior to 01 July 2007. We also excluded individuals who had their first admissions after 30 June 2010 to ensure appropriate follow-up period. The index

admission started at the date of the first admission to the psychiatric facility and ended when the separation was noted, index separation.

Three different intervals were used in the study. 0-1 Month: this interval started at the date of the index separation to the 29th day after the index separation date. 2-5 months: this interval started on the 30th day after the index separation to the 29th day of month 5. 6-24 months: this interval started at the 30th day of the 5th month after the index separation date to the 29th day of month 23.

Outcome measures

There were two outcomes in this study, readmission to a psychiatric facility and ED presentations after the index separation. We considered patients who had any records of being admitted to a psychiatric facility after the index separation in each time interval as having a readmission to a psychiatric facility in the specific period. Similarly, patients who had any records of ED presentations after the index separation in each time interval were considered as having an ED presentation outcome. Patients could have more than one type of outcome and could have either outcome multiple times.

Statistical analysis

Logistic regression was used to examine the factors associated with psychiatric admission and ED presentation for the three intervals – 0 to 1 month, 2 to 5 months, and 6 to 24 months after the index separation. Covariates included age, sex, the Index of Relative Socioeconomic Disadvantage (IRSD)²⁴, remoteness area, principle psychiatric diagnoses at index admission, physical comorbidity, ID status, and drug and alcohol comorbidity.

Principle psychiatric diagnoses at the index admission were identified using the ICD-10-AM from the APDC dataset recorded at index admission. The codes started with F00-F99 were grouped into 6 categories: schizophrenia, schizotypal and delusion disorder (F20-F29), mood disorder (F30-F39), disorders of adult personality and behavior (F60-F69), drug and alcohol related disorder (F10-F19). All other codes start with F were coded as other psychiatric disorders. Individuals who were given non-psychiatric codes were coded as not psychiatric disorder.

Physical comorbidities included in each interval were adapted from the Charlson Comorbidity Index^{25 26} and included heart condition, pulmonary disorder, peptic ulcer, liver disease, diabetes, paraplegia, renal disease, and cancer. These conditions were identified from the APDC using ICD-10 codes and are detailed in Supplementary Table 1. We created a binary variable for each condition, set to 0 when an individual was not admitted for the condition and to 1 when an individual was admitted for the condition in each time interval. We excluded physical conditions with small sample size from the analyses, the excluded conditions were connective tissue disease and human immunodeficiency virus (HIV). In addition to the Charlson Comorbidity Index, we examined two comorbidities, drug and alcohol and intellectual disability status, which were known to be highly associated with psychiatric readmissions or ED presentations²⁷²⁸. For drug and alcohol comorbidity, we identified the variable differently in the different outcome. In the psychiatric readmission outcome, when the episodes occurred outside psychiatric facility we include all episodes where drug and alcohol appeared in one of the diagnoses. However, an episode that occurred in a psychiatric facility where drug and alcohol codes were given as a principle diagnosis was excluded. For the ED presentation outcome, we included any hospital episodes where drug and alcohol

appeared in one of the diagnoses, regardless of where the admission occurred. We identified intellectual disability (ID) using the ID flag from DS MDS or the ICD 10 codes (F70–F79) from APDC, or EDDC at any time. The value of the ID flag was set to 1 throughout the study period for everyone who had any records with the relevant codes and set to 0 for everyone who did not have such a record. We also defined a binary variable representing any non-psychiatric hospital episodes for each individual using the APDC dataset. All other variables including age, sex, IRSD, and remoteness of area were identified through the patient record from DS MDS, APDC, and EDDC. Age was a time dependent variable, it was recalculated at each time interval, we grouped aged into three groups young adults (18-35 years), middle aged adults (36-55 years) and older adults (56+).

All statistical analyses were completed with STATA, version 14.0. Odds ratios with 95% confidence intervals were reported, and the threshold for statistical significance was set at $p < .05$.

Ethics approval

Ethics approval was obtained from the NSW Population and Health Services Research Ethics Committee (PHSREC) (CINSW Reference Number 2013/02/446).

Results

Cohort characteristics

There were 115,189 individuals with at least one psychiatric admission from July 1, 2005 to June 30, 2012. Of these, a total of 35,056 individuals met inclusion criteria for the cohort study. Of the 80,133 excluded individuals, 65,812 were excluded for not

having their first record admission between 01 July 2007 to June 30, 2010; 13,116 individuals were excluded for being under the age of 18 on 01 July 2005; 1094 were excluded for having an unknown area of residence and/or IRSD and 111 individuals died before the study period. For those meeting inclusion criteria, half of the population was male with the median and Interquartile Range (IQR) of age at the beginning of the study period of 38 years (28–50 years) and at index admission, 42 years (32–54 years). The majority of people in our cohort lived in major cities (76%), 16% lived in the most disadvantaged area and 22% lived in the least disadvantaged area. Mood disorders accounted for over a third of principle diagnoses for the index admission, while disorders of adult personality and behavior accounted for 3%. One percent of people in our cohort were given ‘Not psychiatric disorder’ codes. The most common comorbidity was drug and alcohol use, followed by pulmonary diseases (4%), heart conditions and intellectual disability (both 3%) (Table 1).

Table 1. Cohort characteristics. N (%) unless otherwise stated.

	Total
Number of people	35,056 (100)
Male	17,822 (51)
Median (IQR) age, years	
At July 2005	38 (28-50)
At index admission	42 (32-54)
Remoteness Area	
Major Cities	26,468 (76)
Inner Regional	6,778(19)
Outer Regional/ Remote/ Very Remote	1,810 (5)
Index of Relative Socioeconomic Disadvantage (IRSD)	
1-2 most disadvantaged	5,686 (16)
3-4	5,655 (16)
5-6	8,644 (25)

7-8	7,332 (21)
9-10 least disadvantaged	7,739 (22)

Primary diagnoses at index admission

Mood disorder	12,710 (36)
Schizophrenia and delusion	6,995 (20)
Disorder of adult personality and behavior	1,055 (3)
Drug and alcohol	5,070 (15)
Other psychiatric disorder	8,771 (25)
Not psychiatric disorder	455 (1)

Comorbidity

Heart Conditions	1,216 (3)
Pulmonary Disease	1,366 (4)
Peptic ulcers	222 (1)
Liver conditions	261 (1)
Diabetes	880 (2)
Paraplegia	277 (1)
Renal Disease	532 (1)
Cancer	425 (1)
Drug and Alcohol (for psychiatric admission)	14,365 (41)
Drug and alcohol (for ED endpoint)	7,691 (22)
Intellectual Disability	899 (3)

Factors associated with ED presentations and psychiatric readmissions after the index admission

ED presentation. 14,386 (41%) individuals had at least one ED presentation in the 24 months after index admission. Of those, 3,723 (26%) of individuals had ED presentations in the first month after the index admission and 6,492 (45%) and 10,527 (73%) individuals had ED presentations in the intervals of 2-5 months and 6-24 months after the index admission, respectively.

Table 2 reports the factors associated with ED presentations after the index separation in the three intervals. Males were less likely to present to ED only in the 2 to 5 months interval compared to females (OR 0.91, 95% CI: 0.86–0.97). Compared to young adults (18–35 years), individuals who were middle aged and older both showed significantly lower ORs for ED presentations after the index separation across all intervals (Middle Aged Adults 35-55 years 0 to 1 month OR 0.83, 95% CI: 0.77–0.90; 2 to 5 months OR 0.86, 95% CI: 0.80–0.91; 6 to 24 months OR 0.82, 95% CI: 0.78–0.87; Older Adults 56-older 0 to 1 month OR 0.64, 95% CI: 0.57–0.71; 2 to 5 months OR 0.66, 95% CI: 0.61–0.72; 6 to 24 months OR 0.64, 95% CI: 0.59–0.69). Area of residence also showed a consistent association with ED presentation. Compared to individuals who lived in major cities, individuals who lived in inner regional areas had more ED presentations after the index admission across all intervals (0 to 1 month OR 1.23, 95% CI: 1.12–1.34; 2 to 5 months OR 1.38, 95% CI: 1.28–1.48; 6 to 24 months

OR 1.43, 95% CI: 1.34–1.52). Individuals who lived in outer regional areas had more ED presentations in the first month after the index separation compared to those who lived in major cities (0 to 1 month OR 1.21, 95% 1.04–1.41). Socioeconomic status had a considerable bearing on ED presentation such that those who lived in the least socioeconomic disadvantaged areas were less likely to present to an ED after the index separation across all intervals than those who lived in the most disadvantaged areas (0–1 month OR 0.63, 95% CI: 0.55–0.71; 2–5 months OR 0.52, 95% CI: 0.46–0.57; 6–24 months OR 0.58, 95% CI: 0.53–0.63).

The principle diagnosis given at the index psychiatric admission had a significant association with ED presentations. Compared to mood disorders, disorders of adult personality and behavior were consistently associated with elevated ED presentations across the three intervals (0 to 1 month OR 1.61, 95% CI: 1.35–1.93; 2 to 5 months OR 1.83, 95% CI: 1.57–2.12; 6 to 24 months OR 1.65, 95% CI: 1.43–1.89). The association with other psychiatric disorders was only significant in the first 2 intervals (0 to 1 month OR 1.20, 95% CI: 1.10–1.32; 2 to 5 months OR 1.16, 95% CI: 1.07–1.25).

Schizophrenia and delusion disorder were associated with more ED presentations compared to mood disorder in the first month after index separation only (0 to 1 month OR 0.89, 95% CI: 0.80–0.99). Individuals who were given a ‘Not psychiatric disorder’ label at index admission had fewer ED presentations across the time interval compared to individuals with a mood disorder diagnoses (0 to 1 month OR 0.03, 95% CI: 0.00–

0.02; 2 to 5 months OR 0.13, 95% CI: 0.07–0.23; 6 to 24 months OR 0.14, 95% CI: 0.09–0.22).

Comorbidity had an incremental association with ED presentation after the index separation, with the number of physical conditions associated with ED presentation increasing as time progressed. Having a heart condition and renal disease emerged as two consistent associations with ED presentation across all intervals. Individuals with heart conditions were more likely to present to ED (0 to 1 month OR 2.52, 95% CI: 1.67–3.80; 2 to 5 months OR 2.75, 95% CI: 2.05–3.68; 6 to 24 months OR 2.01, 95% CI: 1.65–2.45). Renal disease on average doubled the likelihood of ED presentation (0 to 1 month OR 2.03, 95% CI: 1.37–3.02; 2 to 5 months OR 2.25, 95% CI: 1.46–3.45; 6 to 24 months OR 1.91, 95% CI: 1.42–2.56). Having a pulmonary disorder and paraplegia was associated with ED presentation in the intervals of 2 to 5 months and 6 to 24 months (Pulmonary Disorder 2 to 5 months OR 2.02, 95% CI: 1.52–2.68; 6 to 24 months OR 1.98, 95% CI: 1.64–2.39; Paraplegia 2 to 5 months OR 2.14, 95% CI: 1.18–3.89; 6 to 24 months OR 1.81, 95% CI: 1.19–2.75). Diabetes started to show an association with ED presentations more than one month after index separation (2 to 5 months OR 2.46, 95% CI: 1.81–3.33; 6–24 months OR 1.86, 95% CI: 1.43–2.41). Peptic ulcer and cancer were associated with ED presentation only in the last interval (peptic ulcer 6-24 months OR 1.84, 95% CI: 1.14–2.96; cancer 6-24 months OR 1.56, 95% CI: 1.15–2.13). Of all physical comorbidities, liver disease showed the

strongest association with ED presentation after the index admission 2 to 5 months after the index admission, and the odds ratio dropped again in the last interval (0 to 1 month OR 1.87, 95% CI: 1.05–3.33; 2 to 5 months OR 4.40, 95% CI: 2.32–8.33; 6 to 24 months OR 1.82, 95% CI: 1.22–2.73). Intellectual disability had a consistent and robust association with ED presentation following the index admission. ID status was strongly associated with ED presentation across all intervals (0 to 1 month OR 2.93, 95% CI: 2.49–3.45; 2 to 5 months OR 2.82, 95% CI: 2.43–3.26; 6 to 24 months OR 2.79, 95% CI: 2.42–3.22). The association between drug and alcohol comorbidity and ED presentation increased as time progressed (0 to 1 month OR 1.77, 95% CI: 1.63–1.93; 2 to 5 months OR 4.75, 95% CI: 4.37–5.16; 6 to 24 months OR 5.29, 95% CI: 4.92–5.68).

Non-psychiatric hospitalisations were associated with ED presentations across all intervals; however, the strongest association was in the first month after the index admission and the odds ratios decreased with time (0 to 1 month OR 3.07, 95% CI: 2.72–3.46; 2 to 5 months OR 2.06, 95% CI: 1.92–2.24; 6 to 24 months OR 1.67, 95% CI: 1.54–1.77).

(Table 2: Factors associated with Emergency department (ED) presentation after the index admission)

Table 2. Factors associated with ED presentation after the index admission.

	One month (N =35,056)			Two to five months (N = 34,955)			Six months to twenty four months (N = 34,643)		
Variable	Odds Ratio	95% CI	p-value	Odds Ratio	95% CI	p-value	Odds Ratio	95% CI	p-value
Gender									
Female	Ref			Ref			Ref		
Male	0.95	0.88-1.02	0.145	0.91	0.86-0.97	0.003	0.97	0.92-1.02	0.254
Age category			<0.001			<0.001			<0.001
Young adults (18-35 years)	Ref			Ref			Ref		
Middle aged adults (36-55 years)	0.83	0.77-0.90	<0.001	0.86	0.80-0.91	<0.001	0.82	0.78-0.87	<0.001
Older adults (56+)	0.64	0.57-0.71	<0.001	0.66	0.61-0.72	<0.001	0.64	0.59-0.69	<0.001
Remoteness Area			<0.001			<0.001			0.113
Major cities	Ref			Ref			Ref		
Inner Regional	1.23	1.12-1.34	<0.001	1.38	1.28-1.48	<0.001	1.43	1.34-1.52	<0.001
Outer Regional/ Remote/ Very Remote	1.21	1.04-1.41	0.016	1.05	0.92-1.19	0.507	1.05	0.93-1.17	0.441
Index of Relative Socioeconomic Disadvantage (IRSD)			<0.001			<0.001			<0.001
1-2 Most Disadvantaged	Ref			Ref			Ref		
3-4	0.90	0.80-1.01	0.086	1.01	0.92-1.12	0.769	1.02	0.94-1.11	0.950
5-6	0.93	0.84-1.04	0.215	0.95	0.86-1.02	0.259	1.00	0.93-1.08	0.667

7-8	0.84	0.75-0.95	0.004	0.73	0.64-0.78	<0.001	0.76	0.70-0.83	<0.001
9-10 Least Disadvantaged	0.63	0.55-0.71	<0.001	0.52	0.46-0.57	<0.001	0.58	0.53-0.63	<0.001
Principle Psychiatric Diagnosis at Index Admission			<0.001			<0.001			
Mood disorder	Ref			Ref			Ref		
Schizophrenia and delusion	0.89	0.80-0.99	0.036	0.98	0.90-1.06	0.566	1.07	1.00-1.15	0.050
Disorder of adult personality and behavior	1.61	1.35-1.93	<0.001	1.83	1.57-2.12	<0.001	1.65	1.43-1.89	<0.001
Drug and Alcohol	0.97	0.86-1.09	0.621	1.00	0.91-1.10	0.999	0.84	0.78-0.91	<0.001
Other psychiatric disorder	1.20	1.10-1.32	<0.001	1.16	1.07-1.25	<0.001	1.05	0.98-1.12	0.142
Not psychiatric disorder	0.03	0.00-0.20	<0.001	0.13	0.07-0.23	<0.001	0.14	0.09-0.22	<0.001
Comorbidity									
Heart condition	2.52	1.67-3.80	<0.001	2.75	2.05-3.68	<0.001	2.01	1.65-2.45	<0.001
Pulmonary disorder	1.12	0.84-1.49	0.451	2.02	1.52-2.68	<0.001	1.98	1.64-2.39	<0.001
Peptic ulcer	1.76	0.64-5.03	0.271	1.15	0.50-2.65	0.698	1.84	1.14-2.96	0.012
Liver disease	1.87	1.05-3.33	0.033	4.40	2.32-8.33	<0.001	1.82	1.22-2.73	0.004
Diabetes	1.19	0.89-1.58	0.239	2.46	1.81-3.33	<0.001	1.86	1.43-2.41	<0.001
Paraplegia	1.76	0.90-3.43	0.100	2.14	1.18-3.89	0.013	1.81	1.19-2.75	0.005

Renal disease	2.03	1.37-3.02	<0.001	2.25	1.46-3.45	<0.001	1.91	1.42-2.56	<0.001
Cancer	0.97	0.46-2.05	0.933	1.71	1.06-2.78	0.029	1.56	1.15-2.13	0.005
Drug and Alcohol	1.77	1.63-1.93	<0.001	4.75	4.37-5.16	<0.001	5.29	4.92-5.68	<0.001
Intellectual Disability	2.93	2.49-3.45	<0.001	2.82	2.43-3.26	<0.001	2.79	2.42-3.22	<0.001
Non-psychiatric hospitalisation	3.07	2.72-3.46	<0.001	2.09	1.92-2.28	<0.001	1.67	1.57-1.77	<0.001

Psychiatric readmissions. In the study period, 15,692 (45%) individuals had at least one psychiatric readmission in the 24 months after the index admission. Of those, there were 6,942 (44 %) individuals with readmissions in the first month, 6,537 (42%) individuals with readmissions 2-5 months after the index admission and 7,805 (50%) with readmissions 6-24 months after the index admission.

Table 3 reports the factors associated with psychiatric readmissions. Males were consistently less likely to be readmitted to a psychiatric facility compared to females [0 to 1 month OR 0.84, 95% CI: 0.79–0.89; 2 to 5 months OR 0.82, 95% CI: 0.77–0.87; 6 to 24 months OR 0.82, 95% CI: 0.77–0.87]. Compared to young adults (18-35 years), older adults (56 years and above) were more likely to be readmitted for 0-1 months and 2-5 months periods after the index separation (0 to 1 month OR 1.10, 95% CI: 1.01-1.19; 2 to 5 months OR 1.26, 95% CI: 1.16-1.38), and individuals aged between 35 and 55 were more likely to be readmitted in the 2 to 5 months interval (2 to 5 months OR 1.16, 95% CI: 1.08-1.25). Individuals who lived in the outer regional, remote, and very remote areas were less likely to have a psychiatric readmission after the index separation than individuals who lived in major cities (0 to 1 month OR 0.72, 95% CI: 0.61-0.85; 2 to 5 months OR 0.72, 95% CI: 0.61–0.85; 6 to 24 months OR 0.81, 95% CI: 0.70–0.94). A similar effect was observed for individuals who lived in inner regional areas compared to individuals who lived in major cities (0 to 1 month OR 0.71, 95% CI: 0.65–0.77; 2 to 5 months OR 0.87, 95% CI: 0.80–0.95; 6 to 24 months OR

0.90, 95% CI: 0.83–0.97). Individuals who lived in the least disadvantaged area were more likely to be readmitted to a psychiatric facility than individuals who lived in the most disadvantaged area (0 to 1 month OR 2.31, 95% CI: 2.09–2.56; 2 to 5 months OR 1.57, 95% CI: 1.41–1.74; 6 to 24 months OR 1.19, 95% CI: 1.08–1.31).

Principle psychiatric diagnosis at index admission was associated with psychiatric readmission. Compared to mood disorders, both schizophrenia and delusion disorder, and drug and alcohol related disorder diagnostic categories had a persistent association with psychiatric readmission. The association changed at different intervals. Schizophrenia and delusion disorder was associated with a lower likelihood of readmission within the first six months but was associated with a higher likelihood in the last interval (0 to 1 month OR 0.60, 95% CI 0.55–0.66; 2 to 5 months OR 0.82, 95% CI: 0.75–0.90; 6 to 24 months OR 1.37, 95% CI: 1.27–1.48). A principal diagnosis in the drug and alcohol category was associated with psychiatric readmission in the last 2 intervals (2 to 5 months OR 0.71, 95% CI: 0.64–0.78; 6 to 24 months OR 0.56, 95% CI: 0.51–0.62). And other psychiatric disorder diagnosis was associated with fewer psychiatric readmissions in the last 2 intervals (2 to 5 months OR 0.78, 95% CI: 0.72–0.85; 6 to 24 months OR 0.69, 95% CI: 0.64–0.74). Having a ‘Not psychiatric disorder’ diagnosis at index admission increased the likelihood of readmission in the first month and decreased the likelihood of readmission in the last 2 intervals (0 to 1 month OR

3.21, 95% CI 2.62–3.93; 2 to 5 months OR 0.17, 95% CI: 0.12–0.26; 6 to 24 months OR 0.13, 95% CI: 0.07–0.23).

The number of statistically significant physical conditions associated with psychiatric readmissions increased as time progressed. Heart condition showed a change in direction of the association with psychiatric readmission between 0-1 month and 2-5 months (0 to 1 month OR 1.91, 95% CI 1.23–2.96; 2 to 5 months OR 0.62, 95% CI: 0.42–0.92) Paraplegia was only significant in the 2 to 5 months interval (2 to 5 months OR 2.84, 95% CI: 1.49–5.41). Liver disease was significantly associated with psychiatric readmissions across all intervals (0 to 1 month OR 0.29, 95% CI 0.14–0.60; 2 to 5 months OR 0.45, 95% CI: 0.23–0.86; 6 to 24 months OR 0.35, 95% CI: 0.23–0.53). Diabetes showed the highest ORs among all comorbid physical conditions (2 to 5 months OR 4.55, 95% CI: 3.32–6.22; 6 to 24 months OR 2.70, 95% CI: 2.05–3.55). Renal disease was associated with readmission only in the 6 to 24-month interval (OR 1.78, 95% CI: 1.28–2.47). Intellectual disability was consistently associated with psychiatric readmissions across all intervals (0 to 1 month OR 1.67, 95% CI 1.41–1.98; 2 to 5 months OR 1.54, 95% CI: 1.29–1.85; 6 to 24 months OR 1.75, 95% CI: 1.49–2.07). There were strong associations between and psychiatric readmissions and drug and alcohol comorbidity (0 to 1 month OR 18.29, 95% CI: 16.33–20.48; 2 to 5 months OR 15.21, 95% CI: 13.72–16.86; 6 to 24 months OR 11.35, 95% CI: 10.44–12.34).

1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
16
17
18
19
20
21
22
23
24
25
26
27
28
29
30
31
32
33
34
35
36
37
38
39
40
41
42
43
44
45
46
47
48
49
50
51
52
53
54
55
56
57
58
59
60

Non-psychiatric hospitalisations were associated with psychiatric readmissions in the first and last interval with a change in direction (0 to 1 month OR 0.54, 95% CI: 0.47–0.63; 6 to 24 months OR 1.22, 95% CI: 1.14–1.31).

For peer review only

Table 3. Factors associated with psychiatric re-admission after the index admission.

	One month (N =35,056)			Two to five months (N = 34,955)			Six months to twenty four months (N = 34,634)		
Variable	Odds Ratio	95% CI	p-value	Odds Ratio	95% CI	p-value	Odds Ratio	95% CI	p-value
Gender									
Female	Ref			Ref			Ref		
Male	0.84	0.79-0.89	<0.001	0.82	0.77-0.87	<0.001	0.82	0.77-0.87	<0.001
Age category			<0.001			<0.001			<0.001
Young adults (18-35 years)	Ref			Ref			Ref		
Middle aged adults (36-55 years)	1.05	0.98-1.12	0.153	1.16	1.08-1.25	<0.001	1.06	0.99-1.13	0.112
Older adults (56+)	1.10	1.01-1.19	0.025	1.26	1.16-1.38	<0.001	1.09	1.00-1.18	0.050
Remoteness Area			<0.001			<0.001			
Major cities	Ref			Ref			Ref		
Inner Regional	0.71	0.65-0.77	<0.001	0.87	0.80-0.95	0.003	0.90	0.83-0.97	0.009
Outer Regional/ Remote/ Very Remote	0.72	0.61-0.85	<0.001	0.72	0.61-0.85	<0.001	0.81	0.70-0.94	0.005
Index of Relative Socioeconomic Disadvantage (IRSD)			<0.001			<0.001			<0.001
1-2 Most Disadvantaged	Ref			Ref			Ref		
3-4	0.93	0.83-1.05	0.248	1.09	0.97-1.22	0.169	1.13	1.02-1.26	0.022
5-6	1.23	1.11-1.37	<0.001	1.15	1.03-1.27	0.012	1.13	1.03-1.24	0.011
7-8	1.46	1.32-1.62	<0.001	1.27	1.14-1.41	<0.001	1.15	1.04-1.27	0.005
9-10 Least Disadvantaged	2.31	2.09-2.56	<0.001	1.57	1.41-1.74	<0.001	1.19	1.08-1.31	0.001

1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
16
17
18
19
20
21
22
23
24
25
26
27
28
29
30
31
32
33
34
35
36
37
38
39
40
41
42
43
44
45
46
47

Principle psychiatric diagnosis			<0.001			<0.001			<0.001
Mood disorder	Ref			Ref			Ref		
Schizophrenia and delusion disorder	0.60	0.55-0.66	<0.001	0.82	0.75-0.90	<0.001	1.37	1.27-1.48	<0.001
Disorder of adult personality and behavior	1.01	0.85-1.20	0.922	0.85	0.70-1.02	0.076	0.90	0.76-1.07	0.240
Drug and alcohol	1.00	0.92-1.10	0.956	0.71	0.64-0.78	<0.001	0.56	0.51-0.62	<0.001
Other psychiatric	1.01	0.93-1.08	0.884	0.78	0.72-0.85	<0.001	0.69	0.64-0.74	<0.001
Not psychiatric disorder	3.21	2.62-3.93	<0.001	0.17	0.12-0.26	<0.001	0.13	0.07-0.23	<0.001
Comorbidity									
Heart condition	1.91	1.23-2.96	0.004	0.62	0.42-0.92	0.018	0.95	0.75-1.20	0.679
Pulmonary disorder	0.76	0.58-1.01	0.059	0.92	0.66-1.30	0.653	1.13	0.92-1.39	0.238
Peptic ulcer	1.76	0.72-4.30	0.215	0.86	0.32-2.28	0.757	0.70	0.41-1.21	0.205
Liver disease	0.29	0.14-0.60	0.001	0.45	0.23-0.86	0.016	0.35	0.23-0.53	<0.001
Diabetes	1.10	0.87-1.40	0.433	4.55	3.32-6.22	<0.001	2.70	2.05-3.55	<0.001
Paraplegia	0.57	0.24-1.35	0.200	2.84	1.49-5.41	0.001	0.69	0.41-1.15	0.152
Renal disease	1.08	0.74-1.59	0.684	1.05	0.63-1.74	0.852	1.78	1.28-2.47	0.001
Cancer	0.78	0.41-1.48	0.440	0.65	0.34-1.25	0.198	0.96	0.67-1.40	0.848
Drug and Alcohol	18.29	16.33-20.48	<0.001	15.21	13.72-16.86	<0.001	11.35	10.44-12.34	<0.001
Intellectual Disability	1.67	1.41-1.98	<0.001	1.54	1.29-1.85	<0.001	1.75	1.49-2.07	<0.001
Non-psychiatric hospitalisation	0.54	0.47-0.63	<0.001	1.06	0.96-1.17	0.246	1.22	1.14-1.31	<0.001

Discussion

This study investigated factors associated with ED presentation and psychiatric readmission in adults after their index admission. To our knowledge, it is the only population study internationally that has examined these associations at multiple time intervals.

Sociodemographic factors, principle psychiatric diagnoses at index admission, comorbidities and non-psychiatric inpatient admissions were all significantly associated with ED presentation and psychiatric readmission. While some factors had a robust and consistent association across all time intervals, each interval also revealed a distinctive pattern of associations.

Age and sex had a significant association with ED presentations and psychiatric readmissions after the index admission which is in line with previous studies demonstrating that sociodemographic factors are associated with mental health service use^{29 30}. Consistent with previous population data¹², being young increased the likelihood of ED presentation. Similar to previous research that found females use more mental health services¹³, being male was associated with fewer psychiatric readmissions in our study. While low socioeconomic status and remoteness of the living area were associated with more ED presentations, they were associated with fewer psychiatric readmissions. Our findings are consistent with previous studies which found that individuals with higher education and income use more mental health services^{31 32} whereas individuals with lower socioeconomic status tend to use more crisis driven services such as ED^{33 34}. The positive relationship between living in major cities and psychiatric readmission may in part be explained by scarcity of psychiatric resources in rural and remote areas of Australia³⁵.

The continuing association between principle diagnoses at index admission and subsequent ED presentations and readmission showed how psychiatric diagnosis can impact the service trajectory of an individual. For example, the persistent association between

personality and behavioral disorder and ED presentation may relate to symptoms associated with self-harm which is a well-recognised reason for presentation to ED ³⁶. However, reflecting the emphasis on enduring community based supports in its management, personality and behavioral disorder was not associated with readmission. Compared to mood disorder diagnoses, schizophrenia and delusion disorder were associated with fewer readmissions in the first six months after the index admission which is inconsistent with previous findings showing schizophrenia as a principle diagnosis was highly correlated to ED presentation and psychiatric readmission within 30 days after index admission ¹². This may be explained by the clustered code used in this study which combined the most common psychiatric disorders such as depression and anxiety into one category-mood disorder.

Drug and alcohol related disorders as principle diagnoses was associated with fewer psychiatric readmissions, and yet as a comorbid condition drug and alcohol related diagnoses showed the highest association of all covariates with psychiatric readmission across the time intervals. Only 15% of the cohort had a principle drug and alcohol related diagnosis, whereas 41% of the cohort had a drug and alcohol comorbidity, suggesting that these two labels pick up different conditions, in different contexts and with different clinical supports. In NSW, strong emphasis is placed on the management of primary drug and alcohol diagnoses within specific services which sit outside of mainstream mental health services, whereas those with mental illness and drug and alcohol comorbidities are often managed jointly by mental health and specific drug and alcohol services. The two highly correlated diagnoses of drug and alcohol use and mental ill health are often referred to as dual diagnosis in mental health care ³⁷. It is understood that drug and alcohol comorbidity can lead to reductions of compliance with psychiatric treatment, and as a result dual diagnosis are often managed in inpatient mental health services ²⁸. The strength of the association between drug and alcohol

comorbidity and ED presentation and psychiatric readmission suggests that drug and alcohol intervention should not only occur early, but should be a sustained focus in healthcare.

Past studies³⁸ suggest that other comorbid conditions are strongly associated with mental health service use. Previous studies¹⁵ reported a high prevalence of physical comorbidity among individuals with mental illness and we found that the number of physical conditions associated with ED presentations and psychiatric readmissions increased over time. Although the current study was unable to investigate whether an escalation in physical health comorbidities were related to the index admission, a distinctive pattern of comorbidity was observed at each time interval after index admission. Our results reflect complex healthcare needs in the cohort in the later time intervals. These findings suggest the importance of physical health after first admission to a psychiatric facility and that an emphasis on tailored and holistic healthcare is needed within both mental health services and primary healthcare settings during this time.

The presence of ID was persistently and strongly associated with ED presentation and psychiatric readmission across the study period which is consistent with previous research²⁷. As reported elsewhere^{39 40}, the mental health system in Australia is not yet equipped to provide comprehensive mental health supports for individuals with ID. Consistent with a previous study¹⁴, the current study suggests that ID adds to complex support needs which have a direct bearing on ED and inpatient mental health service use, above and beyond that due to the mental illness alone. Unlike many physical conditions an individual can acquire at any point in time, ID is a permanent disability that is often identified at an early stage in life. Our findings reaffirm that equipping mental health services to meet the mental health needs of people with ID is useful and may assist in buffering the impact of this disability on service use.

The significant associations between non-psychiatric hospitalisation, ED presentation and psychiatric admissions, and the proportion of individuals admitted to a psychiatric facility at index admission with a non-psychiatric diagnosis, suggest that strong relationships exist between each component of acute healthcare services. In line with observations made by social researchers, the strong relationship between different acute inpatient contacts suggest that individuals with complex support needs require the development of strong interdisciplinary frameworks to avoid becoming frequent users of acute services ⁴¹

The distinctive focus on time intervals in this study revealed the changing needs of the cohort and specific windows of opportunity for intervention. The intervals revealed that while some factors such as area of residence and socioeconomic status were strongly associated with ED presentation or psychiatric readmission within 30 days after the index admission, others only became significant in the later intervals such as diabetes. The change of direction of the association of principle diagnoses and psychiatric readmission at different time intervals suggest that the service trajectories of individuals with different psychiatric disorders and symptoms can vary and that the 30 days readmission predictors may not capture such change. The unique association between comorbid conditions and psychiatric readmissions and ED presentation as discussed above showed that the healthcare profile and needs of the cohort changed within the 24 months observation period after the first psychiatric admission. Further research should seek to explore in more detail the drivers and dynamics of fluctuations in service use over time.

Strengths and limitations

The current data-linkage study provides a comprehensive overview of factors associated with psychiatric readmissions and ED presentations. We investigated and controlled for a range of factors by linking government databases that cover all acute hospitals in NSW. We used a method to capture the first psychiatric admission using administrative data by isolating two

years for each included individual. There is a likelihood that the index admissions captured by our analyses included individuals who had previous admissions prior to July 2007. However, given that 60% of mental health service users in Australia had a mental health disorder lasting 12 months⁸ and a previous study⁴² found that 66% of mental health users readmitted to a psychiatric facility within a year; it is unlikely that this has affected the results. Although the current study used three different administrative databases to identify individuals with ID status, our separate cohort analysis showed that only 4% of the ID population in this dataset was identified by the admitted patient records and emergency department data collection alone which is unlikely to influence the validity of ID status identification⁴³.

A limitation of the current study is that the data collected by NSW Health are administrative data rather than clinical data and thus lack potentially important clinical information. We were unable to examine the severity of symptoms when admitted to the hospital and its association with readmissions and ED presentation. As NSW APDC data are collected on separation from the hospital, we were also unable to identify the very small percentage of individuals who had an index admission during the study period and yet remained in the facility throughout the study period.

Conclusions

This study provides important insights into the range of factors that are associated with acute health services use after index psychiatric admission. We propose the following recommendations to improve service integration: a stronger public health approach to address the impact of social determinants on service utilisation, early intervention programs for dual diagnosis of mental illness and drug and alcohol comorbidity, an urgent response to address the unmet needs of individuals with ID and mental illness and a more holistic care approach to address comorbidity in the inpatient setting. In addition, more research is needed to

understand the service trajectories of individuals with different psychiatric conditions beyond the commonly used 30 days interval. The results of the current study provide opportunities for researchers and policymakers to explore the complex nature of an often fragmented health system, and to build improved models which support early intervention and reduce burden on individuals and acute health services.

Acknowledgements

We would like to acknowledge all investigators and partner organisations contributing to the project: Chief Investigators: Julian Trollor, Eric Emerson, Rhoshel Lenroot, Karen Fisher, Kimberlie Dean, Leanne Dowse

Associate Investigators: Eileen Baldry, Tony Florio, Grant Sara, Phillip Snoyman, Les White,

Project Staff and Students: Angela Dew, Preeyaporn Srasuebkul, Erin Whittle, Simone Reppermund, Xue Li, Bronwyn Newman, Theresa Heintze

Partner Organisations: Agency for Clinical Innovation – Intellectual Disability Network, NSW Department of Family & Community Services - Ageing, Disability and Home Care, NSW Department of Education, NSW Department of Justice - Corrective Services NSW, NSW Ministry of Health – Justice Health & Forensic Mental Health Network, Mental Health Commission of NSW, NSW Ministry of Health – Mental Health & Drug & Alcohol Office, NSW Ministry of Health - InforMH, Mental Health Review Tribunal, National and NSW Council for Intellectual Disability, National Disability Services, NSW Office of the Public Guardian, NSW Ombudsman.

Contributors

JNT, PS, SL and XL participated in the conceptual design of the study. XL wrote the first draft of the manuscript. PS performed the analyses. All authors critically revised the manuscript and contributed to interpretation of the data. All authors read and approved the final version of the manuscript.

Funding

This study was funded by a National Health and Medical Research Council Australia funded Partnerships for Better Health grant (ID: APP1056128; Title: Improving the Mental Health Outcomes of People with an Intellectual Disability).

Competing interests: None declared.

Patient consent: No.

Ethics approval

Ethics approval was obtained from the NSW Population and Health Services Research Ethics Committee (AU RED Study Reference Number: HREC/13/CIPHS/7; CINSW Reference Number: 2013/02/446), and access to the data sets was granted by relevant data custodians.

Provenance and peer review: Not commissioned; externally peer reviewed.

Data sharing statement: Direct access to the data and analytical files is not permitted without the expressed permission of the approving human research ethics committees and data custodians. Researchers interested in collaboration should contact the corresponding author with their expression of interest.

References

1. Jacobi F, Wittchen H, Holting C, et al. Prevalence, co-morbidity and correlates of mental disorders in the general population: results from the German Health Interview and Examination Survey (GHS). *Psychological Medicine* 2004;34(4):597-611.

2. Whiteford H, Degenhardt L, Rehm J, et al. Global burden of disease attributable to mental and substance use disorders: findings from the Global Burden of Disease Study 2010. *Lancet* 2013;382(9904):1575-86. doi: 10.1016/S0140-6736(13)61611-6

3. Kalucy R, Thomas L, King D. Changing demand for mental health services in the emergency department of a public hospital. *Aust N Z J Psych* 2005;39(1-2):74-80.

4. Whiteford HA. Australia's national mental health policy. *Hospital & community psychiatry* 1993;44(10):963.

5. Whiteford H, Buckingham W. Ten years of mental health service reform in Australia: are we getting it right? *Medical Journal of Australia* 2005;182(8):396-400.

6. Allison S, Bastiampillai T. Mental health services reach the tipping point in Australian acute hospitals: The OECD warns about Australia's low psychiatric bed numbers. *Medical Journal of Australia* 2015;203(11):432-34. doi: 10.5694/mja15.00782

7. Jaramillo-Gonzalez L, Sanchez-Pedraza R, Herazo M. The frequency of rehospitalization and associated factors in Colombian psychiatric patients: a cohort study. *BMC Psychiatry* 2014;14 doi: 10.1186/1471-244X-14-161

8. Slade T JA, Teesson M, Whiteford H, Burgess P, Pirkis J, and Saw S. . The Mental Health of Australians 2. Report on the 2007 National Survey of Mental Health and Wellbeing. In: Ageing DoHa, ed. Canberra, 2009.

9. Lorine K, Schmidt K, Goenjian AK, et al. Risk factors associated with psychiatric readmission. *Journal of Nervous and Mental Disease* 2015;203(6):425-30. doi: 10.1097/NMD.0000000000000305

10. Régis Eric Maia B, João Mazzoncini de Azevedo M, Isabela Panzeri C, et al. Short admission in an emergency psychiatry unit can prevent prolonged lengths of stay in a psychiatric institution Internação breve em unidade de emergência psiquiátrica pode prevenir permanência prolongada em instituições psiquiátricas. *Revista Brasileira de Psiquiatria* 2010;32(2):145-51.

11. Loch AA. Stigma and higher rates of psychiatric re-hospitalization: Sao Paulo public mental health system. *Revista Brasileira de Psiquiatria* 2012;34(2):185-92.

12. Smith M, Stocks C, Santora P. Hospital Readmission Rates and Emergency Department Visits for Mental Health and Substance Abuse Conditions. *Community Mental Health Journal* 2015;51(2):190-97. doi: 10.1007/s10597-014-9784-x

13. Raudino A, Carr V, Bush R, et al. Patterns of service utilisation in psychosis: findings of the 2010 Australian National Survey of Psychosis. *Australian and New Zealand Journal of Psychiatry* 2014;48(4):341-51. doi: 10.1177/0004867413511996

14. Lunskey Y, Lin E, Balogh R, et al. Emergency Department Visits and Use of Outpatient Physician Services by Adults With Developmental Disability and Psychiatric Disorder. *Can J Psychiat-Rev Can Psychiat* 2012;57(10):601-07.

15. Parslow RA, Jorm AF. Who uses mental health services in Australia? An analysis of data from the National Survey of Mental Health and Wellbeing. *Australian and New Zealand Journal of Psychiatry* 2000;34(6):997-1008. doi: 10.1046/j.1440-1614.2000.00839.x

16. Billings J, Blunt I, Steventon A, et al. Development of a predictive model to identify inpatients at risk of re-admission within 30 days of discharge (PARR-30). *BMJ Open* 2012;2(4):e001667. doi: 10.1136/bmjopen-2012-001667

17. McGorry P. Early intervention in psychosis. *Aust N Z J Psych* 2006;40:A109-A09.

18. Shadmi E, Flaks-Manov N, Hoshen M, et al. Predicting 30-day readmissions with preadmission electronic health record data. *Medical Care* 2015;53(3):283-89.

19. van Walraven C, Dhalla I, Bell C, et al. Derivation and validation of an index to predict early death or unplanned readmission after discharge from hospital to the community.

- Canadian Medical Association Journal* 2010;182(6):551-57. doi: 10.1503/cmaj.091117
20. Shadmi E, Flaks-Manov N, Hoshen M, et al. Predicting 30-Day Readmissions With Preadmission Electronic Health Record Data. *Med Care* 2015;53(3):283-89.
 21. Lin C, Chen W, Lin CM, et al. Predictors of psychiatric readmissions in the short- and long-term: a population-based study in taiwan. *Clinics* 2010;65(5):481-89. doi: 10.1590/S1807-59322010000500005
 22. NSW Mental Health Commission. Living well: A strategic plan for mental health in 2014–2024. Commonwealth of Australia: Commonwealth of Australia; 2014 [Available from: [http://nswmentalhealthcommission.com.au/sites/default/files/141002%20Living%20Well%20-%20A%20Strategic%20Plan%20\(1\).pdf](http://nswmentalhealthcommission.com.au/sites/default/files/141002%20Living%20Well%20-%20A%20Strategic%20Plan%20(1).pdf) accessed 02 February 2017.
 23. World Health Organization. The ICD-10 Classification of Mental and Behavioural Disorders: Clinical Descriptions and Diagnostic Guidelines. Geneva: World Health Organization 1992.
 24. Australian Bureau of Statistics. Socio-Economic Index for Areas: Australian Bureau of Statistics, 2013.
 25. Quan HD, Sundararajan V, Halfon P, et al. Coding algorithms for defining comorbidities in ICD-9-CM and ICD-10 administrative data. *Medical Care* 2005;43(11):1130-39.
 26. Charlson ME, Pompei P, Ales KA, et al. A new method of classifying prognostic comorbidity in longitudinal studies: Development and validation. *Journal of Chronic Diseases* 1987;40(5):373-83.
 27. Lunskey Y, Balogh R, Cairney J. Predictors of emergency department visits by persons with intellectual disability experiencing a psychiatric crisis. *Psychiatric Services* 2012;63(3):287-90.
 28. Regier D, Farmer M, Rae D, et al. Comorbidity of Mental Disorders with Alcohol and Other Drug Abuse: Results from the Epidemiologic Catchment Area (ECA) Study. *JAMA* 1990;264(19):2511.
 29. Turrell G, Oldenburg B, Harris E, et al. Utilisation of general practitioner services by socio-economic disadvantage and geographic remoteness. *Australian and New Zealand Journal of Public Health* 2004;28(2):152-58.
 30. Narrow W, Regier D, Norquist G, et al. Mental health service use by Americans with severe mental illnesses. *Social Psychiatry and Psychiatric Epidemiology* 2000;35(4):147-55.
 31. Alegria M, Bijl R, Lin E, et al. Income differences in persons seeking outpatient treatment for mental disorders - a comparison of the United States with Ontario and the Netherlands. *Archives of General Psychiatry* 2000;57(4):383-91.
 32. Vasiliadis H-M, Lesage A, Adair C, et al. Do Canada and the United States differ in prevalence of depression and utilization of services? *Psychiatric Services* 2007;58(1):63-71.
 33. Australian Institute of Health and Welfare. Australian hospital statistics 2007-08 Canberra: AIHW; 2009 [updated 12 January 2017; cited 2017 12 January]. Available from: <http://www.aihw.gov.au/publication-detail/?id=6442468249> accessed 02 February 2017.
 34. Hadley J. Insurance coverage, medical care use, and short-term health changes following an unintentional injury or the onset of a chronic condition. *JAMA* 2007;297(10):1073-84.
 35. Wilks CM, Browne M, Jenner B. Attracting psychiatrists to a rural area - 10 years on. *Rural Remote Health* 2008;8(1):824.

36. Haq SU, Subramanyam D, Agius M. Assessment of self harm in an accident and emergency service - the development of a proforma to assess suicide intent and mental state in those presenting to the emergency department with self harm. *Psychiatra Danubina* 2010;22 Suppl 1:S26-32. [published Online First: 2011/02/08]

37. Donald M, Dower J, Kavanagh D. Integrated versus non-integrated management and care for clients with co-occurring mental health and substance use disorders: A qualitative systematic review of randomised controlled trials. *Social Science and Medicine* 2005;60(6):1371-83. doi: 10.1016/j.socscimed.2004.06.052

38. Lay B, Lauber C, Rossler W. Prediction of in-patient use in first-admitted patients with psychosis. *European Psychiatry* 2006;21(6):401-09. doi: 10.1016/j.eurpsy.2005.12.004

39. Howlett S, Florio T, Xu H, et al. Ambulatory mental health data demonstrates the high needs of people with an intellectual disability: results from the New South Wales intellectual disability and mental health data linkage project. *Australian and New Zealand Journal of Psychiatry* 2015;49(2):137-44. doi: 10.1177/0004867414536933

40. Chaplin R. Mental health services for people with intellectual disabilities. *Current Opinion in Psychiatry* 2011;24(5):372-6.

41. Keene J. Clients with Complex Needs: Interprofessional Practice. Oxford: Blackwell Science 2001.

42. Wheeler A, Moyle S, Jansen C, et al. Five-year follow-up of an acute psychiatric admission cohort in Auckland, New Zealand. *New Zealand Medical Journal* 2011;124(1336)

43. Reppermund S, Srasuebkul P, Heintze T, et al. Cohort profile: a data linkage cohort to examine health service profiles of people with intellectual disability in New South Wales, Australia. *BMJ Open* 2017;7(4).

Supplementary Table 1: ICD-10 codes for the included conditions

Condition	ICD-10 Code
Primary diagnoses at index admission	
Mood disorder	F30-F39
Schizophrenia and delusion	F20-F29
Disorder of adult personality and behavior	F60-F69
Drug and alcohol	F10-F19
Other psychiatric disorder	F0-F09; F40-F59; F70-F100
Not psychiatric disorder	Non-F codes
Comorbidity	
Heart Conditions	I60- I66, G450-G452, G458, G459, G46, I64, G454, I670- I672, I674-I679, I681, I682, I688, I69, I71, I790, I739, R02, Z958, Z959. I50, I21, I22, I252
Pulmonary Disease	J40, J41, J42, J44, J43, J45, J46, J47, J67, J44, J60, J61, J62, J63, J66, J64, J65
Peptic ulcers	K25, K26, K27, K28
Liver conditions	K702, K703, K73, K717, K740, K742, K746, K743, K729, K766, K767, K721, K744, K745
Diabetes	E109, E119, E139, E149, E101, E111, E131, E141, E105, E115, E135, E145, E102, E112, E132, E142, E103, E113, E133, E143, E104, E114, E134, E144
Paraplegia	G81 G041, G820, G821, G822
Renal Disease	N03, N052, N053, N054, N055, N056, N072, N073, N074, N01, N18, N19, N25
Cancer	C0, C1, C2, C3, C40, C41, C43, C45, C46, C47, C48, C49, C5, C6, C70, C71, C72, C73, C74, C75, C76, C80, C81, C82, C83, C84, C85, C883, C887, C889, C900, C901, C91, C92, C93, C940, C941, C942, C943, C9451, C947, C95, C96, C77, C78, C79, C80
Drug and Alcohol	F10-F19
Intellectual Disability	F70-F79

STROBE 2007 (v4) checklist of items to be included in reports of observational studies in epidemiology*
Checklist for cohort, case-control, and cross-sectional studies (combined)

Section/Topic	Item #	Recommendation	Reported on page #
Title and abstract	1	(a) Indicate the study’s design with a commonly used term in the title or the abstract	2
		(b) Provide in the abstract an informative and balanced summary of what was done and what was found	2
Introduction			
Background/rationale	2	Explain the scientific background and rationale for the investigation being reported	5
Objectives	3	State specific objectives, including any pre-specified hypotheses	6,7
Methods			
Study design	4	Present key elements of study design early in the paper	8
Setting	5	Describe the setting, locations, and relevant dates, including periods of recruitment, exposure, follow-up, and data collection	8,9
Participants	6	(a) Cohort study—Give the eligibility criteria, and the sources and methods of selection of participants. Describe methods of follow-up Case-control study—Give the eligibility criteria, and the sources and methods of case ascertainment and control selection. Give the rationale for the choice of cases and controls Cross-sectional study—Give the eligibility criteria, and the sources and methods of selection of participants	9
		(b) Cohort study—For matched studies, give matching criteria and number of exposed and unexposed Case-control study—For matched studies, give matching criteria and the number of controls per case	9
Variables	7	Clearly define all outcomes, exposures, predictors, potential confounders, and effect modifiers. Give diagnostic criteria, if applicable	9
Data sources/ measurement	8*	For each variable of interest, give sources of data and details of methods of assessment (measurement). Describe comparability of assessment methods if there is more than one group	10,11
Bias	9	Describe any efforts to address potential sources of bias	10
Study size	10	Explain how the study size was arrived at	9
Quantitative variables	11	Explain how quantitative variables were handled in the analyses. If applicable, describe which groupings were chosen and why	10
Statistical methods	12	(a) Describe all statistical methods, including those used to control for confounding	10
		(b) Describe any methods used to examine subgroups and interactions	11
		(c) Explain how missing data were addressed	
		(d) Cohort study—If applicable, explain how loss to follow-up was addressed Case-control study—If applicable, explain how matching of cases and controls was addressed	

		<i>Cross-sectional study</i> —If applicable, describe analytical methods taking account of sampling strategy	
		(e) Describe any sensitivity analyses	
Results			
Participants	13*	(a) Report numbers of individuals at each stage of study—eg numbers potentially eligible, examined for eligibility, confirmed eligible, included in the study, completing follow-up, and analysed	13
		(b) Give reasons for non-participation at each stage	13
		(c) Consider use of a flow diagram	
Descriptive data	14*	(a) Give characteristics of study participants (eg demographic, clinical, social) and information on exposures and potential confounders	13,14
		(b) Indicate number of participants with missing data for each variable of interest	13
		(c) <i>Cohort study</i> —Summarise follow-up time (eg, average and total amount)	
Outcome data	15*	<i>Cohort study</i> —Report numbers of outcome events or summary measures over time	15,22
		<i>Case-control study</i> —Report numbers in each exposure category, or summary measures of exposure	
		<i>Cross-sectional study</i> —Report numbers of outcome events or summary measures	
Main results	16	(a) Give unadjusted estimates and, if applicable, confounder-adjusted estimates and their precision (eg, 95% confidence interval). Make clear which confounders were adjusted for and why they were included	15-28
		(b) Report category boundaries when continuous variables were categorized	
		(c) If relevant, consider translating estimates of relative risk into absolute risk for a meaningful time period	
Other analyses	17	Report other analyses done—eg analyses of subgroups and interactions, and sensitivity analyses	
Discussion			
Key results	18	Summarise key results with reference to study objectives	29
Limitations	19	Discuss limitations of the study, taking into account sources of potential bias or imprecision. Discuss both direction and magnitude of any potential bias	32
Interpretation	20	Give a cautious overall interpretation of results considering objectives, limitations, multiplicity of analyses, results from similar studies, and other relevant evidence	29-33
Generalisability	21	Discuss the generalisability (external validity) of the study results	32-33
Other information			
Funding	22	Give the source of funding and the role of the funders for the present study and, if applicable, for the original study on which the present article is based	35

*Give information separately for cases and controls in case-control studies and, if applicable, for exposed and unexposed groups in cohort and cross-sectional studies.

Note: An Explanation and Elaboration article discusses each checklist item and gives methodological background and published examples of transparent reporting. The STROBE checklist is best used in conjunction with this article (freely available on the Web sites of PLoS Medicine at <http://www.plosmedicine.org/>, Annals of Internal Medicine at <http://www.annals.org/>, and Epidemiology at <http://www.epidem.com/>). Information on the STROBE Initiative is available at www.strobe-statement.org.

BMJ Open

Emergency department presentation and readmission after index psychiatric admission: a data linkage study

Journal:	<i>BMJ Open</i>
Manuscript ID	bmjopen-2017-018613.R1
Article Type:	Research
Date Submitted by the Author:	26-Oct-2017
Complete List of Authors:	Li, Xue; UNSW Australia, Department of Developmental Disability Neuropsychiatry Srasuebkul, Preeyaporn; UNSW Australia, Department of Developmental Disability Neuropsychiatry Reppermund, Simone; UNSW Australia, Department of Developmental Disability Neuropsychiatry Trollor, Julian; University of New South Wales, Department of Developmental Disability Neuropsychiatry
Primary Subject Heading:	Health services research
Secondary Subject Heading:	Mental health
Keywords:	Psychiatric admission, readmission, emergency department presentation, mental health service, data linkage

SCHOLARONE™
Manuscripts

Only

TITLE:

Emergency department presentation and readmission after index psychiatric admission: a data linkage study

RUNNING TITLE:

Acute care re-presentations following index mental health admission

AUTHORS

Xue Li¹, Preeyaporn Srasuebkul¹, Simone Reppermund^{1,2}, Julian Trollor^{1,2}

¹ Department of Developmental Disability Neuropsychiatry, School of Psychiatry, UNSW Sydney, Australia

² Centre for Healthy Brain Ageing, School of Psychiatry, UNSW Sydney, Australia

CORRESPONDING AUTHOR:

Professor Julian Trollor, Department of Developmental Disability Neuropsychiatry,
School of Psychiatry, 34 Botany Street, UNSW Sydney, Sydney NSW 2052, Australia.
Email: j.trollor@unsw.edu.au

Abstract

Objective: To use linked administrative datasets to assess factors associated with Emergency Department (ED) presentation and psychiatric readmission in three distinctive time intervals after the index psychiatric admission.

Design: A retrospective data-linkage study.

Setting: Cohort study using four linked government minimum datasets including acute hospital care from July 2005 to June 2012 in New South Wales, Australia.

Participants: People who were alive and aged ≥ 18 years on 01 July 2005 and who had their index admission to a psychiatric ward from 01 July 2007 to 30 June 2010.

Outcome measures: Odds ratios of factors associated with psychiatric admission and ED presentation were calculated for three intervals: 0-1 month, 2-5 months, and 6-24 months after the separation from the index admission.

Results:

Index admission was identified in 35,056 individuals (51% males) with a median age of 42 years. A total of 12,826 (37%) individuals had at least one ED presentation in the first 24 months after the index admission. Of those, 3,608 (28%) presented within 0-1 month, 6,350 (50%) within 2-5 months and 10,294 (80%) within 6-24 months after index admission. A total of 14,153 (40%) individuals had at least one psychiatric readmission in the first 24 months. Of those, 6,808 (48%) were admitted within 0-1 month, 6,433 (45%) within 2-5 months and 7,649 (54%) within 6-24 months after index admission. Principle diagnoses and length of stay at index admission, sociodemographic factors, Charlson comorbidity index score, drug and alcohol comorbidity, intellectual disability and other inpatient service utilisation were significantly associated with ED presentations and psychiatric readmissions.

Conclusion:

Social determinants of service utilisation, drug and alcohol intervention and addressing needs of individuals with intellectual disability are key areas for investment to improve trajectories after index admission and should be emphasised in recovery-oriented approaches in mental health care.

Keywords

Psychiatric admission, readmission, emergency department presentation, mental health service, data linkage

Strengths and limitations

- This study identifies factors associated with psychiatric readmissions and ED presentations following index admission after controlling for potential confounding factors in a large population based dataset.
- This study represents the only study internationally that has examined Emergency Department presentation and psychiatric readmission at multiple time intervals after index separation.
- The major limitation of this study is the use of administrative data, which lacks potentially important clinical information.

1 Introduction

Mental illness is one of the leading cause of disability in most developed countries^{1 2}. Building a mental health system that cohesively supports individuals with severe mental illness is a challenge for mental health services in many countries. Despite enhancements in community psychiatric supports, demand for acute services for people with mental ill health remains high, as evidenced by escalating use of Emergency Departments (ED)³ and high demand for acute psychiatric inpatient services⁴⁻⁶. Most acute psychiatric episodes of care are by repeat users^{7 8}. Thus, the development of a clear understanding of the drivers of ED utilisation and psychiatric readmission for those with mental illness is of potential benefit to mental health consumers, service providers and health service administrators.

Administrative data can provide substantial insights to the factors associated with mental health service use. Factors such as sociodemographic factors, specific psychiatric conditions, comorbidities, and characteristics of previous hospital admissions all have significant impacts on mental health related service use⁹⁻¹². For example, the 2010 Australian National Survey of Psychosis¹³ revealed that being younger, having high severity of psychotic symptoms, and poor social functioning were associated with greater mental health service use. Another US study found among individuals with a mental health or substance abuse diagnosis psychiatric conditions such as schizophrenia and affective disorders not only increase the likelihood of psychiatric readmission, they were also found to be predictors of ED presentations¹². Other strong predictors with a robust and reciprocal impact on both ED use and psychiatric service use are comorbid conditions including physical and psychiatric comorbidity, cognitive and psychiatric comorbidity, intellectual disability (ID) and drug

1 service trajectory of a cohort^{21 23-25}. It is likely that sociodemographic factors and
2 physical and mental health comorbidities may interact to produce increasing complexity
3 over time, with associated increases in the likelihood of re-presentation to acute
4 services. Thus, examination of the factors associated with acute mental health service
5 use over several intervals, and for a substantial time period, is an important step in
6 development of comprehensive understanding of the drivers of service use.

7 Population health administrative records in Australia provide an opportunity to
8 examine acute health services use and their determinants. The current study aims to
9 identify the factors associated with acute care service use following index psychiatric
10 admission. Doing so will provide an opportunity to understand drivers of acute service
11 use in this context, and to better plan services and policy responses which underpin
12 recovery from an initial mental health episode. To understand the dynamics of acute
13 service use we examined the factors associated with psychiatric readmissions and ED
14 presentation in three distinctive time intervals: from discharge to 1 month, from 2 to 5
15 months (short-term), and from 6 to 24 months (medium-term) after the index admission.
16 We hypothesised that the principle psychiatric diagnoses at index admission,
17 sociodemographic factors, comorbid conditions and non-psychiatric admissions would
18 have a significant association with ED presentations and psychiatric readmissions and
19 that predictors of these may vary over time.

1

2 ***Study population***

3 We included people who were alive and aged ≥ 18 years on 01 July 2005 and who were
4 admitted to a psychiatric ward within the period of 01 July 2007 to 30 June 2010.
5 Information regarding admission to and a separation from a psychiatric ward was
6 obtained from the APDC record.

7 Data on admissions to a psychiatric ward was available from 2005-2012.
8 However, to capture an approximation of the potential first psychiatric admission, we
9 defined the index admission as being the first psychiatric admission of an individual
10 between 01 July 2007 and 30 June 2010, following exclusion of those individuals who
11 were admitted prior to 01 July 2007. We also excluded individuals who had their first
12 admissions after 30 June 2010 to ensure appropriate follow-up period. The index
13 admission started at the date of the first admission to the psychiatric facility and ended
14 when the separation was noted, index separation.

15 Three different intervals were used in the study: i) 0-1 Month: this interval
16 started at the date of the index separation to the 29th day after the index separation date;
17 ii) 2-5 months: this interval started on the 30th day after the index separation to the 29th
18 day of month 5; iii) 6-24 months: this interval started at the 30th day of the 5th month
19 after the index separation date to the 29th day of month 23.

20 ***Outcome measures***

21 There were two outcomes in this study, ED presentations and readmission to a
22 psychiatric facility after the index separation. We considered patients who had any
23 records of being admitted to a psychiatric facility after the index separation in each time
24 interval as having a readmission to a psychiatric facility in the specific period.

Similarly, patients who had any records of ED presentations after the index separation in each time interval were considered as having an ED presentation outcome. An individual could have more than one type of outcome and could have multiple admissions within one interval and across the time span.

Statistical analysis

Logistic regression was used to examine the factors associated with psychiatric admission and ED presentation for the three intervals – 0 to 1 month, 2 to 5 months, and 6 to 24 months after the index separation. Covariates included age, sex, the Index of Relative Socioeconomic Disadvantage (IRSD)²⁸, remoteness area, principle psychiatric diagnoses at index admission, length of stay at index admission, Charlson comorbidity index score²⁹, ID status, and drug and alcohol comorbidity.

The principal diagnosis was defined as the condition mainly responsible for a patient's episode of care in hospital³⁰. Principle psychiatric diagnoses at the index admission were identified using ICD-10-AM from the APDC dataset recorded at index admission. The codes from F00-F99 were grouped into 7 categories: organic mental health disorder (F00-F09); drug and alcohol related disorder (F10-F19); schizophrenia, schizotypal and delusion disorder (F20-F29); mood disorder (F30-F39); anxiety and stress related disorder (F40-48); disorders of adult personality and behavior (F60-F69). All other F codes were coded as other psychiatric disorders. Individuals who were given non-psychiatric codes were coded as not having a psychiatric disorder. The length of stay at index admission was calculated from the admission day to the separation day. Same day admission was considered as one day.

Comorbidity scores in each interval were calculated using the modified Charlson comorbidity index score^{29,31} and included heart condition, pulmonary disorder, peptic

ulcer, liver disease, diabetes, paraplegia, renal disease, and cancer. These conditions were identified from the APDC using ICD-10 codes. In addition to the Charlson comorbidity index, we examined two comorbidities, drug and alcohol and intellectual disability status, which were known to be highly associated with psychiatric readmissions or ED presentations^{32 33}.

For drug and alcohol comorbidity, we identified the variable differently for each of the psychiatric readmission and ED presentation outcomes. In the psychiatric readmission outcome, when the episodes occurred outside psychiatric facility, we included all episodes where drug and alcohol appeared in one of the recorded diagnoses. An episode that occurred in a psychiatric facility where drug and alcohol codes were given as a principle diagnosis were excluded to ensure the included condition was not an outcome variable. For the ED presentation outcome, we included any hospital episodes where drug and alcohol appeared in one of the diagnoses regardless of where the admission happened. Consistent with our previous approach, we identified ID with codes including: childhood disintegrative and overactive disorders associated with mental retardation; intellectual development delay; mild through profound mental retardation; Down syndrome and other chromosomal anomalies associated with mental retardation; Fragile X syndrome and congenital malformation syndromes due to known exogenous causes³⁴. The value of the ID flag was set to 1 throughout the study period for everyone who had any records with the relevant codes and set to 0 for everyone who did not have such a record. We also defined a binary variable representing any non-psychiatric hospital episodes for each individual using the APDC dataset. All other variables including age, sex, IRSD, and remoteness of area were identified through the patient record from DS MDS, APDC, and EDDC. Age was a time dependent variable, it

1 was recalculated at each time interval. Age was categorised into three groups: young
2 adults (18-35 years); middle aged adults (36-55 years); older adults (56+).
3 All statistical analyses were completed with STATA, version 14.0. Odds ratios
4 (ORs) with 95% confidence intervals (CI) were reported, and the threshold for statistical
5 significance was set at $p < .05$.

6 **Ethics approval**

7 Ethics approval was obtained from the NSW Population and Health Services Research
8 Ethics Committee (PHSREC) (CINSW Reference Number 2013/02/446).

Results

Cohort characteristics

There were 115,189 individuals with at least one psychiatric admission from July 1, 2005 to June 30, 2012. Of these, a total of 35,056 individuals met inclusion criteria for the study. Of the 80,133 excluded individuals, 65,812 were excluded for not having their first record admission between 01 July 2007 and June 30, 2010; 13,116 were excluded due to being under the age of 18 years on 01 July 2005; 111 were excluded for having an unknown area of residence and/or IRSD; and 1,094 individuals died before the study period. For those meeting inclusion criteria, half of the population was males with the median and Interquartile Range (IQR) of age at the beginning of the study period of 38 years (28–50 years) and at index admission, 42 years (32–54 years). The majority of people in our cohort lived in the major cities (76%), 16% lived in the most disadvantaged area and 22% lived in the least disadvantaged area. Mood disorders accounted for over a third of principle diagnoses for the index admission (36%); followed by anxiety and stress related psychiatric disorder (21%), while disorders of adult personality and behavior accounted for 3%. One percent of people in our cohort were coded as not having a psychiatric disorder. The median (IQR) length of stay at index admission was 9 days (2–21 days). Percentages of drug and alcohol use were 41% and 22% for the ED presentation outcome and psychiatric readmission, respectively. People with intellectual disability represented 3% of the cohort (Table 1).

1 **Table 1.** Cohort characteristics. N (%) unless otherwise stated.

	Total
Number of people	35,056 (100)
Male	17,822 (51)
Median (IQR) age, years	
At July 2005	38 (28-50)
At index admission	42 (32-54)
Median (IQR) length of stay at index admission, days	9 (2-21)
Remoteness Area	
Major Cities	26,468 (76)
Inner Regional	6,778(19)
Outer Regional/ Remote/ Very Remote	1,810 (5)
Index of Relative Socioeconomic Disadvantage (IRSD)	
1-2 most disadvantaged	5,686 (16)
3-4	5,655 (16)
5-6	8,644 (25)
7-8	7,332 (21)
9-10 least disadvantaged	7,739 (22)
Principle diagnoses at index admission	
Mood disorder	12,707 (36)
Schizophrenia and delusion	6,998 (20)
Disorder of adult personality and behavior	1,056 (3)
Drug and alcohol	5,070 (14)
Anxiety and stress related psychiatric disorder	7,363 (21)
Organic psychiatric disorder	667 (2)
Other psychiatric disorder	740 (2)
Not psychiatric disorder	455 (1)
Comorbidity	
Drug and Alcohol (for psychiatric admission)	6,475 (22)
Drug and alcohol (for ED endpoint)	13,858 (41)
Intellectual Disability	899 (3)

1 ***Factors associated with ED presentations and psychiatric readmissions after the***
2 ***index admission***

3 ***ED presentation.*** 12,826 (37%) individuals had at least one ED presentation in the 24
4 months after index admission. Of those, 3,608 (28%) had ED presentations in the first
5 month after the index admission and 6,350 (50%) and 10,294 (80%) individuals had ED
6 presentations in the intervals of 2-5 months and 6-24 months after the index admission,
7 respectively. The median time (IQR) to an ED presentation after the index admission
8 was 107 (24-296) days.

9 Table 2 reports the odds ratios, confident intervals and p values of the factors
10 associated with ED presentations after the index separation in the three intervals. Males
11 were less likely to present to ED in the 2 to 5 months and 6 to 24 months intervals
12 compared to females. Compared to young adults (18–35 years), individuals who were
13 middle aged and older were both significantly less likely to present to an ED after the
14 index separation across all intervals. Area of residence also showed a consistent
15 association with ED presentation. Compared to individuals who lived in major cities,
16 individuals who lived in inner regional areas had increased likelihood of ED
17 presentation after the index admission across all intervals. Individuals who lived in
18 outer regional areas were more likely to have ED presentations in the first month after
19 the index separation compared to those who lived in major cities. Area socioeconomic
20 status had a considerable bearing on ED presentation such that those who lived in the

1 least socioeconomic disadvantaged areas were less likely to present to an ED after the
2 index separation than those who lived in the most disadvantaged areas across all
3 intervals.

4 The principle diagnosis given at the index psychiatric admission had a significant
5 association with ED presentations. Compared to mood disorders, disorders of adult
6 personality and behavior were consistently associated with elevated ED presentations
7 across the three intervals. Those individuals who were coded as not a psychiatric
8 disorder at index admission had lower likelihood of ED presentations across the time
9 interval compared to individuals with a mood disorder diagnoses. Longer length of stay
10 at index admission reduced the likelihood of ED presentations across the study period.

11 Comorbidity had an incremental association with ED presentation after the index
12 separation. Comparing to individuals with no other physical illness (Charlson
13 comorbidity index score of 0) recorded, individuals with a Charlson comorbidity index
14 score of 1 to 3 were more likely to present to an ED across the 3 intervals. Having a
15 Charlson comorbidity index score of 4 to 6 and 7 or more was associated with greater
16 likelihood of ED presentation in the last 2 intervals. Intellectual disability had a
17 consistent and robust association with ED presentation following the index admission
18 across all intervals. The association between drug and alcohol comorbidity and ED
19 presentation increased as time progressed.

1 Non-psychiatric hospitalisations were associated with ED presentations across
2 all intervals; however, the strongest association was in the first month after the index
3 admission and the odds ratios decreased with time.
4 (Table 2: Factors associated with Emergency department (ED) presentation after the
5 index admission)

Table 2. Factors associated with ED presentation after the index admission.

	One month (N =35,056)			Two to five months (N = 34,955)			Six months to twenty four months (N = 34,643)		
Variable	Odds Ratio	95% CI	p-value	Odds Ratio	95% CI	p-value	Odds Ratio	95% CI	p-value
Gender									
Female	Ref			Ref			Ref		
Male	0.93	0.87-1.00	0.066	0.90	0.84-0.95	<0.001	0.95	0.90-1.00	0.047
Age category			<0.001			<0.001			<0.001
Young adults (18-35 years)	Ref			Ref			Ref		
Middle aged adults (36-55 years)	0.85	0.79-0.92	<0.001	0.87	0.81-0.93	<0.001	0.83	0.78-0.88	<0.001
Older adults (56+)	0.71	0.64-0.80	<0.001	0.71	0.65-0.78	<0.001	0.67	0.62-0.72	<0.001
Remoteness Area			<0.001			<0.001			0.113
Major cities	Ref			Ref			Ref		
Inner Regional	1.23	1.13-1.35	<0.001	1.38	1.28-1.48	<0.001	1.43	1.34-1.53	<0.001
Outer Regional/ Remote/ Very Remote	1.22	1.05-1.42	0.011	1.06	0.93-1.21	0.392	1.06	0.95-1.19	0.309
Index of Relative Socioeconomic Disadvantage (IRSD)			<0.001			<0.001			<0.001
1-2 Most Disadvantaged	Ref			Ref			Ref		
3-4	0.91	0.81-1.02	0.107	1.02	0.93-1.12	0.674	1.02	0.94-1.11	0.629
5-6	0.94	0.85-1.05	0.272	0.96	0.88-1.05	0.341	1.01	0.94-1.09	0.767

18

7-8	0.86	0.76-0.96	0.009	0.74	0.67-0.81	<0.001	0.77	0.71-0.83	<0.001
9-10 Least Disadvantaged	0.64	0.57-0.73	<0.001	0.52	0.47-0.58	<0.001	0.59	0.54-0.64	<0.001
Principle Psychiatric Diagnosis at Index Admission			<0.001			<0.001			<0.001
Mood disorder	Ref			Ref			Ref		
Schizophrenia and delusion	0.99	0.88-1.10	0.794	1.04	0.95-1.13	0.379	1.14	1.06-1.23	<0.001
Disorder of adult personality and behavior	1.41	1.18-1.69	<0.001	1.64	1.41-1.91	<0.001	1.50	1.30-1.72	<0.001
Drug and Alcohol related disorder	0.91	0.81-1.02	0.113	0.94	0.85-1.03	0.157	0.80	0.73-0.86	<0.001
Anxiety and stress related disorder	1.05	0.95-1.16	0.331	1.06	0.98-1.15	0.148	0.95	0.89-1.02	0.153
Organic psychiatric disorders	1.21	0.93-1.57	0.159	1.21	0.97-1.50	0.092	1.41	1.16-1.70	<0.001
Other psychiatric disorder	0.97	0.75-1.25	0.809	0.76	0.61-0.95	0.016	0.77	0.64-0.92	0.005
Not psychiatric disorder	0.02	0.00-0.14	<0.001	0.11	0.06-0.19	<0.001	0.11	0.07-0.17	<0.001
Length of stay at index admission	0.83	0.80-0.85	<0.001	0.87	0.85-0.89	<0.001	0.88	0.87-0.90	<0.001
Charlson comorbidity Index Score			<0.001			<0.001			<0.001
0	Ref			Ref			Ref		
1-3	2.38	1.82-3.13	<0.001	3.24	2.70-3.90	<0.001	2.34	2.05-2.67	<0.001

18

4-6	3.92	1.60-9.63	0.003	3.81	1.96-7.38	<0.001	2.88	1.97-4.22	<0.001
7+	0.95	0.33-2.78	0.927	2.50	1.44-4.34	0.001	2.14	1.52-3.00	<0.001
Other comorbidity									
Drug and Alcohol	1.76	1.61-1.91	<0.001	5.00	4.60-5.43	<0.001	5.49	5.11-5.90	<0.001
Intellectual Disability	3.03	2.56-3.58	<0.001	3.00	2.58-3.47	<0.001	2.94	2.54-3.40	<0.001
Non-psychiatric hospitalisation	2.87	2.53-3.26	<0.001	2.00	1.84-2.18	<0.001	1.65	1.55-1.75	<0.001

Psychiatric readmissions. In the study period, 14,153 (40%) individuals had at least one psychiatric readmission in the 24 months after the index admission. Of those, there were 6,808 (48%) individuals with readmissions in the first month, 6,433 (45%) individuals with readmissions 2-5 months after the index admission and 7,649 (54%) with readmissions 6-24 months after the index admission. The median (IQR) time to a psychiatric readmission after the index admission was 36 (4-209) days.

Table 3 reports the odds ratios, confident intervals and *p* values of the factors associated with psychiatric readmissions. Males were consistently less likely to be readmitted to a psychiatric facility compared to females. Compared to young adults (18-35 years), older adults (56 years and above) and individuals aged between 35 and 55 were more likely to be readmitted for 0-1 months and 2-5 months periods after the index separation. Individuals who lived in the outer regional, remote, and very remote areas were less likely to have a psychiatric readmission after the index separation than individuals who lived in major cities. A similar effect was observed for individuals who lived in inner regional areas compared to individuals who lived in major cities. Individuals who lived in the least disadvantaged area were more likely to be readmitted to a psychiatric facility than individuals who lived in the most disadvantaged area.

Principle psychiatric diagnosis at index admission was associated with psychiatric readmission. Compared to mood disorders, both schizophrenia and delusion disorder and organic psychiatric disorder had a persistent association with psychiatric

1 readmission. Schizophrenia and delusion disorder was associated with lower likelihood
2 of readmission within the first six months but was associated with higher likelihood in
3 the last interval. Organic psychiatric disorder diagnosis was associated with lower
4 likelihood psychiatric readmissions across the study period. A principal diagnosis in the
5 drug and alcohol category was associated with greater likelihood psychiatric
6 readmission in the last 2 intervals. Anxiety and stress related psychiatric disorder were
7 significantly associated with reduced likelihood of readmission in the first and last
8 interval. A principle diagnosis in ‘Other psychiatric disorder’ was only associated with
9 more psychiatric readmissions in the first interval. Having a no psychiatric diagnosis at
10 index admission increased the likelihood of readmission in the first month and
11 decreased the likelihood of readmission in the last 2 intervals. Greater length of stay at
12 index admission was associated with lower likelihood of readmissions in the first
13 interval, but with increased likelihood of readmission in the last 2 intervals.

14 Higher Charlson comorbidity index scores were generally associated with a
15 lower likelihood of psychiatric readmissions. Compared with a Charlson comorbidity
16 index score of 0, a score of 1 to 3 was only significantly associated with psychiatric
17 readmission in the last interval. Charlson comorbidity index score of 4 to 6 was
18 significantly associated with decreased likelihood of psychiatric readmissions across all
19 intervals. Charlson comorbidity index score of 7 and more was associated with lower
20 likelihood of readmission only in the second intervals (2-5 months). Intellectual

1 disability was consistently associated with higher rates of psychiatric readmissions
2 across all intervals. There were strong associations between and psychiatric
3 readmissions and drug and alcohol comorbidity. Drug and alcohol comorbidity
4 significantly increased the likelihood of readmission across all intervals.

5 Non-psychiatric hospitalisations were associated with decreased likelihood of
6 psychiatric readmissions in the first interval and increased likelihood of readmission in
7 the last 2 intervals.

Table 3. Factors associated with psychiatric readmission after the index admission.

	One month (N =35,056)			Two to five months (N = 34,955)			Six months to twenty-four months (N = 34,634)		
Variable	Odds Ratio	95% CI	p-value	Odds Ratio	95% CI	p-value	Odds Ratio	95% CI	p-value
Gender									
Female	Ref			Ref			Ref		
Male	0.82	0.78-0.87	<0.001	0.84	0.79-0.90	<0.001	0.84	0.80-0.90	<0.001
Age category			<0.001			<0.001			<0.373
Young adults (18-35 years)	Ref			Ref			Ref		
Middle aged adults (36-55 years)	1.11	1.03-1.18	0.002	1.16	1.08-1.24	<0.001	1.05	0.98-1.12	0.174
Older adults (56+)	1.38	1.27-1.50	<0.001	1.21	1.11-1.32	<0.001	1.04	0.96-1.14	0.321
Remoteness Area			<0.001			<0.001			0.001
Major cities	Ref			Ref			Ref		
Inner Regional	0.70	0.64-0.77	<0.001	0.87	0.80-0.95	0.002	0.89	0.79-0.92	0.006
Outer Regional/ Remote/ Very Remote	0.74	0.63-0.87	<0.001	0.72	0.61-0.85	<0.001	0.81	0.70-0.94	0.004
Index of Relative Socioeconomic Disadvantage (IRSD)			<0.001			<0.001			0.030
1-2 Most Disadvantaged	Ref			Ref			Ref		
3-4	0.94	0.84-1.06	0.326	1.08	0.96-1.22	0.193	1.12	1.01-1.24	0.031
5-6	1.25	1.13-1.38	<0.001	1.13	1.02-1.26	0.022	1.12	1.02-1.24	0.018
7-8	1.49	1.35-1.66	<0.001	1.25	1.12-1.39	<0.001	1.14	1.03-1.26	0.011
9-10 Least Disadvantaged	2.42	2.18-2.68	<0.001	1.52	1.36-1.69	<0.001	1.17	1.06-1.30	0.002

Principle psychiatric diagnosis			<0.001			<0.001			<0.001
Mood disorder	Ref			Ref			Ref		
Schizophrenia and delusion disorder	0.70	0.64-0.77	<0.001	0.74	0.68-0.81	<0.001	1.25	1.15-1.35	<0.001
Disorder of adult personality and behavior	0.82	0.69-0.98	0.025	0.98	0.81-1.18	0.842	1.05	0.88-1.24	0.661
Drug and alcohol related disorder	0.92	0.84-1.06	0.055	0.74	0.67-0.82	<0.001	0.59	0.53-0.65	<0.001
Anxiety and stress related disorder	0.82	0.75-0.89	<0.001	0.94	0.86-1.02	0.155	0.79	0.73-0.86	<0.001
Organic psychiatric disorders	0.51	0.39-0.68	<0.001	0.40	0.29-0.54	<0.001	0.47	0.35-0.63	<0.001
Other psychiatric	1.39	1.15-1.67	0.001	0.94	0.76-1.15	0.549	0.88	0.72-1.08	0.231
Not psychiatric disorder	1.82	1.48-2.24	<0.001	0.26	0.17-0.39	<0.001	0.19	0.11-0.35	<0.001
Length of stay at index admission	0.75	0.73-0.77	<0.001	1.23	1.20-1.26	<0.001	1.22	1.19-1.25	<0.001
Charlson comorbidity Index Score			0.006			0.004			<0.001
0	Ref			Ref			Ref		
1-3	0.79	0.55-1.12	0.186	0.90	0.71-1.14	0.379	0.80	0.68-0.94	0.005
4-6	0.14	0.04-0.48	0.002	0.34	0.14-0.82	0.017	0.38	0.24-0.60	<0.001
7+	0.48	0.14-1.59	0.229	0.26	0.10-0.69	0.007	0.69	0.45-1.06	0.092
Other comorbid conditions									

Drug and Alcohol	18.25	16.29-20.45	<0.001	15.52	13.99-17.22	<0.001	11.58	10.65-12.60	<0.001
Intellectual Disability	1.63	1.37-1.94	<0.001	1.54	1.28-1.85	<0.001	1.75	1.49-2.07	<0.001
Non-psychiatric hospitalisation	0.57	0.50-0.67	<0.001	1.11	1.01-1.23	0.032	1.28	1.19-1.37	<0.001

Discussion

This study investigated factors associated with ED presentation and psychiatric readmission in adults after their index admission. To our knowledge, it is the only cohort study internationally that has examined these associations at multiple time intervals. Sociodemographic factors, principle psychiatric diagnoses at index admission, length of stay at index admission, comorbidities and non-psychiatric inpatient admissions were all significantly associated with ED presentation and psychiatric readmission. While some factors had a robust and consistent association across all time intervals, each interval also revealed a distinctive pattern of associations.

Age and sex had a significant association with ED presentations and psychiatric readmissions after the index admission which is similar to previous studies demonstrating that sociodemographic factors are associated with mental health service use^{35 36}. Consistent with previous population data¹², being young increased the likelihood of ED presentation. Similar to previous research that found females use more mental health services¹³, being male was associated with lower likelihood of psychiatric readmissions in our study. While low socioeconomic status and remoteness of the living area were associated with more ED presentations, they were associated with lower likelihood of psychiatric readmissions. Our findings are consistent with previous studies which found that individuals with higher education and income use more mental health services^{37 38} whereas individuals with lower socioeconomic status tend to use more crisis driven services such as ED^{39 40}. The positive relationship between living in major cities and psychiatric readmission may in part be explained by scarcity of psychiatric resources in rural and remote areas of Australia⁴¹.

The continuing association between principle diagnoses at index admission and subsequent ED presentations and readmission showed how psychiatric diagnosis can impact the service trajectory of an individual. For example, the persistent association between

1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
16
17
18
19
20
21
22
23
24
25
26
27
28
29
30
31
32
33
34
35
36
37
38
39
40
41
42
43
44
45
46
47
48
49
50
51
52
53
54
55
56
57
58
59
60

1 personality and behavioral disorder and ED presentation may relate to symptoms associated
2 with self-harm which is a well-recognised reason for presentation to ED ⁴². However,
3 reflecting the emphasis on enduring community based supports in its management,
4 personality and behavioral disorder was not associated with readmission. Compared to mood
5 disorder diagnoses, schizophrenia and delusion disorder were associated with lower
6 likelihood of readmissions in the first six months after the index admission. However,
7 previous findings showed that schizophrenia as a principle diagnosis was highly correlated to
8 ED presentation and psychiatric readmission within 30 days after index admission ¹². This
9 may be explained by the clustered code used in this study which combined the most common
10 psychiatric disorders such as depression and bipolar disorder into one category-mood
11 disorder and it represents 36% of the cohort. The association between length of stay at index
12 admission and ED presentations differed from that observed with readmission, and may have
13 related to the interaction of initial severity/complexity of presentation (determining index
14 admission length) and time-dependent factors such as subsequent clinical pathways. For
15 individuals experiencing first psychiatric admission, subsequent allocation of community
16 supports may be most cohesive for those with higher levels of complexity, for which length
17 of index admission may be a proxy. This could have mitigated representation to ED and early
18 rates of readmission. With time, it is possible that community supports become less cohesive
19 over time, and indeed a weakening of the relationship between length of index admission and
20 representation to ED was noted over time. Whilst the same mitigation was initially apparent
21 in the 1 month readmission data, this appeared to be swamped in subsequent time periods by
22 other factors. Although this is harder to explain, it is possible that those individuals with
23 greater complexity may have subsequently been more likely to present directly to psychiatric
24 inpatient facilities. This occurs in some jurisdictions in Australia for those who are more

1 acutely disturbed. The variable findings over time reaffirm the need to include longer time
2 intervals to gain insights into service trajectory.

3 Drug and alcohol related disorders as principle diagnoses was associated with lower
4 likelihood of psychiatric readmissions, and yet as a comorbid condition drug and alcohol
5 related diagnoses showed the highest association of all covariates with psychiatric
6 readmission and ED presentation across the time intervals. Only 14% of the cohort had a
7 principle drug and alcohol related diagnosis, whereas 41% of the cohort had a drug and
8 alcohol comorbidity in the ED data, suggesting that these two labels pick up different
9 presentations, in different contexts and with different clinical supports. In NSW, strong
10 emphasis is placed on the management of primary drug and alcohol diagnoses within specific
11 services which sit outside of mainstream mental health services, whereas those with mental
12 illness and drug and alcohol comorbidities are often managed jointly by mental health and
13 specific drug and alcohol services. The two highly correlated diagnoses of drug and alcohol
14 use and mental ill health are often referred to as dual diagnosis in mental health care⁴³. It is
15 understood that drug and alcohol comorbidity can lead to reductions of compliance with
16 psychiatric treatment, and as a result dual diagnosis are often managed in inpatient mental
17 health services³³. The strength of the association between drug and alcohol comorbidity and
18 ED presentation and psychiatric readmission suggests that drug and alcohol intervention
19 should not only occur early, but should be a sustained focus in healthcare. Drug and alcohol
20 comorbidity also had a stronger association with psychiatric readmission than ED
21 presentation; such a difference may be partially explained by the proportion of individuals
22 with complex needs being admitted to a psychiatric facility bypassing ED. However, more
23 research is needed to investigate the factors attributed to this distinctive service utilisation
24 pattern.

1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
16
17
18
19
20
21
22
23
24
25
26
27
28
29
30
31
32
33
34
35
36
37
38
39
40
41
42
43
44
45
46
47
48
49
50
51
52
53
54
55
56
57
58
59
60

1 Past studies⁴⁴ suggest that other comorbid conditions are strongly associated with
2 mental health service use and that multimorbidity is a significant risk factor for unplanned
3 hospital admission . Previous studies¹⁵ reported a high prevalence of physical comorbidity
4 among individuals with mental illness and we found that the Charlson comorbidity index
5 score had an opposite impact on ED presentation and psychiatric readmission. The Charlson
6 comorbidity index score is often used to predict mortality rate within a year⁴⁵. Individuals
7 with more severe physical comorbidities were understandably more likely to present to ED
8 and less likely to be readmitted to a psychiatric facility. The current study was unable to
9 investigate whether physical health comorbidities were related to the index admission or the
10 onset of a psychiatric illness. The findings do however suggest that an emphasis on tailored
11 and holistic healthcare is needed within both mental health services and primary healthcare
12 settings.

13 The presence of ID was persistently and strongly associtaed with ED presentation and
14 psychiatric readmission across the study period which is consistent with previous research³².
15 As reported elsewhere^{46 47}, the mental health system in Australia is not yet equipped to
16 provide comprehensive mental health supports for individuals with ID. Consistent with a
17 previous study¹⁴, the current study suggests that ID adds to complex support needs which
18 have a direct bearing on ED and inpatient mental health service use, above and beyond that
19 due to the mental illness alone . Unlike many physical conditions which an individual can
20 acquire at any point in time, ID is a permanent disability that is often identified at an early
21 stage in life. Our findings reaffirm that equipping mental health services to meet the mental
22 health needs of people with ID is useful and may assist in buffering the impact of this
23 disability on service use.

24 The significant associations between non-psychiatric hospitalisation, ED presentation
25 and psychiatric admissions, and the proportion of individuals admitted to a psychiatric

facility at index admission with a non-psychiatric diagnosis, suggest that strong relationships exist between each component of acute healthcare services. In line with observations made by social researchers, the strong relationship between different acute inpatient contacts suggest that individuals with complex support needs require the development of strong interdisciplinary frameworks to avoid becoming frequent users of acute services⁴⁸.

The distinctive focus on time intervals in this study revealed the changing needs of the cohort and specific windows of opportunity for intervention. The intervals revealed that while some factors such as area of residence and socioeconomic status strongly associated with ED presentation or psychiatric readmission within 30 days after the index admission, other only became significant in the later intervals such as length of stay at index admission. The change of direction of the association of principle diagnoses such as schizophrenia and delusion disorder and psychiatric readmission at different time intervals suggest that the service trajectories of individuals with different psychiatric disorders and symptoms can vary and that the 30 days readmission predictors may not capture such change. Further research should seek to explore in more detail the drivers and dynamics of fluctuations in service use over time.

Strengths and limitations

The current data-linkage study provides a comprehensive overview of factors associated with psychiatric readmissions and ED presentations. We investigated and controlled for a range of factors by linking government databases that cover all acute hospitals in NSW. We used a method to capture the first- psychiatric admission using administrative data by isolating two years for each included individual. There is a likelihood that the index admissions captured by our analyses included individuals who had previous admissions prior to July 2007. However, given that 60% of mental health service users in Australia had a mental health disorder lasting 12 months⁸ and a previous study⁴⁹ found that 66% of mental health users

1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
16
17
18
19
20
21
22
23
24
25
26
27
28
29
30
31
32
33
34
35
36
37
38
39
40
41
42
43
44
45
46
47
48
49
50
51
52
53
54
55
56
57
58
59
60

1 readmitted to a psychiatric facility within a year; it is unlikely that this has affected the
2 results. Although the current study used three different administrative databases to identify
3 individuals with ID, our separate cohort analysis showed that majority of the ID population
4 were identified through the disability dataset or multiple datasets, and only 4% of the ID
5 population in this dataset was identified by the admitted patient records and emergency
6 department data collection alone which is unlikely to influence the validity of ID status
7 identification⁴³.

8 A limitation of the current study is that the data collected by NSW Health are
9 administrative data rather than clinical data and thus lack potentially important clinical
10 information. We were unable to examine the severity of symptoms when admitted to the
11 hospital and its association with readmissions and ED presentation. As NSW APDC data are
12 collected on separation from the hospital, we were also unable to identify the very small
13 percentage of individuals who had an index admission during the study period and yet
14 remained in the facility throughout the study period. ID had a robust and persistent impact on
15 both ED presentation and psychiatric readmission; however, due to the limitation of the
16 research scope of this study, we did not further examine sub-groups of people with ID. The
17 results of the current study are a strong indicator of the unmet needs of the ID population.
18 Further research that examines sub-populations such as individuals with Autism, Down
19 syndrome and FAS within the ID population is needed to understand their needs. We also
20 acknowledge that a small proportion of individuals with borderline and mild ID may not be
21 identified in the ID cohort if they did not receive disability services previously.

22 **Conclusions**

23 This study provides important insights into the range of factors that are associated with acute
24 health services use after index psychiatric admission. We propose the following
25 recommendations to improve service integration: a stronger public health approach to address

the impact of social determinants on service utilisation, early intervention programs for dual diagnosis of mental illness and drug and alcohol comorbidity, an urgent response to address the unmet needs of individuals with ID and mental illness and a more holistic care approach to address comorbidity in the inpatient setting. In addition, more research is needed to understand the service trajectories of individuals with different psychiatric conditions beyond the commonly used 30 days interval. The results of the current study provide opportunities for researchers and policymakers to explore the complex nature of an often fragmented health system, and to build improved models which support early intervention and reduce burden on individuals and acute health services.

1 **Competing interests:** None declared.

2 **Patient consent:** No.

3 **Ethics approval**

4 Ethics approval was obtained from the NSW Population and Health Services Research Ethics
5 Committee (AU RED Study Reference Number: HREC/13/CIPHS/7; CINSW Reference
6 Number: 2013/02/446), and access to the data sets was granted by relevant data custodians.

7 **Provenance and peer review:** Not commissioned; externally peer reviewed.

8 **Data sharing statement:** No additional data are available.

Reference

1. Jacobi F, Wittchen H, Holting C, et al. Prevalence, co-morbidity and correlates of mental disorders in the general population: results from the German Health Interview and Examination Survey (GHS). *Psychological Medicine* 2004;34(4):597-611.

2. Whiteford H, Degenhardt L, Rehm J, et al. Global burden of disease attributable to mental and substance use disorders: findings from the Global Burden of Disease Study 2010. *Lancet* 2013;382(9904):1575-86. doi: 10.1016/S0140-6736(13)61611-6

3. Kalucy R, Thomas L, King D. Changing demand for mental health services in the emergency department of a public hospital. *Aust N Z J Psych* 2005;39(1-2):74-80.

4. Whiteford HA. Australia's national mental health policy. *Hospital & community psychiatry* 1993;44(10):963.

5. Whiteford H, Buckingham W. Ten years of mental health service reform in Australia: are we getting it right? *Medical Journal of Australia* 2005;182(8):396-400.

6. Allison S, Bastiampillai T. Mental health services reach the tipping point in Australian acute hospitals: The OECD warns about Australia's low psychiatric bed numbers. *Medical Journal of Australia* 2015;203(11):432-34. doi: 10.5694/mja15.00782

7. Jaramillo-Gonzalez L, Sanchez-Pedraza R, Herazo M. The frequency of rehospitalization and associated factors in Colombian psychiatric patients: a cohort study. *BMC Psychiatry* 2014;14 doi: 10.1186/1471-244X-14-161

8. Slade T JA, Teesson M, Whiteford H, Burgess P, Pirkis J, and Saw S. . The Mental Health of Australians 2. Report on the 2007 National Survey of Mental Health and Wellbeing. In: Ageing DoHa, ed. Canberra, 2009.

9. Lorine K, Schmidt K, Goenjian AK, et al. Risk factors associated with psychiatric readmission. *Journal of Nervous and Mental Disease* 2015;203(6):425-30. doi: 10.1097/NMD.0000000000000305

10. Régis Eric Maia B, João Mazzoncini de Azevedo M, Isabela Panzeri C, et al. Short admission in an emergency psychiatry unit can prevent prolonged lengths of stay in a psychiatric institution Internação breve em unidade de emergência psiquiátrica pode prevenir permanência prolongada em instituições psiquiátricas. *Revista Brasileira de Psiquiatria* 2010;32(2):145-51.

11. Loch AA. Stigma and higher rates of psychiatric re-hospitalization: Sao Paulo public mental health system. *Revista Brasileira de Psiquiatria* 2012;34(2):185-92.

12. Smith M, Stocks C, Santora P. Hospital Readmission Rates and Emergency Department Visits for Mental Health and Substance Abuse Conditions. *Community Mental Health Journal* 2015;51(2):190-97. doi: 10.1007/s10597-014-9784-x

13. Raudino A, Carr V, Bush R, et al. Patterns of service utilisation in psychosis: findings of the 2010 Australian National Survey of Psychosis. *Australian and New Zealand Journal of Psychiatry* 2014;48(4):341-51. doi: 10.1177/0004867413511996

14. Lunskey Y, Lin E, Balogh R, et al. Emergency Department Visits and Use of Outpatient Physician Services by Adults With Developmental Disability and Psychiatric Disorder. *Can J Psychiat-Rev Can Psychiat* 2012;57(10):601-07.

15. Parslow RA, Jorm AF. Who uses mental health services in Australia? An analysis of data from the National Survey of Mental Health and Wellbeing. *Australian and New Zealand Journal of Psychiatry* 2000;34(6):997-1008. doi: 10.1046/j.1440-1614.2000.00839.x

16. Billings J, Blunt I, Steventon A, et al. Development of a predictive model to identify inpatients at risk of re-admission within 30 days of discharge (PARR-30). *BMJ Open* 2012;2(4):e001667. doi: 10.1136/bmjopen-2012-001667

17. McGorry P. Early intervention in psychosis. *Aust N Z J Psych* 2006;40:A109-A09.

18. Shadmi E, Flaks-Manov N, Hoshen M, et al. Predicting 30-day readmissions with preadmission electronic health record data. *Medical Care* 2015;53(3):283-89.
19. van Walraven C, Dhalla I, Bell C, et al. Derivation and validation of an index to predict early death or unplanned readmission after discharge from hospital to the community. *Canadian Medical Association Journal* 2010;182(6):551-57. doi: 10.1503/cmaj.091117
20. Shadmi E, Flaks-Manov N, Hoshen M, et al. Predicting 30-Day Readmissions With Preadmission Electronic Health Record Data. *Med Care* 2015;53(3):283-89.
21. Lin C, Chen W, Lin CM, et al. PREDICTORS OF PSYCHIATRIC READMISSIONS IN THE SHORT- AND LONG-TERM: A POPULATION-BASED STUDY IN TAIWAN. *Clinics* 2010;65(5):481-89. doi: 10.1590/S1807-59322010000500005
22. Kadam UT, Lawson CA, Moody DK, et al. Consumer segmentation and time interval between types of hospital admission: a clinical linkage database study. *Journal of Public Health* 2017;1-9. doi: 10.1093/pubmed/fox028
23. Librero J, Peiró S, Ordinana R. Chronic Comorbidity and Outcomes of Hospital Care: Length of Stay, Mortality, and Readmission at 30 and 365 Days. *Journal of Clinical Epidemiology* 1999;52(3):171-79. doi: [https://doi.org/10.1016/S0895-4356\(98\)00160-7](https://doi.org/10.1016/S0895-4356(98)00160-7)
24. Tsao CI, Chou NK, Chi NH, et al. Unplanned Readmission Within 1 Year After Heart Transplantation in Taiwan. *Transplantation Proceedings* 2010;42(3):946-47. doi: <https://doi.org/10.1016/j.transproceed.2010.02.053>
25. Ono T, Tamai A, Takeuchi D, et al. Factors related to readmission to a ward for dementia patients: Sex differences. *Psychiatry Clin Neurosci* 2011;65(5):490-98. doi: 10.1111/j.1440-1819.2011.02251.x
26. The Centre for Health Record Linkage (CHeReL). How record linkage works 2016 [Available from: <http://www.cherel.org.au/how-record-linkage-works> accessed 26 October 2017.
27. World Health Organization. The ICD-10 Classification of Mental and Behavioural Disorders: Clinical Descriptions and Diagnostic Guidelines. Geneva: World Health Organization 1992.
28. Australian Bureau of Statistics. Socio-Economic Index for Areas: Australian Bureau of Statistics, 2013.
29. Charlson ME, Pompei P, Ales KA, et al. A new method of classifying prognostic comorbidity in longitudinal studies: Development and validation. *Journal of Chronic Diseases* 1987;40(5):373-83.
30. Australian Institute of Health and Welfare. Principal Diagnosis data cubes 2017 [Available from: <https://www.aihw.gov.au/reports/hospitals/principal-diagnosis-data-cubes/contents/data-cubes> accessed October 2017.
31. Quan HD, Sundararajan V, Halfon P, et al. Coding algorithms for defining comorbidities in ICD-9-CM and ICD-10 administrative data. *Medical Care* 2005;43(11):1130-39.
32. Lunskey Y, Balogh R, Cairney J. Predictors of emergency department visits by persons with intellectual disability experiencing a psychiatric crisis. *Psychiatric Services* 2012;63(3):287-90.
33. Regier D, Farmer M, Rae D, et al. Comorbidity of Mental Disorders with Alcohol and Other Drug Abuse: Results from the Epidemiologic Catchment Area (ECA) Study. *JAMA* 1990;264(19):2511.
34. Reppermund S, Srasuebku P, Heintze T, et al. Cohort profile: a data linkage cohort to examine health service profiles of people with intellectual disability in New South Wales, Australia. *BMJ Open* 2017;7(4)

1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
16
17
18
19
20
21
22
23
24
25
26
27
28
29
30
31
32
33
34
35
36
37
38
39
40
41
42
43
44
45
46
47
48
49
50
51
52
53
54
55
56
57
58
59
60

35. Turrell G, Oldenburg B, Harris E, et al. Utilisation of general practitioner services by socio-economic disadvantage and geographic remoteness. *Australian and New Zealand Journal of Public Health* 2004;28(2):152-58.

36. Narrow W, Regier D, Norquist G, et al. Mental health service use by Americans with severe mental illnesses. *Social Psychiatry and Psychiatric Epidemiology* 2000;35(4):147-55.

37. Alegria M, Bijl R, Lin E, et al. Income differences in persons seeking outpatient treatment for mental disorders - a comparison of the United States with Ontario and the Netherlands. *Archives of General Psychiatry* 2000;57(4):383-91.

38. Vasiliadis H-M, Lesage A, Adair C, et al. Do Canada and the United States differ in prevalence of depression and utilization of services? *Psychiatric Services* 2007;58(1):63-71.

39. Australian Institute of Health and Welfare. Australian hospital statistics 2007-08 Canberra: AIHW; 2009 [updated 12 January 2017; cited 2017 12 January]. Available from: <http://www.aihw.gov.au/publication-detail/?id=6442468249> accessed 02 February 2017.

40. Hadley J. Insurance coverage, medical care use, and short-term health changes following an unintentional injury or the onset of a chronic condition. *JAMA* 2007;297(10):1073-84.

41. Wilks CM, Browne M, Jenner B. Attracting psychiatrists to a rural area - 10 years on. *Rural Remote Health* 2008;8(1):824.

42. Haq SU, Subramanyam D, Agius M. Assessment of self harm in an accident and emergency service - the development of a proforma to assess suicide intent and mental state in those presenting to the emergency department with self harm. *Psychiatria Danubina* 2010;22 Suppl 1:S26-32. [published Online First: 2011/02/08]

43. Donald M, Dower J, Kavanagh D. Integrated versus non-integrated management and care for clients with co-occurring mental health and substance use disorders: A qualitative systematic review of randomised controlled trials. *Social Science and Medicine* 2005;60(6):1371-83. doi: 10.1016/j.socscimed.2004.06.052

44. Lay B, Lauber C, Rossler W. Prediction of in-patient use in first-admitted patients with psychosis. *European Psychiatry* 2006;21(6):401-09. doi: 10.1016/j.eurpsy.2005.12.004

45. Quan H, Li B, Couris CM, et al. Updating and Validating the Charlson Comorbidity Index and Score for Risk Adjustment in Hospital Discharge Abstracts Using Data From 6 Countries. *American Journal of Epidemiology* 2011;173(6):676-82. doi: 10.1093/aje/kwq433

46. Howlett S, Florio T, Xu H, et al. Ambulatory mental health data demonstrates the high needs of people with an intellectual disability: results from the New South Wales intellectual disability and mental health data linkage project. *Australian and New Zealand Journal of Psychiatry* 2015;49(2):137-44. doi: 10.1177/0004867414536933

47. Chaplin R. Mental health services for people with intellectual disabilities. *Current Opinion in Psychiatry* 2011;24(5):372-6.

48. Keene J. Clients with Complex Needs: Interprofessional Practice. Oxford: Blackwell Science 2001.

49. Wheeler A, Moyle S, Jansen C, et al. Five-year follow-up of an acute psychiatric admission cohort in Auckland, New Zealand. *New Zealand Medical Journal* 2011;124(1336):<xocs:firstpage xmlns:xocs=""/>.

STROBE 2007 (v4) checklist of items to be included in reports of observational studies in epidemiology*

Checklist for cohort, case-control, and cross-sectional studies (combined)

Section/Topic	Item #	Recommendation	Reported on page #
Title and abstract	1	(a) Indicate the study’s design with a commonly used term in the title or the abstract	2
		(b) Provide in the abstract an informative and balanced summary of what was done and what was found	2
Introduction			
Background/rationale	2	Explain the scientific background and rationale for the investigation being reported	5
Objectives	3	State specific objectives, including any pre-specified hypotheses	6,7
Methods			
Study design	4	Present key elements of study design early in the paper	8
Setting	5	Describe the setting, locations, and relevant dates, including periods of recruitment, exposure, follow-up, and data collection	8,9
Participants	6	(a) Cohort study—Give the eligibility criteria, and the sources and methods of selection of participants. Describe methods of follow-up Case-control study—Give the eligibility criteria, and the sources and methods of case ascertainment and control selection. Give the rationale for the choice of cases and controls Cross-sectional study—Give the eligibility criteria, and the sources and methods of selection of participants	9
		(b) Cohort study—For matched studies, give matching criteria and number of exposed and unexposed Case-control study—For matched studies, give matching criteria and the number of controls per case	9
Variables	7	Clearly define all outcomes, exposures, predictors, potential confounders, and effect modifiers. Give diagnostic criteria, if applicable	9
Data sources/ measurement	8*	For each variable of interest, give sources of data and details of methods of assessment (measurement). Describe comparability of assessment methods if there is more than one group	10,11
Bias	9	Describe any efforts to address potential sources of bias	10
Study size	10	Explain how the study size was arrived at	9
Quantitative variables	11	Explain how quantitative variables were handled in the analyses. If applicable, describe which groupings were chosen and why	10
Statistical methods	12	(a) Describe all statistical methods, including those used to control for confounding	10
		(b) Describe any methods used to examine subgroups and interactions	11
		(c) Explain how missing data were addressed	
		(d) Cohort study—If applicable, explain how loss to follow-up was addressed Case-control study—If applicable, explain how matching of cases and controls was addressed	

		<i>Cross-sectional study</i> —If applicable, describe analytical methods taking account of sampling strategy	
		(e) Describe any sensitivity analyses	
Results			
Participants	13*	(a) Report numbers of individuals at each stage of study—eg numbers potentially eligible, examined for eligibility, confirmed eligible, included in the study, completing follow-up, and analysed	13
		(b) Give reasons for non-participation at each stage	13
		(c) Consider use of a flow diagram	
Descriptive data	14*	(a) Give characteristics of study participants (eg demographic, clinical, social) and information on exposures and potential confounders	13,14
		(b) Indicate number of participants with missing data for each variable of interest	13
		(c) <i>Cohort study</i> —Summarise follow-up time (eg, average and total amount)	
Outcome data	15*	<i>Cohort study</i> —Report numbers of outcome events or summary measures over time	15,22
		<i>Case-control study</i> —Report numbers in each exposure category, or summary measures of exposure	
		<i>Cross-sectional study</i> —Report numbers of outcome events or summary measures	
Main results	16	(a) Give unadjusted estimates and, if applicable, confounder-adjusted estimates and their precision (eg, 95% confidence interval). Make clear which confounders were adjusted for and why they were included	15-28
		(b) Report category boundaries when continuous variables were categorized	
		(c) If relevant, consider translating estimates of relative risk into absolute risk for a meaningful time period	
Other analyses	17	Report other analyses done—eg analyses of subgroups and interactions, and sensitivity analyses	
Discussion			
Key results	18	Summarise key results with reference to study objectives	29
Limitations	19	Discuss limitations of the study, taking into account sources of potential bias or imprecision. Discuss both direction and magnitude of any potential bias	32
Interpretation	20	Give a cautious overall interpretation of results considering objectives, limitations, multiplicity of analyses, results from similar studies, and other relevant evidence	29-33
Generalisability	21	Discuss the generalisability (external validity) of the study results	32-33
Other information			
Funding	22	Give the source of funding and the role of the funders for the present study and, if applicable, for the original study on which the present article is based	35

*Give information separately for cases and controls in case-control studies and, if applicable, for exposed and unexposed groups in cohort and cross-sectional studies.

Note: An Explanation and Elaboration article discusses each checklist item and gives methodological background and published examples of transparent reporting. The STROBE checklist is best used in conjunction with this article (freely available on the Web sites of PLoS Medicine at <http://www.plosmedicine.org/>, Annals of Internal Medicine at <http://www.annals.org/>, and Epidemiology at <http://www.epidem.com/>). Information on the STROBE Initiative is available at www.strobe-statement.org.

TITLE:

Emergency department presentation and readmission after index psychiatric admission:
a data linkage study

RUNNING TITLE:

Acute care re-presentations following index mental health admission

AUTHORS

Xue Li¹, Preeyaporn Srasuebkul¹, Simone Reppermund^{1,2}, Julian Trollor^{1,2}

¹ Department of Developmental Disability Neuropsychiatry, School of Psychiatry,
UNSW Sydney, Australia

² Centre for Healthy Brain Ageing, School of Psychiatry, UNSW Sydney, Australia

CORRESPONDING AUTHOR:

Professor Julian Trollor, Department of Developmental Disability Neuropsychiatry,
School of Psychiatry, 34 Botany Street, UNSW Sydney, Sydney NSW 2052, Australia.

Email: j.trollor@unsw.edu.au

1 **Abstract**

2 **Objective:** To use linked administrative datasets to assess factors associated with
3 Emergency Department (ED) presentation and psychiatric readmission in three
4 distinctive time intervals after the index psychiatric admission.

5 **Design:** A retrospective data-linkage study.

6 **Setting:** ~~Population-based~~Cohort study using four linked government minimum datasets
7 including acute hospital care from July 2005 to June 2012 in New South Wales,
8 Australia.

9 **Participants:** People who were alive and aged ≥ 18 years on 01 July 2005 and who had
10 their index admission to a psychiatric ward from 01 July 2007 to 30 June 2010.

11 **Outcome measures:** Odds ratios of factors associated with psychiatric admission and
12 ED presentation were calculated for three intervals: 0-1 month, 2-5 months, and 6-24
13 months after the separation from the index admission.

14 **Results:**

15 Index admission was identified in 35,056 individuals (51% males) with a median age of
16 42 years. A total of 12,826 (37%) individuals had at least one ED presentation in the
17 first 24 months after the index admission. Of those, 3,608 (28%) presented within 0-1
18 month, 6,350 (50%) within 2-5 months and 10,294 (80%) within 6-24 months after
19 index admission. A total of 14,153 (40%) individuals had at least one psychiatric
20 readmission in the first 24 months. Of those, 6,808 (48%) were admitted within 0-1
21 month, 6,433 (45%) within 2-5 months and 7,649 (54%) within 6-24 months after index
22 admission. Principle diagnoses and length of stay at index admission, sociodemographic
23 factors, Charlson comorbidity index score, drug and alcohol comorbidity, intellectual

disability and other inpatient service utilisation were significantly associated with ED presentations and psychiatric readmissions.

Conclusion:

Social determinants of service utilisation, drug and alcohol intervention and addressing needs of individuals with intellectual disability are key areas for investment to improve trajectories after index admission and should be emphasised in recovery-oriented approaches in mental health care.

Results:

~~Index admission was identified in 35,056 individuals (51% males) with a median age of 42 years. A total of 12,826 (4537%) individuals with had at least one ED presentation in the first 24 months after the index admission. Of those, 3608 (23%) presented within 0-1 month, 6,350439 (40%) within 2-5 months and 10,294436 (8064%) within 6-24 months after index admission. A total of 14,153523 (450%) individuals with had at least one psychiatric readmission in the first 24 months. Of those, 81106,808 (56%) were admitted within 0-1 month, 6,433539 (45%) within 2-5 months and 7,649740 (53%) within 6-24 months after index admission. Principle sociodemographic factors, comorbidity and other inpatient service utilisation were significantly associated with ED presentations and psychiatric readmissions. In particular, drug and alcohol comorbidity was associated with increased psychiatric readmissions in the last two intervals and intellectual disability with increased ED presentations and psychiatric readmissions across all intervals.~~

Conclusion:

~~Social determinants of service utilisation, early drug and alcohol intervention and addressing the unmet needs of individuals with intellectual disability and mental illness~~

1 Introduction

Mental illness is one of the leading cause of disability in most developed countries^{1,2}. Building a mental health system that cohesively supports individuals with severe mental illness is a challenge for mental health services in many countries. Despite enhancements in community psychiatric supports, demand for acute services for people with mental ill health remains high, as evidenced by escalating use of Emergency Departments (ED)³ and high demand for acute psychiatric inpatient services⁴⁻⁶. Most acute psychiatric episodes of care are by repeat users^{7,8}. Thus, the development of a clear understanding of the drivers of ED utilisation and psychiatric readmission for those with mental illness is of potential benefit to mental health consumers, service providers and health service administrators.

Administrative data can provide substantial insights to the factors associated with mental health service use. Factors such as sociodemographic factors, specific psychiatric conditions, comorbidities, and characteristics of previous hospital admissions all have significant impacts on mental health related service use⁹⁻¹². For example, the 2010 Australian National Survey of Psychosis¹³ revealed that being younger, having high severity of psychotic symptoms, and poor social functioning were associated with greater mental health service use. Another US study found among individuals with a mental health or substance abuse diagnosis psychiatric conditions such as schizophrenia and affective disorders not only increase the likelihood of psychiatric readmission, they were also found to be predictors of ED presentations¹². Other strong predictors with a robust and reciprocal impact on both ED use and psychiatric service use are comorbid conditions including physical and psychiatric comorbidity, cognitive and psychiatric comorbidity, intellectual disability (ID) and drug

and alcohol comorbid conditions^{14 15}. For example, a Canadian¹⁴ study found that individuals with ID and mental illness were more likely to have ED presentations and psychiatric admissions when comparing to individuals with ID only and mental illness only. Research relating to specific factors associated with acute mental health service use and ED use after index psychiatric admission has yet to be undertaken.

Rising demand for acute healthcare services and the substantial costs associated with repeat acute healthcare emphasise the importance of cohesive mental health supports and early intervention¹⁶. Within the mental health context, the first psychotic episode is well recognised as a key opportunity for intervention with early engagement in recovery oriented support resulting in demonstrated improvements in outcome¹⁷, however this concept has broader relevance for a range of mental disorders. For many individuals, index admission represents a sentinel opportunity for mobilisation of first episode supports, yet little is known about service system trajectories after first admission. Understanding drivers of re-presentation to acute psychiatric services will help to develop services appropriate to needs with their index admission, will enable potential strategies to improve service efficiency^{18 19}, and will potentially improve outcomes for affected individuals.

To date, emphasis has been placed on early readmission rates such as readmission within 28 days or 30 days as indicators of acute care service efficiency²⁰. However, predictors of readmission can be different at different time intervals following discharge²¹. A recent study by Kadam et al (2017)²² of acute healthcare service use and unplanned hospital admissions suggests that future research should include longer readmission intervals. Time intervals such as 6, 12 and 24 months after an admission have been used by various studies to gain a more comprehensive perspective on the

service trajectory of a cohort^{21 23-25}. It is likely that sociodemographic factors and physical and mental health comorbidities may interact to produce increasing complexity over time, with associated increases in the likelihood of re-presentation to acute services. Thus, examination of the factors associated with acute mental health service use over several intervals, and for a substantial time period, is an important step in development of comprehensive understanding of the drivers of service use.

Population health administrative records in Australia provide an opportunity to examine acute health services use and their determinants. The current study aims to identify the factors associated with acute care service use following index psychiatric admission. Doing so will provide an opportunity to understand drivers of acute service use in this context, and to better plan services and policy responses which underpin recovery from an initial mental health episode. To understand the dynamics of acute service use we examined the factors associated with psychiatric readmissions and ED presentation in three distinctive time intervals: from discharge to 1 month, from 2 to 5 months (short-term), and from 6 to 24 months (medium-term) after the index admission. We hypothesised that the principle psychiatric diagnoses at index admission, sociodemographic factors, comorbid conditions and non-psychiatric admissions would have a significant association with ED presentations and psychiatric readmissions and that predictors of these may vary over time.

1 **Methods**

2 ***Datasets and record linkage***

3 Four linked datasets were used to define the cohort and/or exposure in this study. De-
4 identified linkage was performed by the New South Wales Centre for Health Record
5 Linkage based on a statistical linkage key (SLK581)²⁶. In accordance with best
6 practice privacy preserving protocols, the linked unit record data was provided to the
7 researchers after removal of personal identifiers. The databases contained data collected
8 from 1 July 2005 to 30 June 2012 in NSW. The databases used in this analysis were the
9 following:

10 The Admitted Patient Data Collection (APDC) contains information on all
11 admissions to public and private hospitals in NSW including psychiatric facilities. It
12 also contains information on psychiatric, drug and alcohol and intellectual disability
13 diagnoses. Diagnoses in this data collection were coded in the International Statistical
14 Classification of Diseases and Related Health Problems, Tenth Revision, Australian
15 Modification (ICD-10-AM)²⁷.

16 The Emergency Department Data Collection (EDDC) contains information on
17 emergency department (ED) presentations at NSW public hospitals.

18 The Disability Services Minimum Dataset (DS MDS) is a state service data
19 collection scheme that is collected by a disability administrator in each Australian
20 jurisdiction. It contains information on intellectual disability diagnosis, which was used
21 in conjunction with the APDC and EDDC to identify intellectual disability status.

22 The Registry of Birth Death and Marriage (RBDM) contain registration of
23 death information, which was used to determine the period of exposure for this study.

1

2 ***Study population***

3 We included people who were alive and aged ≥ 18 years on 01 July 2005 and who were
4 admitted to a psychiatric ward within the period of 01 July 2007 to 30 June 2010.
5 Information regarding admission to and a separation from a psychiatric ward was
6 obtained from the APDC record.

7 Data on admissions to a psychiatric ward was available from 2005-2012.
8 However, to capture an approximation of the potential first psychiatric admission, we
9 defined the index admission as being the first psychiatric admission of an individual
10 between 01 July 2007 and 30 June 2010, following exclusion of those individuals who
11 were admitted prior to 01 July 2007. We also excluded individuals who had their first
12 admissions after 30 June 2010 to ensure appropriate follow-up period. The index
13 admission started at the date of the first admission to the psychiatric facility and ended
14 when the separation was noted, index separation.

15 Three different intervals were used in the study: i) 0-1 Month: this interval
16 started at the date of the index separation to the 29th day after the index separation date;
17 ii) 2-5 months: this interval started on the 30th day after the index separation to the
18 29th day of month 5; iii) ~~6~~ 6-24 months: this interval started at the 30th day of the 5th
19 month after the index separation date to the 29th day of month 23.

20 ***Outcome measures***

21 There were two outcomes in this study, ED presentations and readmission to a
22 psychiatric facility after the index separation. We considered patients who had any
23 records of being admitted to a psychiatric facility after the index separation in each time
24 interval as having a readmission to a psychiatric facility in the specific period.

Similarly, patients who had any records of ED presentations after the index separation in each time interval were considered as having an ED presentation outcome. An individual could have more than one type of outcome and could have multiple admissions within one interval and across the time span.

Statistical analysis

Logistic regression was used to examine the factors associated with psychiatric admission and ED presentation for the three intervals – 0 to 1 month, 2 to 5 months, and 6 to 24 months after the index separation. Covariates included age, sex, the Index of Relative Socioeconomic Disadvantage (IRSD)²⁸, remoteness area, principle psychiatric diagnoses at index admission, length of stay at index admission, Charlson comorbidity index score²⁹, ID status, and drug and alcohol comorbidity.

The principal diagnosis was defined as the condition mainly responsible for a patient's episode of care in hospital³⁰. Principle psychiatric diagnoses at the index admission were identified using ICD-10-AM from the APDC dataset recorded at index admission. The codes from F00-F99 were grouped into 6-7 categories: organic mental health disorder (F00-F09); drug and alcohol related disorder (F10-F19); schizophrenia, schizotypal and delusion disorder (F20-F29); mood disorder (F30-F39); anxiety and stress related disorder (F40-48); disorders of adult personality and behavior (F60-F69); All other F codes were coded as other psychiatric disorders. Individuals who were given non-psychiatric codes were coded as not having a psychiatric disorder. The length of stay at index admission was calculated from the admission day to the separation day. Same day admission was considered as one day.

Comorbidity scores in each interval were calculated using the modified Charlson comorbidity index score^{29 31} and included heart condition, pulmonary disorder, peptic

ulcer, liver disease, diabetes, paraplegia, renal disease, and cancer. These conditions were identified from the APDC using ICD-10 codes, ~~and are detailed in Supplementary Table 1. We created a binary variable for each condition, set to 0 when an individual was not admitted for the condition and to 1 when an individual was admitted for the condition in each time interval. We excluded physical conditions with small sample size from the analyses, the excluded conditions were connective tissue disease and human immunodeficiency virus (HIV).~~ In addition to the ~~Charlson~~ comorbidity index, we examined two comorbidities, drug and alcohol and intellectual disability status, which were known to be highly associated with psychiatric readmissions or ED presentations³².

For drug and alcohol comorbidity, we identified the variable differently for each of the psychiatric readmission and ED presentation outcomes. In the psychiatric readmission outcome, when the episodes occurred outside psychiatric facility, we included all episodes where drug and alcohol appeared in one of the recorded diagnoses. An episode that occurred in a psychiatric facility where drug and alcohol codes were given as a principle diagnosis were excluded to ensure the included condition was not an outcome variable. For the ED presentation outcome, we included any hospital episodes where drug and alcohol appeared in one of the diagnoses regardless of where the admission happened. Consistent with our previous approach, we identified ID with codes including: childhood disintegrative and overactive disorders associated with mental retardation; intellectual development delay; mild through profound mental retardation; Down syndrome and other chromosomal anomalies associated with mental retardation; Fragile X syndrome and congenital malformation syndromes due to known exogenous causes³⁴. The value of the ID flag was set to 1 throughout the study period

for everyone who had any records with the relevant codes and set to 0 for everyone who did not have such a record. We also defined a binary variable representing any non-psychiatric hospital episodes for each individual using the APDC dataset. All other variables including age, sex, IRSD, and remoteness of area were identified through the patient record from DS MDS, APDC, and EDDC. Age was a time dependent variable, it was recalculated at each time interval. Age was categorised into three groups: young adults (18-35 years); middle aged adults (36-55 years); older adults (56+).

All statistical analyses were completed with STATA, version 14.0. Odds ratios (ORs) with 95% confidence intervals (CI) were reported, and the threshold for statistical significance was set at $p < .05$.

Ethics approval

Ethics approval was obtained from the NSW Population and Health Services Research Ethics Committee (PHSREC) (CINSW Reference Number 2013/02/446).

Results

Cohort characteristics

There were 115,189 individuals with at least one psychiatric admission from July 1, 2005 to June 30, 2012. Of these, a total of 35,056 individuals met inclusion criteria for the study. Of the 80,133 excluded individuals, 65,812 were excluded for not having their first record admission between 01 July 2007 and June 30, 2010; 13,116 were excluded due to being under the age of 18 years on 01 July 2005; 111 were excluded for having an unknown area of residence and/or IRSD; and 1,094 individuals died before the study period. For those meeting inclusion criteria, half of the population was males with the median and Interquartile Range (IQR) of age at the beginning of the study period of 38 years (28–50 years) and at index admission, 42 years (32–54 years). The majority of people in our cohort lived in the major cities (76%), 16% lived in the most disadvantaged area and 22% lived in the least disadvantaged area. Mood disorders accounted for over a third of principle diagnoses for the index admission (36%); followed by anxiety and stress related psychiatric disorder (21%), while disorders of adult personality and behavior accounted for 3%. One percent of people in our cohort were coded as not having a psychiatric disorder. The median (IQR) length of stay at index admission was 9 days (2-21 days). Percentages of drug and alcohol use were 41% and 22% for the ED presentation outcome and psychiatric readmission, respectively. People with intellectual disability represented 3% of the cohort (Table 1).

1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
16
17
18
19
20
21
22
23
24
25
26
27
28
29
30
31
32
33
34
35
36
37
38
39
40
41
42
43
44
45
46
47
48
49
50
51
52
53
54
55
56
57
58
59
60

Table 1. Cohort characteristics. N (%) unless otherwise stated.

	Total
Number of people	35,056 (100)
Male	17,822 (51)
Median (IQR) age, years	
At July 2005	38 (28-50)
At index admission	42 (32-54)
<u>Median (IQR) length of stay at index admission, days</u>	<u>9 (2-21)</u>
Remoteness Area	
Major Cities	26,468 (76)
Inner Regional	6,778(19)
Outer Regional/ Remote/ Very Remote	1,810 (5)
Index of Relative Socioeconomic Disadvantage (IRSD)	
1-2 most disadvantaged	5,686 (16)
3-4	5,655 (16)
5-6	8,644 (25)
7-8	7,332 (21)
9-10 least disadvantaged	7,739 (22)

Principle diagnoses at index admission

Mood disorder	12,712 (36)
Schizophrenia and delusion	70036,998 (20)1,055(3)
Disorder of adult personality and behavior	1,0576 (3)5,070 (15)
Drug and alcohol	5,08370 (14)5
Anxiety and stress related psychiatric disorder	7,3673 (214)
Organic psychiatric disorder	667
	(2)8,771(25)
Other psychiatric disorder	740 (2)455 (1)
Not psychiatric disorder	455 (1)

Comorbidity

Heart Conditions	1,216 (3)
Pulmonary Disease	1,366 (4)
Peptic ulcers	222 (1)
Liver conditions	261 (1)
Diabetes	880 (2)
Paraplegia	277 (1)
Renal Disease	532 (1)
Cancer	425 (1)
Drug and Alcohol (for psychiatric admission)	14,3656,475 (2241)
Drug and alcohol (for ED endpoint)	7,69413,858 (2241)
Intellectual Disability	899 (3)

1 *Factors associated with ED presentations and psychiatric readmissions after the*
2 *index admission*

3 ED presentation. 12,826- (37%) individuals had at least one ED presentation in the 24
4 months after index admission. Of those, 3,608 (28%) had ED presentations in the first
5 month after the index admission and 6,350 (50%) and 10,294 (80%) individuals had ED
6 presentations in the intervals of 2-5 months and 6-24 months after the index admission,
7 respectively. The median time (IQR) to an ED presentation after the index admission
8 was 107 (24-296) days.

9 Table 2 reports the odds ratios, confident intervals and p values of the factors
10 associated with ED presentations after the index separation in the three intervals. Males
11 were less likely to present to ED in the 2 to 5 months and 6 to 24 months intervals
12 compared to females. Compared to young adults (18–35 years), individuals who were
13 middle aged and older were both significantly less likely to present to an ED after the
14 index separation across all intervals. Area of residence also showed a consistent
15 association with ED presentation. Compared to individuals who lived in major cities,
16 individuals who lived in inner regional areas had moreincreased likelihood of -ED
17 presentations after the index admission across all intervals. Individuals who lived in
18 outer regional areas had morewere more likely to have ED presentations in the first
19 month after the index separation compared to those who lived in major cities. Area
20 socioeconomic status had a considerable bearing on ED presentation such that those

1 who lived in the least socioeconomic disadvantaged areas were less likely to present to
2 an ED after the index separation than those who lived in the most disadvantaged areas
3 across all intervals.

4 The principle diagnosis given at the index psychiatric admission had a significant
5 association with ED presentations. Compared to mood disorders, disorders of adult
6 personality and behavior were consistently associated with elevated ED presentations
7 across the three intervals. Those individuals who were coded as not a psychiatric
8 disorder at index admission had lower likelihood of ED presentations across the time
9 interval compared to individuals with a mood disorder diagnoses. Longer length of stay
10 at index admission reduced the likelihood of ED presentations across the study period.

11 Comorbidity had an incremental association with ED presentation after the index
12 separation. Comparing to individuals with no other physical illness (Charlson
13 comorbidity index score of 0) recorded, individuals with a Charlson comorbidity index
14 score of 1 to 3 were more likely to present to an ED across the 3 intervals. Having a
15 Charlson comorbidity index score of 4 to 6 and 7 or more was associated with greater
16 likelihood of ED presentation in the last 2 intervals. Intellectual disability had a
17 consistent and robust association with ED presentation following the index admission
18 across all intervals. The association between drug and alcohol comorbidity and ED
19 presentation increased as time progressed.

1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
16
17
18
19
20
21
22
23
24
25
26
27
28
29
30
31
32
33
34
35
36
37
38
39
40
41
42
43
44
45
46
47
48
49
50
51
52
53
54
55
56
57
58
59
60

1 Non-psychiatric hospitalisations were associated with ED presentations across
2 all intervals; however, the strongest association was in the first month after the index
3 admission and the odds ratios decreased with time.
4 (Table 2: Factors associated with Emergency department (ED) presentation after the
5 index admission)

Table 2. Factors associated with ED presentation after the index admission.

Variable	One month (N =35,056)			Two to five months (N = 34,955)			Six months to twenty four months (N = 34,643)		
	Odds Ratio	95% CI	p-value	Odds Ratio	95% CI	p-value	Odds Ratio	95% CI	p-value
Gender									
Female	Ref			Ref			Ref		
Male	0.9593	0.887-1.002	0.145066	0.9091	0.86-0.970.84-0.95	<0.0010.003	0.957	0.90-1.000.92-1.02	0.04770.254
Age category			<0.001			<0.001			<0.001
Young adults (18-35 years)	Ref			Ref			Ref		
Middle aged adults (36-55 years)	0.8385	0.7977-0.920	<0.001<0.001	0.8786	0.810-0.931	<0.001<0.006	0.832	0.78-0.878	<0.001
Older adults (56+)	0.7164	0.6457-0.8071	<0.001	0.7166	0.6561-0.7872	<0.001	0.647	0.6259-0.7269	<0.001
Remoteness Area			<0.001			<0.001			0.113
Major cities	Ref			Ref			Ref		
Inner/Regional	1.23	1.132-1.354	<0.001	1.38	1.28-1.48	<0.001	1.43	1.34-1.532	<0.001
Outer/Regional/Remote/ Very Remote	1.224	1.054-1.421	0.01146	1.056	0.93-92-1.219	0.507392	1.065	0.95-1.19.93-1.17	0.309444
Index of Relative Socioeconomic Disadvantage (IRSD)			<0.001			<0.001			<0.001
1-2 Most Disadvantaged	Ref			Ref			Ref		

3-4		0.9190	0.8180-1.021	0.086107	1.024	0.932-1.12	0.769674	1.02	0.94-1.11	0.950629
5-6		0.9493	0.854-1.054	0.215272	0.965	0.8886-1.052	0.259341	1.010	0.943-1.089	0.667767
7-8		0.8684	0.765-0.965	0.00904	0.743	0.674-0.8178	<0.001	0.776	0.710-0.83	<0.001
9-10	Least Disadvantaged	0.6463	0.575-0.7371	<0.001	0.52	0.467-0.578	<0.001	0.598	0.534-0.634	<0.001
Principle Psychiatric Diagnosis at Index Admission				<0.001			<0.001			<0.001
Mood disorder		Ref			Ref			Ref		
Schizophrenia and delusion		0.9989	0.880-1.10099	0.036794	1.04098	0.950-1.1306	0.566379	1.1407	1.060-1.2315	<0.0010.050
Disorder of adult personality and behavior		1.6141	1.1835-1.6993	<0.001	1.6483	1.5741-1.91212	<0.001	1.5065	1.3043-1.7289	<0.001<0.001
Drug and Alcohol related disorder		0.91097	0.816-1.0209	0.62113807	1.00940	0.8591-1.1403	0.157999	0.8084	0.73-78-0.8691	<0.001
Anxiety and stress related disorder		1.05	0.95-1.16	0.1860.331	1.06	0.98-1.15	0.148	0.95	0.89-1.02	0.153
Organic brain psychiatric disorders		1.241	0.953-1.5762	0.15941	1.21	0.97-1.50	0.092	1.41	1.16-1.70	<0.001
Other psychiatric disorder		1.20097	0.75-1.25110-1.32	<0.0010.809	0.76116	1.070.61-0.95125	<0.0010.016	0.77105	0.64-0.9298-1.12	0.1420.005
Not psychiatric disorder		0.023	0.00-0.1420	<0.001	0.1113	0.067-0.1923	<0.001	0.141	0.097-0.2172	<0.001
Length of stay at index admission		0.83	0.80-0.85	<0.001	0.87	0.85-0.89	<0.001	0.88	0.87-0.90	<0.001

21

Charlson comorbidity Index Score		<0.001			<0.001			<0.001		
0	Ref				Ref			Ref		
1-3	2.38	1.82-3.13	<0.001		3.24	2.70-3.90	<0.001	2.34	2.05-2.67	<0.001
4-6	3.92	1.60-9.63	0.003		3.81	1.96-7.38	<0.001	2.88	1.97-4.22	<0.001
7+	0.95	0.33-2.78	0.927		2.50	1.44-4.34	0.001	2.14	1.52-3.00	<0.001
Other comorbidity										
Heart condition	2.52	1.67-3.80	<0.001		2.75	2.05-3.68	<0.001	2.01	1.65-2.45	<0.001
Pulmonary disorder	1.12	0.84-1.49	0.451		2.02	1.52-2.68	<0.001	1.98	1.64-2.39	<0.001
Peptic ulcer	1.76	0.64-5.03	0.271		1.15	0.50-2.65	0.698	1.84	1.14-2.96	0.012
Liver disease	1.87	1.05-3.33	0.033		4.40	2.32-8.33	<0.001	1.82	1.22-2.73	0.004
Diabetes	1.19	0.89-1.58	0.239		2.46	1.81-3.33	<0.001	1.86	1.43-2.41	<0.001
Paraplegia	1.76	0.90-3.43	0.100		2.14	1.18-3.89	0.013	1.81	1.19-2.75	0.005
Renal disease	2.03	1.37-3.02	<0.001		2.25	1.46-3.45	<0.001	1.91	1.42-2.56	<0.001
Cancer	0.97	0.46-2.05	0.933		1.71	1.06-2.78	0.029	1.56	1.15-2.13	0.005
Drug and Alcohol	1.77	1.63-1.93	1.61-1.91	<0.001	4.75	4.37-5.16	<0.001	5.45	5.11-5.90	<0.001
Intellectual Disability	2.93	2.49-3.45	2.56-3.58	<0.001	3.00	2.58-3.47	<0.001	2.94	2.54-3.40	<0.001

Non-psychiatric hospitalisation	3.07 <u>2.87</u>	2.72 <u>3.46</u>	2.53 <u>3.26</u>	<0.001	2.00 <u>2.0</u> 9	1.84 <u>2.18</u> 1.92 <u>2.28</u>	<0.001	1.67 <u>65</u>	1.55 <u>7</u>	1.77 <u>5</u>	<0.001
------------------------------------	-----------------------------	-----------------------------	-----------------------------	--------	---------------------------------	--	--------	---------------------------	--------------------------	--------------------------	--------

For peer review only

Psychiatric readmissions. In the study period, 14,153 (40%) individuals had at least one psychiatric admission in the 24 months after the index admission. Of those, there were 6,808 (48.4%) individuals with readmissions in the first month, 6,433 (45.5%) individuals with readmissions 2-5 months after the index admission and 7,649 (54.0%) with readmissions 6-24 months after the index admission. The median (IQR) time to a psychiatric admission after the index admission was 36 (4-209) days.

Table 3 reports the odds ratios, confidence intervals and *p* values of the factors associated with psychiatric readmissions. Males were consistently less likely to be readmitted to a psychiatric facility compared to females. Compared to young adults (18-35 years), older adults (56 years and above) and individuals aged between 35 and 55 were more likely to be readmitted for 0-1 months and 2-5 months periods after the index separation. Individuals who lived in the outer regional, remote, and very remote areas were less likely to have a psychiatric admission after the index separation than individuals who lived in major cities. A similar effect was observed for individuals who lived in inner regional areas compared to individuals who lived in major cities. Individuals who lived in the least disadvantaged area were more likely to be readmitted to a psychiatric facility than individuals who lived in the most disadvantaged area.

Principal psychiatric diagnosis at index admission was associated with psychiatric admission. Compared to mood disorders, both schizophrenia and delusion disorder and organic psychiatric disorder had a persistent association with psychiatric

1 readmission. Schizophrenia and delusion disorder was associated with lower likelihood
2 of readmission within the first six months but was associated with higher likelihood in
3 the last interval. And Organic psychiatric disorder diagnosis was associated with fewer
4 lower likelihood psychiatric readmissions across the study period. A principal diagnosis
5 in the drug and alcohol category was associated with greater likelihood psychiatric
6 readmission in the last 2 intervals. Anxiety and stress related psychiatric disorder were
7 significantly associated with reduced likelihood of readmission in the first and last
8 interval. A principle diagnosis in 'Other psychiatric disorder' was only associated with
9 more psychiatric readmissions in the first interval. Having a no psychiatric diagnosis at
10 index admission increased the likelihood of readmission in the first month and
11 decreased the likelihood of readmission in the last 2 intervals. Greater length of stay at
12 index admission was associated with lower likelihood of readmissions in the first
13 interval, but with increased likelihood of readmission in the last 2 intervals.

14 Higher Charlson comorbidity index scores were generally associated with a
15 lower likelihood of psychiatric readmissions. Compared with a Charlson comorbidity
16 index score of 0, a score of 1 to 3 was only significantly associated with psychiatric
17 readmission in the last interval. Charlson comorbidity index score of 4 to 6 was
18 significantly associated with decreased likelihood of psychiatric readmissions across all
19 intervals. Charlson comorbidity index score of 7 and more was associated with lower
20 likelihood of readmission only in the second intervals (2-5 months). Intellectual

1 disability was consistently associated with higher rates of psychiatric readmissions
2 across all intervals. There were strong associations between and psychiatric
3 readmissions and drug and alcohol comorbidity. Drug and alcohol comorbidity
4 significantly increased the likelihood of readmission across all intervals.
5 Non-psychiatric hospitalisations were associated with decreased likelihood of
6 psychiatric readmissions in the first interval and increased likelihood of readmission in
7 the last 2 intervals.

Table 3. Factors associated with psychiatric readmission after the index admission.

	One month (N =35,056)			Two to five months (N = 34,955)			Six months to twenty-four months (N = 34,634)		
Variable	Odds Ratio	95% CI	p-value	Odds Ratio	95% CI	p-value	Odds Ratio	95% CI	p-value
Gender									
Female	Ref			Ref			Ref		
Male	0.82	0.78-0.87	<0.001	0.84	0.79-0.90	<0.001	0.84	0.80-0.90	<0.001
Age category			<0.001			<0.001			<0.001
Young adults (18-35 years)	Ref			Ref			Ref		
Middle aged adults (36-55 years)	1.11	1.03-1.18	0.002	1.16	1.08-1.24	<0.001	1.05	0.98-1.12	0.174
Older adults (56+)	1.38	1.27-1.50	<0.001	1.21	1.11-1.32	<0.001	1.04	0.96-1.14	0.321
Remoteness Area			<0.001			<0.001			0.001
Major cities	Ref			Ref			Ref		
Inner Regional	0.70	0.64-0.77	<0.001	0.87	0.80-0.95	0.002	0.89	0.79-0.92	0.006
Outer Regional/ Remote/ Very Remote	0.74	0.63-0.87	<0.001	0.72	0.61-0.85	<0.001	0.81	0.70-0.94	0.004
Index of Relative Socioeconomic Disadvantage (IRSD)			<0.001			<0.001			<0.001
1-2 Most Disadvantaged	Ref			Ref			Ref		
3-4	0.94	0.84-1.06	0.326	1.08	0.96-1.22	0.193	1.12	1.01-1.24	0.031
5-6	1.25	1.13-1.38	<0.001	1.13	1.02-1.26	0.022	1.12	1.02-1.24	0.018
7-8	1.49	1.35-1.66	<0.001	1.25	1.12-1.39	<0.001	1.14	1.03-1.26	0.011
9-10 Least Disadvantaged	2.42	2.18-2.68	<0.001	1.52	1.36-1.69	<0.001	1.17	1.06-1.30	0.002

<u>Principle psychiatric diagnosis</u>			<u><0.001</u>			<u><0.001</u>			<u><0.001</u>
<u>Mood disorder</u>	<u>Ref</u>			<u>Ref</u>			<u>Ref</u>		
<u>Schizophrenia and delusion disorder</u>	<u>0.70</u>	<u>0.64-0.77</u>	<u><0.001</u>	<u>0.74</u>	<u>0.68-0.81</u>	<u><0.001</u>	<u>1.25</u>	<u>1.15-1.35</u>	<u><0.001</u>
<u>Disorder of adult personality and behavior</u>	<u>0.82</u>	<u>0.69-0.98</u>	<u>0.025</u>	<u>0.98</u>	<u>0.81-1.18</u>	<u>0.842</u>	<u>1.05</u>	<u>0.88-1.24</u>	<u>0.661</u>
<u>Drug and alcohol related disorder</u>	<u>0.92</u>	<u>0.84-1.06</u>	<u>0.055</u>	<u>0.74</u>	<u>0.67-0.82</u>	<u><0.001</u>	<u>0.59</u>	<u>0.53-0.65</u>	<u><0.001</u>
<u>Anxiety and stress related disorder</u>	<u>0.82</u>	<u>0.75-0.89</u>	<u><0.001</u>	<u>0.94</u>	<u>0.86-1.02</u>	<u>0.155</u>	<u>0.79</u>	<u>0.73-0.86</u>	<u><0.001</u>
<u>Organic brain/psychiatric disorders</u>	<u>0.51</u>	<u>0.39-0.68</u>	<u><0.001</u>	<u>0.40</u>	<u>0.29-0.54</u>	<u><0.001</u>	<u>0.47</u>	<u>0.35-0.63</u>	<u><0.001</u>
<u>Other psychiatric</u>	<u>1.39</u>	<u>1.15-1.67</u>	<u>0.001</u>	<u>0.94</u>	<u>0.76-1.15</u>	<u>0.549</u>	<u>0.9988</u>	<u>0.72-1.08</u>	<u>0.231</u>
<u>Not psychiatric disorder</u>	<u>1.82</u>	<u>1.48-2.24</u>	<u><0.001</u>	<u>0.26</u>	<u>0.17-0.39</u>	<u><0.001</u>	<u>0.19</u>	<u>0.11-0.35</u>	<u><0.001</u>
<u>Length of stay at index admission</u>	<u>0.75</u>	<u>0.73-0.77</u>	<u><0.001</u>	<u>1.23</u>	<u>1.20-1.26</u>	<u><0.001</u>	<u>1.22</u>	<u>1.19-1.25</u>	<u><0.001</u>
<u>Charlson comorbidity Index Score</u>			<u><0.0064</u>			<u><0.0041</u>			<u><0.001</u>
<u>0</u>	<u>Ref</u>			<u>Ref</u>			<u>Ref</u>		
<u>1-3</u>	<u>0.79</u>	<u>0.55-1.12</u>	<u>0.186</u>	<u>0.90</u>	<u>0.71-1.14</u>	<u>0.3795</u>	<u>0.80</u>	<u>0.68-0.94</u>	<u>0.005</u>
<u>4-6</u>	<u>0.14</u>	<u>0.04-0.48</u>	<u>0.002</u>	<u>0.34</u>	<u>0.14-0.82</u>	<u>0.017</u>	<u>0.38</u>	<u>0.24-0.60</u>	<u><0.001</u>
<u>7+</u>	<u>0.48</u>	<u>0.14-1.59</u>	<u>0.229</u>	<u>0.26</u>	<u>0.10-0.69</u>	<u>0.007</u>	<u>0.69</u>	<u>0.45-1.06</u>	<u>0.092</u>
<u>Other comorbid conditions</u>									

1

2

3

4

5

6

7

8

9

10

11

12

13

14

15

16

17

18

19

20

21

22

23

24

25

26

27

28

29

30

31

32

33

34

35

36

37

38

39

40

41

42

43

44

45

46

47

<u>Drug and Alcohol</u>	<u>18.25</u>	<u>16.29-20.45</u>	<u><0.001</u>	<u>15.52</u>	<u>13.99-17.22</u>	<u><0.001</u>	<u>11.58</u>	<u>10.65-12.60</u>	<u><0.001</u>
<u>Intellectual Disability</u>	<u>1.63</u>	<u>1.37-1.94</u>	<u><0.001</u>	<u>1.54</u>	<u>1.28-1.85</u>	<u><0.001</u>	<u>1.75</u>	<u>1.49-2.07</u>	<u><0.001</u>
<u>Non-psychiatric hospitalisation</u>	<u>0.57</u>	<u>0.50-0.67</u>	<u><0.001</u>	<u>1.11</u>	<u>1.01-1.23</u>	<u>0.032</u>	<u>1.28</u>	<u>1.19-1.37</u>	<u><0.001</u>

Discussion

This study investigated factors associated with ED presentation and psychiatric readmission in adults after their index admission. To our knowledge, it is the only population-cohort study internationally that has examined these associations at multiple time intervals. Sociodemographic factors, principle psychiatric diagnoses at index admission, length of stay at index admission, comorbidities and non-psychiatric inpatient admissions were all significantly associated with ED presentation and psychiatric readmission. While some factors had a robust and consistent association across all time intervals, each interval also revealed a distinctive pattern of associations.

Age and sex had a significant association with ED presentations and psychiatric readmissions after the index admission which is similar to previous studies demonstrating that sociodemographic factors are associated with mental health service use^{35 36}. Consistent with previous population data¹², being young increased the likelihood of ED presentation. Similar to previous research that found females use more mental health services¹³, being male was associated with lower likelihood of psychiatric readmissions in our study. While low socioeconomic status and remoteness of the living area were associated with more ED presentations, they were associated with lower likelihood of psychiatric readmissions. Our findings are consistent with previous studies which found that individuals with higher education and income use more mental health services^{37 38} whereas individuals with lower socioeconomic status tend to use more crisis driven services such as ED^{39 40}. The positive relationship between living in major cities and psychiatric readmission may in part be explained by scarcity of psychiatric resources in rural and remote areas of Australia⁴¹.

 The continuing association between principle diagnoses at index admission and subsequent ED presentations and readmission showed how psychiatric diagnosis can impact the service trajectory of an individual. For example, the persistent association between

1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
16
17
18
19
20
21
22
23
24
25
26
27
28
29
30
31
32
33
34
35
36
37
38
39
40
41
42
43
44
45
46
47
48
49
50
51
52
53
54
55
56
57
58
59
60

1 personality and behavioral disorder and ED presentation may relate to symptoms associated
2 with self-harm which is a well-recognised reason for presentation to ED ⁴². However,
3 reflecting the emphasis on enduring community based supports in its management,
4 personality and behavioral disorder was not associated with readmission. Compared to mood
5 disorder diagnoses, schizophrenia and delusion disorder were associated with lower
6 likelihood of readmissions in the first six months after the index admission. However,
7 previous findings showed that schizophrenia as a principle diagnosis was highly correlated to
8 ED presentation and psychiatric readmission within 30 days after index admission ¹². This
9 may be explained by the clustered code used in this study which combined the most common
10 psychiatric disorders such as depression and bipolar disorder into one category-mood
11 disorder and it represents 36% of the cohort. The association between length of stay at index
12 admission and ED presentations differed from that observed with readmission, and may have
13 related to the interaction of initial severity/complexity of presentation (determining index
14 admission length) and time-dependent factors such as subsequent clinical pathways. For
15 individuals experiencing first psychiatric admission, subsequent allocation of community
16 supports may be most cohesive for those with higher levels of complexity, for which length
17 of index admission may be a proxy. This could have mitigated representation to ED and early
18 rates of readmission. With time, it is possible that community supports become less cohesive
19 over time, and indeed a weakening of the relationship between length of index admission and
20 representation to ED was noted over time. Whilst the same mitigation was initially apparent
21 in the 1 month readmission data, this appeared to be swamped in subsequent time periods by
22 other factors. Although this is harder to explain, it is possible that those individuals with
23 greater complexity may have subsequently been more likely to present directly to psychiatric
24 inpatient facilities. This occurs in some jurisdictions in Australia for those who are more

acutely disturbed. The variable findings over time reaffirm the need to include a longer time intervals to gain insights into service trajectory.

Drug and alcohol related disorders as principle diagnoses was associated with lower likelihood of psychiatric readmissions, and yet as a comorbid condition drug and alcohol related diagnoses showed the highest association of all covariates with psychiatric readmission and ED presentation across the time intervals. Only 154% of the cohort had a principle drug and alcohol related diagnosis, whereas 410% of the cohort had a drug and alcohol comorbidity in the ED data, suggesting that these two labels pick up different presentations, in different contexts and with different clinical supports. In NSW, strong emphasis is placed on the management of primary drug and alcohol diagnoses within specific services which sit outside of mainstream mental health services, whereas those with mental illness and drug and alcohol comorbidities are often managed jointly by mental health and specific drug and alcohol services. The two highly correlated diagnoses of drug and alcohol use and mental ill health are often referred to as dual diagnosis in mental health care⁴³. It is understood that drug and alcohol comorbidity can lead to reductions of compliance with psychiatric treatment, and as a result dual diagnosis are often managed in inpatient mental health services³³. The strength of the association between drug and alcohol comorbidity and ED presentation and psychiatric readmission suggests that drug and alcohol intervention should not only occur early, but should be a sustained focus in healthcare. Drug and alcohol comorbidity also had a stronger association with psychiatric readmission than ED presentation; such a difference may be partially explained by the proportion of individuals with complex needs being admitted to a psychiatric facility bypassing ED. However, more research is needed to investigate the factors attributed to this distinctive service utilisation pattern.

1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
16
17
18
19
20
21
22
23
24
25
26
27
28
29
30
31
32
33
34
35
36
37
38
39
40
41
42
43
44
45
46
47
48
49
50
51
52
53
54
55
56
57
58
59
60

~~_____Past studies⁴⁴ suggest that other comorbid conditions are strongly associated with mental health service use and that multimorbidity is a significant risk factor for unplanned hospital admission. Previous studies¹⁵ reported a high prevalence of physical comorbidity among individuals with mental illness and we found that the Charlson comorbidity index score had an opposite impact on ED presentation and psychiatric readmission. The Charlson comorbidity index score is often used to predict mortality rate within a year⁴⁵. Individuals with more severe physical comorbidities were understandably more likely to present to ED and less likely to be readmitted to a psychiatric facility. The current study was unable to investigate whether physical health comorbidities were related to the index admission or the onset of a psychiatric illness. The findings do however suggest that an emphasis on tailored and holistic healthcare is needed within both mental health services and primary healthcare settings. Previous studies¹⁵ reported a high prevalence of physical comorbidity among individuals with mental illness and we found that the number of physical conditions associated with ED presentations and psychiatric readmissions increased over time. the Charlson The Charlson es⁴⁶ tiesbe teds Although the current study was unable to investigate whether an escalation in physical health comorbidities were related to the index admission, a distinctive pattern of comorbidity was observed at each time interval after index admission. Our results reflect complex healthcare needs in the cohort in the later time intervals. These findings suggest the importance of physical health after first admission to a psychiatric facility and that an emphasis on tailored and holistic healthcare is needed within both mental health services and primary healthcare settings during this time.~~

The presence of ID was persistently and strongly associataed with ED presentation and psychiatric readmission across the study period which is consistent with previous research³². As reported elsewhere^{46 47}, the mental health system in Australia is not yet equipped to provide comprehensive mental health supports for individuals with ID. Consistent with a

previous study¹⁴, the current study suggests that ID adds to complex support needs which have a direct bearing on ED and inpatient mental health service use, above and beyond that due to the mental illness ~~along~~ alone. Unlike many physical conditions which an individual can acquire at any point in time, ID is a permanent disability that is often identified at an early stage in life. Our findings reaffirm that equipping mental health services to meet the mental health needs of people with ID is useful and may assist in buffering the impact of this disability on service use.

The significant associations between non-psychiatric hospitalisation, ED presentation and psychiatric admissions, and the proportion of individuals admitted to a psychiatric facility at index admission with a non-psychiatric diagnosis, suggest that strong relationships exist between each component of acute healthcare services. In line with observations made by social researchers, the strong relationship between different acute inpatient contacts suggest that individuals with complex support needs require the development of strong interdisciplinary frameworks to avoid becoming frequent users of acute services⁴⁸.

The distinctive focus on time intervals in this study revealed the changing needs of the cohort and specific windows of opportunity for intervention. The intervals revealed that while some factors such as area of residence and socioeconomic status strongly associated with ED presentation or psychiatric readmission within 30 days after the index admission, other only became significant in the later intervals such as length of stay at index admission. The change of direction of the association of principle diagnoses such as schizophrenia and delusion disorder and psychiatric readmission at different time intervals suggest that the service trajectories of individuals with different psychiatric disorders and symptoms can vary and that the 30 days readmission predictors may not capture such change. ~~The unique association between comorbid conditions and psychiatric readmissions and ED presentation as discussed above showed that the healthcare profile and needs of the cohort changed within the 24~~

1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
16
17
18
19
20
21
22
23
24
25
26
27
28
29
30
31
32
33
34
35
36
37
38
39
40
41
42
43
44
45
46
47
48
49
50
51
52
53
54
55
56
57
58
59
60

~~months observation period after the first psychiatric admission.~~ Further research should seek to explore in more detail the drivers and dynamics of fluctuations in service use over time.

Strengths and limitations

The current data-linkage study provides a comprehensive overview of factors associated with psychiatric readmissions and ED presentations. We investigated and controlled for a range of factors by linking government databases that cover all acute hospitals in NSW. We used a method to capture the first- psychiatric admission using administrative data by isolating two years for each included individual. There is a likelihood that the index admissions captured by our analyses included individuals who had previous admissions prior to July 2007. However, given that 60% of mental health service users in Australia had a mental health disorder lasting 12 months ⁸ and a previous study⁴⁹ found that 66% of mental health users readmitted to a psychiatric facility within a year; it is unlikely that this has affected the results. Although the current study used three different administrative databases to identify individuals with ID, our separate cohort analysis showed that majority of the ID population were identified through the disability dataset or multiple datasets, and only 4% of the ID population in this dataset was identified by the admitted patient records and emergency department data collection alone which is unlikely to influence the validity of ID status identification⁴³.

A limitation of the current study is that the data collected by NSW Health are administrative data rather than clinical data and thus lack potentially important clinical information. We were unable to examine the severity of symptoms when admitted to the hospital and its association with readmissions and ED presentation. As NSW APDC data are collected on separation from the hospital, we were also unable to identify the very small percentage of individuals who had an index admission during the study period and yet remained in the facility throughout the study period. ID had a robust and persistent impact on

both ED presentation and psychiatric readmission; however, due to the limitation of the research scope of this study, we did not further examine sub-groups of people with ID. The results of the current study are a strong indicator of the unmet needs of the ID population. Further research that examines sub-populations such as individuals with Autism, Down syndrome and FAS within the ID population is needed to understand their needs. We also acknowledge that a small proportion of individuals with borderline and mild ID may not be identified in the ID cohort if they did not receive disability services previously.

Conclusions

This study provides important insights into the range of factors that are associated with acute health services use after index psychiatric admission. We propose the following recommendations to improve service integration: a stronger public health approach to address the impact of social determinants on service utilisation, early intervention programs for dual diagnosis of mental illness and drug and alcohol comorbidity, an urgent response to address the unmet needs of individuals with ID and mental illness and a more holistic care approach to address comorbidity in the inpatient setting. In addition, more research is needed to understand the service trajectories of individuals with different psychiatric conditions beyond the commonly used 30 days interval. The results of the current study provide opportunities for researchers and policymakers to explore the complex nature of an often fragmented health system, and to build improved models which support early intervention and reduce burden on individuals and acute health services.

1 **Competing interests:** None declared.

2 **Patient consent:** No.

3 **Ethics approval**

4 Ethics approval was obtained from the NSW Population and Health Services Research Ethics
5 Committee (AU RED Study Reference Number: HREC/13/CIPHS/7; CINSW Reference
6 Number: 2013/02/446), and access to the data sets was granted by relevant data custodians.

7 **Provenance and peer review:** Not commissioned; externally peer reviewed.

8 **Data sharing statement:** No additional data are available.

Reference

1. Jacobi F, Wittchen H, Holting C, et al. Prevalence, co-morbidity and correlates of mental disorders in the general population: results from the German Health Interview and Examination Survey (GHS). *Psychological Medicine* 2004;34(4):597-611.

2. Whiteford H, Degenhardt L, Rehm J, et al. Global burden of disease attributable to mental and substance use disorders: findings from the Global Burden of Disease Study 2010. *Lancet* 2013;382(9904):1575-86. doi: 10.1016/S0140-6736(13)61611-6

3. Kalucy R, Thomas L, King D. Changing demand for mental health services in the emergency department of a public hospital. *Aust N Z J Psych* 2005;39(1-2):74-80.

4. Whiteford HA. Australia's national mental health policy. *Hospital & community psychiatry* 1993;44(10):963.

5. Whiteford H, Buckingham W. Ten years of mental health service reform in Australia: are we getting it right? *Medical Journal of Australia* 2005;182(8):396-400.

6. Allison S, Bastiampillai T. Mental health services reach the tipping point in Australian acute hospitals: The OECD warns about Australia's low psychiatric bed numbers. *Medical Journal of Australia* 2015;203(11):432-34. doi: 10.5694/mja15.00782

7. Jaramillo-Gonzalez L, Sanchez-Pedraza R, Herazo M. The frequency of rehospitalization and associated factors in Colombian psychiatric patients: a cohort study. *BMC Psychiatry* 2014;14 doi: 10.1186/1471-244X-14-161

8. Slade T JA, Teesson M, Whiteford H, Burgess P, Pirkis J, and Saw S. . The Mental Health of Australians 2. Report on the 2007 National Survey of Mental Health and Wellbeing. In: Ageing DoHa, ed. Canberra, 2009.

9. Lorine K, Schmidt K, Goenjian AK, et al. Risk factors associated with psychiatric readmission. *Journal of Nervous and Mental Disease* 2015;203(6):425-30. doi: 10.1097/NMD.0000000000000305

10. Régis Eric Maia B, João Mazzoncini de Azevedo M, Isabela Panzeri C, et al. Short admission in an emergency psychiatry unit can prevent prolonged lengths of stay in a psychiatric institution Internação breve em unidade de emergência psiquiátrica pode prevenir permanência prolongada em instituições psiquiátricas. *Revista Brasileira de Psiquiatria* 2010;32(2):145-51.

11. Loch AA. Stigma and higher rates of psychiatric re-hospitalization: Sao Paulo public mental health system. *Revista Brasileira de Psiquiatria* 2012;34(2):185-92.

12. Smith M, Stocks C, Santora P. Hospital Readmission Rates and Emergency Department Visits for Mental Health and Substance Abuse Conditions. *Community Mental Health Journal* 2015;51(2):190-97. doi: 10.1007/s10597-014-9784-x

13. Raudino A, Carr V, Bush R, et al. Patterns of service utilisation in psychosis: findings of the 2010 Australian National Survey of Psychosis. *Australian and New Zealand Journal of Psychiatry* 2014;48(4):341-51. doi: 10.1177/0004867413511996

14. Lunskey Y, Lin E, Balogh R, et al. Emergency Department Visits and Use of Outpatient Physician Services by Adults With Developmental Disability and Psychiatric Disorder. *Can J Psychiat-Rev Can Psychiat* 2012;57(10):601-07.

15. Parslow RA, Jorm AF. Who uses mental health services in Australia? An analysis of data from the National Survey of Mental Health and Wellbeing. *Australian and New Zealand Journal of Psychiatry* 2000;34(6):997-1008. doi: 10.1046/j.1440-1614.2000.00839.x

16. Billings J, Blunt I, Steventon A, et al. Development of a predictive model to identify inpatients at risk of re-admission within 30 days of discharge (PARR-30). *BMJ Open* 2012;2(4):e001667. doi: 10.1136/bmjopen-2012-001667

17. McGorry P. Early intervention in psychosis. *Aust N Z J Psych* 2006;40:A109-A09.

18. Shadmi E, Flaks-Manov N, Hoshen M, et al. Predicting 30-day readmissions with preadmission electronic health record data. *Medical Care* 2015;53(3):283-89.
19. van Walraven C, Dhalla I, Bell C, et al. Derivation and validation of an index to predict early death or unplanned readmission after discharge from hospital to the community. *Canadian Medical Association Journal* 2010;182(6):551-57. doi: 10.1503/cmaj.091117
20. Shadmi E, Flaks-Manov N, Hoshen M, et al. Predicting 30-Day Readmissions With Preadmission Electronic Health Record Data. *Med Care* 2015;53(3):283-89.
21. Lin C, Chen W, Lin CM, et al. PREDICTORS OF PSYCHIATRIC READMISSIONS IN THE SHORT- AND LONG-TERM: A POPULATION-BASED STUDY IN TAIWAN. *Clinics* 2010;65(5):481-89. doi: 10.1590/S1807-59322010000500005
22. Kadam UT, Lawson CA, Moody DK, et al. Consumer segmentation and time interval between types of hospital admission: a clinical linkage database study. *Journal of Public Health* 2017;1-9. doi: 10.1093/pubmed/fox028
23. Librero J, Peiró S, Ordinaña R. Chronic Comorbidity and Outcomes of Hospital Care: Length of Stay, Mortality, and Readmission at 30 and 365 Days. *Journal of Clinical Epidemiology* 1999;52(3):171-79. doi: [https://doi.org/10.1016/S0895-4356\(98\)00160-7](https://doi.org/10.1016/S0895-4356(98)00160-7)
24. Tsao CI, Chou NK, Chi NH, et al. Unplanned Readmission Within 1 Year After Heart Transplantation in Taiwan. *Transplantation Proceedings* 2010;42(3):946-47. doi: <https://doi.org/10.1016/j.transproceed.2010.02.053>
25. Ono T, Tamai A, Takeuchi D, et al. Factors related to readmission to a ward for dementia patients: Sex differences. *Psychiatry Clin Neurosci* 2011;65(5):490-98. doi: 10.1111/j.1440-1819.2011.02251.x
26. The Centre for Health Record Linkage (CHeReL). How record linkage works 2016 [Available from: <http://www.cherel.org.au/how-record-linkage-works> accessed 26 October 2017.
27. World Health Organization. The ICD-10 Classification of Mental and Behavioural Disorders: Clinical Descriptions and Diagnostic Guidelines. Geneva: World Health Organization 1992.
28. Australian Bureau of Statistics. Socio-Economic Index for Areas: Australian Bureau of Statistics, 2013.
29. Charlson ME, Pompei P, Ales KA, et al. A new method of classifying prognostic comorbidity in longitudinal studies: Development and validation. *Journal of Chronic Diseases* 1987;40(5):373-83.
30. Australian Institute of Health and Welfare. Principal Diagnosis data cubes 2017 [Available from: <https://www.aihw.gov.au/reports/hospitals/principal-diagnosis-data-cubes/contents/data-cubes> accessed October 2017.
31. Quan HD, Sundararajan V, Halfon P, et al. Coding algorithms for defining comorbidities in ICD-9-CM and ICD-10 administrative data. *Medical Care* 2005;43(11):1130-39.
32. Lunskey Y, Balogh R, Cairney J. Predictors of emergency department visits by persons with intellectual disability experiencing a psychiatric crisis. *Psychiatric Services* 2012;63(3):287-90.
33. Regier D, Farmer M, Rae D, et al. Comorbidity of Mental Disorders with Alcohol and Other Drug Abuse: Results from the Epidemiologic Catchment Area (ECA) Study. *JAMA* 1990;264(19):2511.
34. Reppermund S, Srasuebku P, Heintze T, et al. Cohort profile: a data linkage cohort to examine health service profiles of people with intellectual disability in New South Wales, Australia. *BMJ Open* 2017;7(4)

1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
16
17
18
19
20
21
22
23
24
25
26
27
28
29
30
31
32
33
34
35
36
37
38
39
40
41
42
43
44
45
46
47
48
49
50
51
52
53
54
55
56

35. Turrell G, Oldenburg B, Harris E, et al. Utilisation of general practitioner services by socio-economic disadvantage and geographic remoteness. *Australian and New Zealand Journal of Public Health* 2004;28(2):152-58.

36. Narrow W, Regier D, Norquist G, et al. Mental health service use by Americans with severe mental illnesses. *Social Psychiatry and Psychiatric Epidemiology* 2000;35(4):147-55.

37. Alegria M, Bijl R, Lin E, et al. Income differences in persons seeking outpatient treatment for mental disorders - a comparison of the United States with Ontario and the Netherlands. *Archives of General Psychiatry* 2000;57(4):383-91.

38. Vasiliadis H-M, Lesage A, Adair C, et al. Do Canada and the United States differ in prevalence of depression and utilization of services? *Psychiatric Services* 2007;58(1):63-71.

39. Australian Institute of Health and Welfare. Australian hospital statistics 2007-08 Canberra: AIHW; 2009 [updated 12 January 2017; cited 2017 12 January]. Available from: <http://www.aihw.gov.au/publication-detail/?id=6442468249> accessed 02 February 2017.

40. Hadley J. Insurance coverage, medical care use, and short-term health changes following an unintentional injury or the onset of a chronic condition. *JAMA* 2007;297(10):1073-84.

41. Wilks CM, Browne M, Jenner B. Attracting psychiatrists to a rural area - 10 years on. *Rural Remote Health* 2008;8(1):824.

42. Haq SU, Subramanyam D, Agius M. Assessment of self harm in an accident and emergency service - the development of a proforma to assess suicide intent and mental state in those presenting to the emergency department with self harm. *Psychiatria Danubina* 2010;22 Suppl 1:S26-32. [published Online First: 2011/02/08]

43. Donald M, Dower J, Kavanagh D. Integrated versus non-integrated management and care for clients with co-occurring mental health and substance use disorders: A qualitative systematic review of randomised controlled trials. *Social Science and Medicine* 2005;60(6):1371-83. doi: 10.1016/j.socscimed.2004.06.052

44. Lay B, Lauber C, Rossler W. Prediction of in-patient use in first-admitted patients with psychosis. *European Psychiatry* 2006;21(6):401-09. doi: 10.1016/j.eurpsy.2005.12.004

45. Quan H, Li B, Couris CM, et al. Updating and Validating the Charlson Comorbidity Index and Score for Risk Adjustment in Hospital Discharge Abstracts Using Data From 6 Countries. *American Journal of Epidemiology* 2011;173(6):676-82. doi: 10.1093/aje/kwq433

46. Howlett S, Florio T, Xu H, et al. Ambulatory mental health data demonstrates the high needs of people with an intellectual disability: results from the New South Wales intellectual disability and mental health data linkage project. *Australian and New Zealand Journal of Psychiatry* 2015;49(2):137-44. doi: 10.1177/0004867414536933

47. Chaplin R. Mental health services for people with intellectual disabilities. *Current Opinion in Psychiatry* 2011;24(5):372-6.

48. Keene J. Clients with Complex Needs: Interprofessional Practice. Oxford: Blackwell Science 2001.

49. Wheeler A, Moyle S, Jansen C, et al. Five-year follow-up of an acute psychiatric admission cohort in Auckland, New Zealand. *New Zealand Medical Journal* 2011;124(1336):<xocs:firstpage xmlns:xocs=""/>.

Supplementary Table 1: ICD-10 codes for the included conditions

Condition	ICD-10 Code
Primary diagnoses at index admission	
— Mood disorder	F30-F39
— Schizophrenia and delusion	F20-F29
— Disorder of adult personality and behavior	F60-F69
— Drug and alcohol	F10-F19
— Other psychiatric disorder	F0-F09; F40-F59; F70-F100
— Not psychiatric disorder	Non-F codes
Comorbidity	
— Heart Conditions	I60-I66, G450-G452, G458, G459, G46, I64, G454, I670-I672, I674-I679, I681, I682, I688, I69, I71, I790, I739, R02, Z958, Z959, I50, I21, I22, I252
— Pulmonary Disease	J40, J41, J42, J44, J43, J45, J46, J47, J67, J44, J60, J61, J62, J63, J66, J64, J65
— Peptic ulcers	K25, K26, K27, K28
— Liver conditions	K702, K703, K73, K717, K740, K742, K746, K743, K729, K766, K767, K721, K744, K745
— Diabetes	E109, E119, E139, E149, E101, E111, E131, E141, E105, E115, E135, E145, E102, E112, E132, E142, E103, E113, E133, E143, E104, E114, E134, E144
— Paraplegia	G81-G041, G820, G821, G822
— Renal Disease	N03, N052, N053, N054, N055, N056, N072, N073, N074, N01, N18, N19, N25
— Cancer	C0, C1, C2, C3, C40, C41, C43, C45, C46, C47, C48, C49, C5, C6, C70, C71, C72, C73, C74, C75, C76, C80, C81, C82, C83, C84, C85, C883, C887, C889, C900, C901, C91, C92, C93, C940, C941, C942, C943, C9451, C947, C95, C96, C77, C78, C79, C80
— Drug and Alcohol	F10-F19
— Intellectual Disability	F70-F79

Reviewers' Comments to Author:

Reviewer: 1

Reviewer Name: Yona Lunsky

Institution and Country: Centre for Addiction and Mental Health CANADA

Please state any competing interests or state 'None declared': None declared

We would like to thank Professor Yona Lunsky for her comments and suggestions, which have helped us to refine the manuscript. Each of the comments have been addressed below. Please note all the included references to the page numbers and lines were based on the track change version of the manuscript.

This is a very well written and important study exploring predictors of ED visits and repeat admissions following a psychiatric hospitalization, using data linkage from NSW Australia. I appreciate that the authors included both ED visits and rehospitalizations, and that they included physical comorbidities, addictions, and intellectual disability. I liked that the explored predictors of rapid and later repeat visits/ admissions separately.

Abstract:

1. Some question about numbers in the abstract: How are the percentages for repeat ED visits and repeat hospitalizations the same when the N's for each differ (both 45%)? [according to results it should be 41% and 45% respectively]

We amended the sample for analysis in both the Emergency Department (ED) presentation and readmission datasets to improve the robustness and clarity of the analysis by restricting all reported numbers of ED presentations and admissions in both the abstract and results only to those which occurred within the 24 months after index admission. The sentence is now revised to "Index admission was identified in 35,056 individuals (51% males) with a median age of 42 years. A total of 12,826 (37%) individuals had at least one ED presentation in the first 24 months after the index admission. Of those, 3,608 (28%) presented within 0-1 month, 6,350 (50%) within 2-5 months and 10,294(80%) within 6-24 months after index admission. A total of 14,153 (40%) individuals had at least one psychiatric readmission in the first 24 months. Of those, 6,808 (48%) were admitted within 0-1 month, 6,433(45%) within 2-5 months and 7,649 (54%) within 6-24 months after index admission" on page 2 line 15. We have also revised the results section to reflect this change.

2. How come the proportion readmitted by time period does not add up to 100%? Is it because of multiple readmissions? - In reading the results, I see this is because you include multiple admissions. If you keep this detail in the abstract, you may have to say at least one ED visit and at least one repeat admission in each of the time periods, so it is understood why they add up to more than 100%.

Due to the word limitation of the abstract, we cannot add an extra sentence as suggested. For clarity, we have added "An individual could have more than one type of outcome and could have multiple admissions within one interval and across the time span" in the method page 10 line 2-4

to indicate that each individual can have multiple admissions within one interval and across the study period.

I thought the introduction was quite well written, and I particularly appreciated the justification to look beyond just 30 days repeat visit/admission.

3. pg 7 line 20 - It is clear why the interest in repeat visits/admissions within 30 days, but why the second division at 6 months to 24 months? Have other studies considered this an important time point? If so, offer the justification

“A recent study by Kadam et al (2017)²² of acute healthcare service use and unplanned hospital admissions suggests that future research should include longer readmission intervals. Time intervals such as 6, 12 and 24 months after an admission have been used by various studies to gain a more comprehensive perspective on the service trajectory of a cohort^{21 23-25} “ This has been added on pages 6 (line 21-24) and page 7 line 1 to justify the inclusion of longer time intervals.

Method

4. pg 7 line 4 - This is the first time intellectual disability diagnosis is introduced. Perhaps it should be clearer in the introduction that this is a specific comorbidity of interest. (the introduction is more general pointing to cognitive comorbidity)

We have added more information in the introduction (page 6 line 1-4) to be clearer that intellectual disability is a comorbidity of interest in our study: “For example, a Canadian¹⁴ study found that individuals with ID and mental illness were more likely to have ED presentations and psychiatric admissions when comparing to individuals with ID only and mental illness only ”

5. pg 7 line 18 introduces the ID MDS and suggests that it is through this dataset that ID is identified, but it also suggests on line 4 that ID is identified in a different dataset. It may be that ID can be identified in either and that linkage allows for greater likelihood of identification, so if this is made evident in a general sentence prior to describing each dataset, this might be helpful. e.g., certain diagnoses could be captured through multiple datasets. I understand from reading later in the methods that ID could be identified from any dataset at any time point. I understand why this was done, but it might not be clear to a reader who is less familiar with the ID population and the reality that depending on the reason for admission and the severity of the ID, it may not be recorded as a diagnosis in this admission (hence inclusion of multiple datasets).

A sentence has been added in the methods section to clarify the use of multiple datasets to identify intellectual disability and drug and alcohol comorbidity. The sentence on page 8 line 21 now reads “The Disability Services Minimum Dataset (DS MDS) is a state service data collection scheme that is collected by a disability administrator in each Australian jurisdiction. It contains information on intellectual disability diagnosis, which was used in conjunction with the APDC and EDDC to identify intellectual disability status”.

6. I see that diagnoses such as Down syndrome, Autism, FAS were not included in the intellectual disability diagnoses. This conservative way of identifying ID could also mean that some individuals with ID were excluded. For example, some individuals with Down

syndrome or ASD may not have the ID diagnosis also recorded. This may be less of an issue within the ID MDS dataset than the health datasets, but it may also mean that this subgroup is biased toward including people receiving ID services. Perhaps this should be commented on within the limitations.

Down syndrome and FAS were included in the ID cohort. We have added “Consistent with our previous approach, we identified ID with codes including: childhood disintegrative and overactive disorders associated with mental retardation; intellectual development delay; mild through profound mental retardation; Down syndrome and other chromosomal anomalies associated with mental retardation; Fragile X syndrome and congenital malformation syndromes due to known exogenous causes³⁵” in the methods section on page 11 line 19-24 to clarify the inclusion of Down syndrome and FAS in our ID cohort. People with ID plus autism spectrum disorder (ASD) is also present in the sample, however, we did not include ASD without ID as this was beyond the scope of the study.

We have added “We also acknowledge that a small proportion of individuals with borderline and mild ID may not be identified in the ID cohort if they did not receive disability services previously.” in the limitation section page 35 line 5-7 to address the potential bias that the included ID population may be skewed more towards the severe end of the spectrum.

7. Given that psychiatric hospitalizations are more common in the ASD population, would it be important to study this group separately? Would they be in the psychiatric comorbidities group under OTHER and could they be studied as part of or separately from the ID group? If not, perhaps this could be addressed in limitations as well (some specific comorbidities not explored that could be relevant).

We agree that health service use in the ASD population is a very interesting research area which we intend to investigate in our future work.

We have added this point on page 34 line 25 to the limitation section: “ID had a robust and persistent impact on both ED presentation and psychiatric readmission; however, due to the limitation of the research scope of this study, we did not further examine sub-groups of people with ID. The results of the current study are a strong indicator of the unmet needs of the ID population. Further research that examines sub-populations such as individuals with Autism, Down syndrome and FAS within the ID population is needed to understand their needs.”

8. p7 line 37 - perhaps make it clearer whether this is the first admission studied in the time period of interest or if it was the patient's first admission. Since data could only be looked back as far as 2005, it is possible there was another admission prior to this time so it might be best to say the first admission from 2005 onward.

“First ever admission” has been replaced by “index admission” in this sentence.

Results

9. Two variables not considered in the predictive models that might be very important are complexity of presentation (something like the number of comorbidities, as opposed to just studying different comorbidities separately), and the length of the first admission. It may be that brief admissions are more likely to have poorer planning following, but that longer admissions lead to improved discharges. The opposite could also be true: those with longer admissions could be more "institutionalized" and have greater difficulty transitioning into the community.

Length of stay at index admission has been added as a new variable. We have also replaced all physical comorbid conditions with the Charlson Comorbidity Index Score.

The results from the new analysis suggested that having a comorbidity index score greater than 0 was associated with ED presentations and psychiatric readmission. A Charlson comorbidity index score of 0 indicates that an individual had no other illness listed under the Charlson Comorbidity Index recorded in the study period. A higher comorbidity index increased the likelihood of ED presentations and decreased the likelihood of psychiatric readmission.

We have added "Previous studies¹⁵ reported a high prevalence of physical comorbidity among individuals with mental illness and we found that the Charlson comorbidity index score had an opposite impact on ED presentation and psychiatric readmission. The Charlson comorbidity index score is often used to predict mortality rate within a year⁴⁶. Individuals with more severe physical comorbidities were understandably more likely to present to ED and less likely to be readmitted to a psychiatric facility. The current study was unable to investigate whether physical health comorbidities were related to the index admission or the onset of a psychiatric illness. The findings do however suggest that an emphasis on tailored and holistic healthcare is needed within both mental health services and primary healthcare settings." on page 32 line 3-12 in the discussion.

The length of stay was associated with fewer ED presentations across the study period and psychiatric readmission in the first month and it increased the likelihood of psychiatric readmission in the last 2 intervals.

We have added "The association between length of stay at index admission and ED presentations differed from that observed with readmission, and may have related to the interaction of initial severity/complexity of presentation (determining index admission length) and time-dependent factors such as subsequent clinical pathways. For individuals experiencing first psychiatric admission, subsequent allocation of community supports may be most cohesive for those with higher levels of complexity, for which length of index admission may be a proxy. This could have mitigated representation to ED and early rates of readmission. With time, it is possible that community supports become less cohesive over time, and indeed a weakening of the relationship between length of index admission and representation to ED was noted over time. Whilst the same mitigation was initially apparent in the 1 month readmission data, this appeared to be swamped in subsequent time periods by other factors. Although this is harder to explain, it is possible that those individuals with greater complexity may have subsequently been more likely to present directly to psychiatric inpatient facilities. This occurs in some jurisdictions in Australia for those who are more acutely disturbed. The variable findings over time reaffirm the need to include longer time intervals to gain insights into service trajectory." on page 30 line 11 in the discussion.

Discussion

10. pg 27 - important discussion of addiction findings with regard to why inpatient readmission so likely. Are there thoughts about why relative to that ED admissions are less likely? Is this because many people have to go to ED in crisis across conditions, but it is the presence of the addiction that is why an individual requires inpatient admission? perhaps further discussion on this would be warranted. the difference btwn the two is huge.

There are potential reasons for the differences between ED presentation and psychiatric readmission but bringing clarifying to these issues using the current analyses and datasets is difficult. In a crisis situation (the individual is at risk of harming others or themselves), it is likely that the person is admitted to a psychiatric facility bypassing the ED.

Drug and alcohol as a comorbid condition showed strongest associations in both ED presentation and psychiatric readmission analyses. In the most recent mental health service report, mental and behavioural disorders due to psychoactive substance use (such as alcohol dependency disorders) were reported as the most frequent recorded principle diagnoses in mental health-related ED presentations, indicating the high number of individuals accessing psychiatric support through ED (AIWH 2017)¹. The relative figures are also understandably stronger for psychiatric readmission given that such comorbidity is commonly managed in a psychiatric facility. The repeat service user is also likely to be admitted directly to a psychiatric facility. However, these clinical interpretations have limited published evidence.

We have added a sentence in the conclusion (page 31 line 19) to advocate for more research in the area. The added sentence is “Drug and alcohol comorbidity also had a stronger association with psychiatric readmission than ED presentation; such a difference may be partially explained by the proportion of individuals with complex needs being admitted to a psychiatric facility bypassing ED. However, more research is needed to investigate the factors attributed to this distinctive service utilisation pattern”.

11. pg 28 line 45 - replace along with alone

The word along is now replaced with alone.

12. p29 line 50 - I might expand further on why physical health comorbidities emerge more over time as predictors. Is this a problem in terms of community based care? or is it the reality that individuals with serious psychiatric disorders develop increased complexity over time? The 30 day indicator is a reflection of poor transition planning, but the longer term indicator may reflect something quite different.

Although evidence in Australia suggests that a high percentage of individuals with psychiatric disorders have comorbid physical conditions, no study has investigated the time dynamics of the development of physical illness after the first contact to a psychiatric facility. The two reasons mentioned in the comment may both be valid. Given that we have changed the physical comorbid conditions to the Charlson comorbidity index score, the emerging effect over time is less obvious in the new results.

We have added “Previous studies¹⁵ reported a high prevalence of physical comorbidity among individuals with mental illness and we found that the Charlson comorbidity index score had an opposite impact on ED presentation and psychiatric readmission. The Charlson comorbidity index score is often used to predict mortality rate within a year⁴⁶. Individuals with more severe physical comorbidities were understandably more likely to present to ED and less likely to be readmitted to a psychiatric facility. The current study was unable to investigate whether physical health comorbidities were related to the index admission or the onset of a psychiatric illness. The findings do however suggest that an emphasis on tailored and holistic healthcare is needed within both mental health services and primary healthcare settings.” on page 32 line 3-12 in the discussion.

¹ Australian Institute of Health and Welfare 2017. Mental health services—in brief 2017. Cat. no. HSE 192. Canberra: AIHW.

13. pg 30 line 14 - are authors suggesting that 4% of individuals identified as having ID were identified only from hospital records, suggesting that 96% were identified also with the ID MDS dataset? This is unclear.

The sentence has been revised to provide a clearer statement: " Although the current study used three different administrative databases to identify individuals with ID, our separate cohort analysis showed that majority of the ID population were identified through the disability dataset or multiple datasets, only 4% of the ID population in this dataset was identified by the admitted patient records and emergency department data collection alone which is unlikely to influence the validity of ID status identification" on page 34 line 13.

Reviewer: 2

Reviewer Name: Helen Snooks

Institution and Country: Swansea University, uk Please state any competing interests or state 'None declared': None declared

This is an important topic and the authors have pulled together a strong dataset. However, the research questions as set out are not - and cannot be answered within this dataset. To answer questions about whether patients are at higher risk of readmission, data are required about other patients - who are not readmitted. The authors need to revise their questions/objectives or their methods (study design and analysis) before this paper should be considered for publication.

We would like to thank Professor Helen Snooks for her comments. However, we believe the reviewer misunderstood the study design. The aim of the study was to assess factors associated with ED presentation and psychiatric readmission after a person had a psychiatric admission, and to understand the factors that influence the service trajectory of the cohort who already had contacts with the mental health system.

Reviewer: 3

Reviewer Name: Fenglian Xu

Institution and Country: University of Technology Sydney, Australia Please state any competing interests or state 'None declared': none

This is a interesting topic and the paper is well organized.

I have a few minor questions for the author:

We would like to thank Associate Professor Fenglian Xu for her comments and suggestions, each of which has been addressed below. These have helped us to refine the manuscript. Each of the comments have been addressed below. Please note all the included references to the page numbers and lines were based on the track change version of the manuscript.

1. In methodology section, definitions of comorbidity, principal diagnoses, additional diagnoses and index admission need to be added. For example, comorbidity refers to additional diagnoses of the readmission with a principal diagnosis of psychiatric disorders? or diseases which occurred in a same period of time with the readmission?

The index admission definition can be found on page 9 line 8-11. We have added the definitions of the principal diagnosis on page 10 line 12. The sentences is “The principal diagnosis was defined as the condition mainly responsible for a patient’s episode of care in hospital³⁰”. We have changed the physical comorbid condition to Charlson comorbidity index score and its definition can be found on page 10 line 23 to page 11 line 2.

1. The picture will be clearer if the total number of total readmissions and length of hospital stay were analysed.

We have extensively extended the included descriptive data and it is now reads “12,826 (37%) individuals had at least one ED presentation in the 24 months after index admission. Of those, 3,608 (28%) had ED presentations in the first month after the index admission and 6,350 (50%) and 10,294 (80%) individuals had ED presentations in the intervals of 2-5 months and 6-24 months after the index admission, respectively. The medium (IQR) time to an ED presentation after the index admission was 107 (24-296) days” and “In the study period, 14,153 (40%) individuals had at least one psychiatric readmission in the 24 months after the index admission. Of those, there were 6,808 (48 %) individuals with readmissions in the first month, 6,433 (45%) individuals with readmissions 2-5 months after the index admission and 7,649 (54%) with readmissions 6-24 months after the index admission. The median(IQR) time to a psychiatric readmission after the index admission was 36 (4-209) days” on page 16 line 3 and page 23 line 1 respectively. The median length of stay has also been added to table one and on page 13 line 18-19 “The median (IQR) length of stay at index admission was 9 days (2-21 days).”

Length of stay at index admission has been added as a new variable. The length of stay was associated with fewer ED presentations across the study period and psychiatric readmission in the first month and it increased the likelihood of psychiatric readmission in the last 2 intervals.

We have added “The association between length of stay at index admission and ED presentations differed from that observed with readmission, and may have related to the interaction of initial severity/complexity of presentation (determining index admission length) and time-dependent factors such as subsequent clinical pathways. For individuals experiencing first psychiatric admission, subsequent allocation of community supports may be most cohesive for those with higher levels of complexity, for which length of index admission may be a proxy. This could have mitigated representation to ED and early rates of readmission. With time, it is possible that community supports become less cohesive over time, and indeed a weakening of the relationship between length of index admission and representation to ED was noted over time. Whilst the same mitigation was initially apparent in the 1 month readmission data, this appeared to be swamped in subsequent time periods by other factors. Although this is harder to explain, it is possible that those individuals with greater complexity may have subsequently been more likely to present directly to psychiatric inpatient facilities. This occurs in some jurisdictions in Australia for those who are more acutely disturbed. The variable findings over time reaffirm the need to include longer time intervals to gain insights into service trajectory.” on page 30 line 11 in the discussion.

This is not 'population study' (page 26 line 8). This study was based on health service data.

We have changed the wording to ‘cohort study’.

Reviewer: 4

Reviewer Name: Ingrid H. Johansen

Institution and Country: National Centre for Emergency Primary Health Care, Uni Research Health, Bergen, Norway Please state any competing interests or state 'None declared': None declared

We would like to thank Associate Professor Ingrid H. Johansen for her comments and suggestions, which have helped us refine the manuscript. Each of the comments have been addressed below. Please note all the included references to the page numbers and lines were based on the track change version of the manuscript.

Thank you for the opportunity to review this paper. This is a potentially interesting paper based on analysis of a huge dataset. It seems that the aim is to explore factors associated with acute somatic or psychiatric care after index psychiatric admission. The authors have chosen to explore associations in three time intervals, to see if there are any differences between the patients readmitted in the given intervals regarding principle diagnosis at index admission, sociodemographic factors and comorbid conditions.

Unfortunately, this manuscript has been prematurely submitted, and need major work before it can be properly judged. Due to the shortcomings of the manuscript, I have focused my review on methods and results, and I have the following suggestions for improvement:

1. The authors have made some choices which needs further explanation in the methods:

a. The authors need to explain or argue for their chosen time intervals (0-1 month, 2-5 months, 6-24 months). Clinically we are often concerned about patients readmitted within the first week of their discharge, as this is a strong indication of a serious condition, premature discharge or insufficient follow up after discharge. The longer timespan from index admission, the more likely it is that a new admission is the result of new disease, new events of life or the general undulation of chronic conditions.

"A recent study by Kadam et al (2017)²² of acute healthcare service use and unplanned hospital admissions suggests that future research should include longer readmission intervals. Time intervals such as 6, 12 and 24 months after an admission have been used by various studies to gain a more comprehensive perspective on the service trajectory of a cohort^{21 23-25}. It is likely that sociodemographic factors and physical and mental health comorbidities may interact to produce increasing complexity over time, with associated increases in the likelihood of re-presentation to acute services. Thus, examination of the factors associated with acute mental health service use over several intervals, and for a substantial time period, is an important step in development of comprehensive understanding of the drivers of service use". This has been added on pages 6 (line 21-24) and page 7 line 1-6 to justify the inclusion of longer time intervals.

b. The principle psychiatric diagnosis was categorized into 6 subgroups, with a huge group of "others" containing F00-09, F40-48, F50-59, F70-79, F80-89, F90-98 and F99. In Table 1 "others" contains 25% of the included patients and constitutes the second biggest subgroup in the study. I will encourage the authors to break this group down. Clinically one would expect that for example the F40-48 group would have a different pattern of service use than the F20-29 or the F00-09 group.

It is a very helpful point which we have addressed this by further separating the anxiety and stress related psychiatric disorder (F40-48) and organic psychiatric disorder (F00-09) from the 'other' group. There were 7,363 individuals with anxiety and stress related psychiatric disorders and 667 individuals with organic psychiatric disorders. Anxiety and stress related disorder was associated with fewer ED presentations in the last interval compared to mood disorder. While organic psychiatric disorder was associated with fewer psychiatric readmissions across the study period,

stress and anxiety related disorder was only significant in the first and last interval. The results are presented in table 1, 2 and 3.

c. The authors have chosen to use the Charlson Comorbidity Index, and it is unclear to me what they want to gain by this, especially as they do not seem to use the index as it is intended. As a result, they have ended up having a mixed list of comorbidities, ranging from specific conditions like paraplegia and peptic ulcers, to large, combined and unspecified groups like heart conditions and pulmonary disease. If they chose to keep the index as a measure for comorbidity, it would be more natural if they grouped the comorbidities according to their Charlson severity score. With the current presentation they could just as well consider using ICD-10 categories.

We have replaced all physical comorbid conditions with the Charlson Comorbidity Index Score. The results from the new analysis suggested that having a comorbidity index score greater than 0 was associated with ED presentations and psychiatric readmission. A Charlson comorbidity index score of 0 indicates that an individual had no other illness listed under the Charlson Comorbidity Index recorded in the study period. A higher comorbidity index increased the likelihood of ED presentations and decreased the likelihood of psychiatric readmission.

We have added “Previous studies¹⁵ reported a high prevalence of physical comorbidity among individuals with mental illness and we found that the Charlson comorbidity index score had an opposite impact on ED presentation and psychiatric readmission. The Charlson comorbidity index score is often used to predict mortality rate within a year⁴⁶. Individuals with more severe physical comorbidities were understandably more likely to present to ED and less likely to be readmitted to a psychiatric facility. The current study was unable to investigate whether physical health comorbidities were related to the index admission or the onset of a psychiatric illness. The findings do however suggest that an emphasis on tailored and holistic healthcare is needed within both mental health services and primary healthcare settings.” on page 32 line 3-12 in the discussion.

d. At page 9 the authors write: “An episode that occurred in a psychiatric facility where drug and alcohol codes were given as a principle diagnosis was excluded”. This needs further explanation, as these episodes should count when registering readmission, as well as when registering drug and alcohol use as a comorbidity. If drug and alcohol misuse without any additional psychiatric symptoms is a reason for admission to psychiatric wards in Australia, this should be declared in the description of the setting.

In the statistical analysis section on page 10 line 16, we have indicated that drug and alcohol related disorder is a principle diagnosis of interest. We have added “An episode that occurred in a psychiatric facility where drug and alcohol codes were given as a principle diagnosis were excluded to ensure the included condition is not an outcome variable” to clarify the exclusion of drug and alcohol as a principle diagnosis for the comorbidity analysis on page 11 line 15-17.

2. In the results the following have to be reconsidered:
a. Currently numbers are presented in both text and tables. This is redundant and disturbs the focus of the reader. Most interested readers will read the tables for themselves, and just need the text for guidance to what the authors found important and want to discuss.

We have removed all odds ratios and confident intervals in the text of the manuscript. We have also added a sentence to direct the reader to the table: “Table 2 reports the odds ratios, confident intervals and p values of the factors associated with ED presentations after the index separation in the three intervals” and “Table 3 reports the odds ratios, confident intervals and p values of the

factors associated with psychiatric readmissions in the three intervals” on page 16 line 9 and page 23 line 7.

b. I miss a general presentation of the pattern of readmission for the group as a whole, including average time to first readmission dependent and independent of service, patterns of readmission to each and both services, including frequent attendance.

We have added the median time to a psychiatric readmission and an ED presentation to the manuscript: “The median time to an ED presentation is 107 days. The 25 percentile is 24 days and the 75 percentile is 296 days” and “The median time to a psychiatric readmission is 36 days. The 25 percentile is 4 days and the 75 percentile is 209 days” on page 16 line 8 and page 23 line 5. The median length of stay has also been added to table one and on page 13 line 18-19 “The median (IQR) length of stay at index admission was 9 days (2-21 days).” The frequent attendance concern is addressed in the next comment.

c. From the numbers presented, some patients must have been readmitted several times during the follow up period. It is also likely that diagnostic groups differ in which services they are readmitted to. The paper does not address the issue of frequent attenders at all, and this is a major shortcoming in a paper where the data seems to allow for that kind of individual analysis. I also miss information about overlap of use of the two services, for example by diagnostic group.

Thank you for the comment. We agree that frequent service users are important to research in general, and we intend to explore this research area in our future work. In this study however, we focussed our efforts on understanding factors associated with ED presentation and psychiatric readmission in people who had no psychiatric admission in the preceding 2 years ie who had an ‘index’ admission. Within this study, there were individuals with multiple admissions and ED presentations after their index admission.

d. The profile for readmissions could probably be more pedagogically presented by using a survival plot for different subgroups. A survival plot would give a better idea about when the patients are readmitted, and could for example concentrate on time from discharge to first readmission in either of the two services. Such plot could also serve as a basis for the chosen time periods.

It is a very good point. Given that the aim of the current study was to explore the factors associated with readmission and ED presentation instead of time to an event, we chose logistic regression. The inclusion of the 3 time intervals is to reflect the service trajectories of the cohort which can have practical implications for service planning and policy design. We intend to explore the datasets using survival analysis in our future work.

As initially mentioned, this is potentially a very interesting paper, based on a huge dataset. I would like to encourage the authors to continue their work with this paper to make their findings accessible to the scientific community.

Reviewer: 5

Reviewer Name: Professor Tarun Bastiampillai Institution and Country: Flinders University, Department of Psychiatry South Australia, Australia Please state any competing interests or state ‘None declared’: None declared

We would like to thank Professor Tarun Bastiampillai for these comments and suggestions which have helped us to refine the manuscript. Each of the comments have been addressed below. Please note all the included references to the page numbers and lines were based on the track change version of the manuscript.

This is an interesting and important study that is well written and argued.
It is of note and surprising that that type of analysis (multiple time intervals) has not been conducted before, which further increases the relevance of this study.
It would have been useful to have also analysed Length of stay metrics in the inpatient ward for the index episode as possible predictor of subsequent readmission and representation.

Length of stay at index admission has been added as a new variable. The length of stay was associated with fewer ED presentations across the study period and psychiatric readmission in the first month and it increased the likelihood of psychiatric readmission in the last 2 intervals.

We have added “The association between length of stay at index admission and ED presentations differed from that observed with readmission, and may have related to the interaction of initial severity/complexity of presentation (determining index admission length) and time-dependent factors such as subsequent clinical pathways. For individuals experiencing first psychiatric admission, subsequent allocation of community supports may be most cohesive for those with higher levels of complexity, for which length of index admission may be a proxy. This could have mitigated representation to ED and early rates of readmission. With time, it is possible that community supports become less cohesive over time, and indeed a weakening of the relationship between length of index admission and representation to ED was noted over time. Whilst the same mitigation was initially apparent in the 1 month readmission data, this appeared to be swamped in subsequent time periods by other factors. Although this is harder to explain, it is possible that those individuals with greater complexity may have subsequently been more likely to present directly to psychiatric inpatient facilities. This occurs in some jurisdictions in Australia for those who are more acutely disturbed. The variable findings over time reaffirm the need to include longer time intervals to gain insights into service trajectory.” on page 30 line 11 in the discussion.

BMJ Open

Emergency department presentation and readmission after index psychiatric admission: a data linkage study

Journal:	<i>BMJ Open</i>
Manuscript ID	bmjopen-2017-018613.R2
Article Type:	Research
Date Submitted by the Author:	13-Dec-2017
Complete List of Authors:	Li, Xue; UNSW Australia, Department of Developmental Disability Neuropsychiatry Srasuebkul, Preeyaporn; UNSW Australia, Department of Developmental Disability Neuropsychiatry Reppermund, Simone; UNSW Australia, Department of Developmental Disability Neuropsychiatry Trollor, Julian; University of New South Wales, Department of Developmental Disability Neuropsychiatry
Primary Subject Heading:	Health services research
Secondary Subject Heading:	Mental health
Keywords:	Psychiatric admission, readmission, emergency department presentation, mental health service, data linkage

SCHOLARONE™
Manuscripts

Only

TITLE:

Emergency department presentation and readmission after index psychiatric admission:
a data linkage study

RUNNING TITLE:

Acute care re-presentations following index mental health admission

AUTHORS

Xue Li¹, Preeyaporn Srasuebkul¹, Simone Reppermund^{1,2}, Julian Trollor^{1,2}

¹ Department of Developmental Disability Neuropsychiatry, School of Psychiatry, UNSW Sydney, Australia

² Centre for Healthy Brain Ageing, School of Psychiatry, UNSW Sydney, Australia

CORRESPONDING AUTHOR:

Professor Julian Trollor, Department of Developmental Disability Neuropsychiatry,
School of Psychiatry, 34 Botany Street, UNSW Sydney, Sydney NSW 2052, Australia.
Email: j.trollor@unsw.edu.au

Abstract

Objective: To use linked administrative datasets to assess factors associated with Emergency Department (ED) presentation and psychiatric readmission in three distinctive time intervals after the index psychiatric admission.

Design: A retrospective data-linkage study.

Setting: Cohort study using four linked government minimum datasets including acute hospital care from July 2005 to June 2012 in New South Wales, Australia.

Participants: People who were alive and aged ≥ 18 years on 01 July 2005 and who had their index admission to a psychiatric ward from 01 July 2007 to 30 June 2010.

Outcome measures: Odds ratios of factors associated with psychiatric admission and ED presentation were calculated for three intervals: 0-1 month, 2-5 months, and 6-24 months after the separation from the index admission.

Results:

Index admission was identified in 35,056 individuals (51% males) with a median age of 42 years. A total of 12,826 (37%) individuals had at least one ED presentation in the first 24 months after the index admission. Of those, 3,608 (28%) presented within 0-1 month, 6,350 (50%) within 2-5 months and 10,294 (80%) within 6-24 months after index admission. A total of 14,153 (40%) individuals had at least one psychiatric readmission in the first 24 months. Of those, 6,808 (48%) were admitted within 0-1 month, 6,433 (45%) within 2-5 months and 7,649 (54%) within 6-24 months after index admission. Principle diagnoses and length of stay at index admission, sociodemographic factors, Charlson comorbidity index score, drug and alcohol comorbidity, intellectual disability and other inpatient service utilisation were significantly associated with ED presentations and psychiatric readmissions.

Conclusion:

Social determinants of service utilisation, drug and alcohol intervention and addressing needs of individuals with intellectual disability are key areas for investment to improve trajectories after index admission and should be emphasised in recovery-oriented approaches in mental health care.

Keywords

Psychiatric admission, readmission, emergency department presentation, mental health service, data linkage

Strengths and limitations

- This study identifies factors associated with psychiatric readmissions and ED presentations following index admission after controlling for potential confounding factors in a large population based dataset.
- This study represents the only study internationally that has examined Emergency Department presentation and psychiatric readmission at multiple time intervals after index separation.
- The major limitation of this study is the use of administrative data, which lacks potentially important clinical information.

1 Introduction

Mental illness is one of the leading cause of disability in developed countries^{1 2}. Building a mental health system that cohesively supports individuals with severe mental illness is a challenge for mental health services. Despite enhancements in community psychiatric supports, demand for acute services for people with mental ill health remains high, as evidenced by escalating use of Emergency Departments (ED)³ and high demand for acute psychiatric inpatient services⁴⁻⁶. Most acute psychiatric episodes of care are by repeat users^{7 8}. Thus, the development of a clear understanding of the drivers of ED utilisation and psychiatric readmission for those with mental illness is of potential benefit to mental health consumers, service providers and health service administrators.

Administrative data can provide substantial insights into factors associated with mental health service use. Factors such as sociodemographic factors, specific psychiatric conditions, comorbidities, and characteristics of previous hospital admissions all have significant impacts on mental health related service use⁹⁻¹². For example, the 2010 Australian National Survey of Psychosis¹³ revealed that being younger, having high severity of psychotic symptoms, and poor social functioning were associated with greater mental health service use. Another US study found among individuals with a mental health or substance abuse diagnosis psychiatric conditions such as schizophrenia and affective disorders not only increase the likelihood of psychiatric readmission, they were also found to be predictors of ED presentations¹². Other strong predictors with a robust and reciprocal impact on both ED use and psychiatric service use are comorbid conditions including physical and psychiatric comorbidity, cognitive and psychiatric comorbidity, intellectual disability (ID) and drug

1 service trajectory of a cohort^{21 23-25}. It is likely that sociodemographic factors and
2 physical and mental health comorbidities may interact to produce increasing complexity
3 over time, with associated increases in the likelihood of re-presentation to acute
4 services. Thus, examination of the factors associated with acute mental health service
5 use over several intervals, and for a substantial time period, is an important step in
6 development of comprehensive understanding of the drivers of service use.

7 Population health administrative records in Australia provide an opportunity to
8 examine acute health services use and their determinants. The current study aims to
9 identify the factors associated with acute care service use following index psychiatric
10 admission. Doing so will provide an opportunity to understand drivers of acute service
11 use in this context, and to better plan services and policy responses which underpin
12 recovery from an initial mental health episode. To understand the dynamics of acute
13 service use, it is important to examine the factors associated with psychiatric
14 readmissions and ED presentation in multiple intervals. We hypothesised that the
15 principle psychiatric diagnoses at index admission, sociodemographic factors, comorbid
16 conditions and non-psychiatric admissions would have a significant association with ED
17 presentations and psychiatric readmissions and that predictors of these may vary over
18 time.

1 The potential study population was people in the APDC with at least one recorded
2 psychiatric occurring before June 30, 2012 and who were alive at 1st July 2005. From
3 this group, we excluded people aged <18 years on 01 July 2005. Further, to determine
4 those likely to be experiencing their 'index' or first ever psychiatric admission in our
5 observation period, we applied a 2-year look back period and excluded from the final
6 cohort those who were admitted to a psychiatric ward before 01 July 2007. In order
7 ensure a 2-year minimum follow up period we also excluded those with first admission
8 after 30 June 2010. Information regarding admission and separation from a psychiatric
9 ward was obtained from the APDC record. Index admission was therefore a psychiatric
10 admission occurring between 01 July 2007 and 30 June 2010, following a 2-year,
11 admission free look back period. The index admission started at the date of the first
12 admission to the psychiatric facility and ended when the separation was noted, index
13 separation.

14 Three different intervals were used in the study: i) 0-1 Month: this interval
15 started at the date of the index separation to the 29th day after the index separation date;
16 ii) 2-5 months: this interval started on the 30th day after the index separation to the 29th
17 day of month 5; iii) 6-24 months: this interval started at the 30th day of the 5th month
18 after the index separation date to the 29th day of month 23.

19 ***Outcome measures***

20 There were two outcomes in this study, ED presentations and readmission to a
21 psychiatric facility after the index separation. We considered patients who had any
22 records of being admitted to a psychiatric facility after the index separation in each time
23 interval as having a readmission to a psychiatric facility in the specific period.
24 Similarly, patients who had any records of ED presentations after the index separation

comorbidities, drug and alcohol and intellectual disability status, which were known to be highly associated with psychiatric readmissions or ED presentations^{32 33}.

Drug and alcohol comorbidity coding was derived differently for the analyses of psychiatric readmission and ED presentation outcomes. For ED presentation outcomes, drug and alcohol comorbidity codes were derived from the APDC and were obtained by hospital episodes where drug and alcohol appeared in one of the diagnoses regardless of the admission type. However, for psychiatric readmission outcomes, to avoid conflation with the primary reason for psychiatric admission, we excluded drug and alcohol comorbidity diagnoses when these were the primary reason for admission to the psychiatric facility. Consistent with our previous approach, we identified ID with codes including: childhood disintegrative and overactive disorders associated with mental retardation; intellectual development delay; mild through profound mental retardation; Down syndrome and other chromosomal anomalies associated with mental retardation; Fragile X syndrome and congenital malformation syndromes due to known exogenous causes³⁴. The value of the ID flag was set to 1 throughout the study period for everyone who had any records with the relevant codes and set to 0 for everyone who did not have such a record. We also defined a binary variable representing any non-psychiatric hospital episodes for each individual using the APDC dataset. All other variables including age, sex, IRSD, and remoteness were identified through the patient record from DS MDS, APDC, and EDDC. Age was a time dependent variable, it was recalculated at each time interval and was categorised into three groups: young adults (18-35 years); middle aged adults (36-55 years); older adults (56+).

1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
16
17
18
19
20
21
22
23
24
25
26
27
28
29
30
31
32
33
34
35
36
37
38
39
40
41
42
43
44
45
46
47
48
49
50
51
52
53
54
55
56
57
58
59
60

1 All statistical analyses were completed with STATA, version 14.0. Odds ratios
2 (ORs) with 95% confidence intervals (CI) were reported, and the threshold for statistical
3 significance was set at $p < .05$.

4 ***Ethics approval***

5 Ethics approval was obtained from the NSW Population and Health Services Research
6 Ethics Committee (PHSREC) (CINSW Reference Number 2013/02/446).

Results

Cohort characteristics

There were 114,095 individuals with at least one psychiatric admission from July 1, 2005 to June 30, 2012 and who were alive at 1st July 2005. Of these, a total of 35,056 individuals met inclusion criteria for the study. Of the 79,039 excluded individuals, 13,116 were excluded due to being under the age of 18 years on 01 July 2005; 65,812 were excluded for not having their first record admission between 01 July 2007 and 30 June 2010 and 111 were excluded for having an unknown area of residence and/or IRSD. For those meeting inclusion criteria, half of the population was male with the median and Interquartile Range (IQR) of age at the beginning of the study period of 38 years (28–50 years) and at index admission, 42 years (32–54 years). The majority of people in our cohort lived in the major cities (76%), 16% lived in the most disadvantaged area and 22% lived in the least disadvantaged area. Mood disorders accounted for over a third of principle diagnoses for the index admission (36%); followed by anxiety and stress related psychiatric disorder (21%), while disorders of adult personality and behavior accounted for 3%. One percent of people in our cohort were coded as not having a psychiatric disorder. The median (IQR) length of stay at index admission was 9 days (2–21 days). Percentages of drug and alcohol use were 41% and 22% for the ED presentation outcome and psychiatric readmission, respectively. People with intellectual disability represented 3% of the cohort (Table 1).

1 **Table 1.** Cohort characteristics. N (%) unless otherwise stated.

	Total
Number of people	35,056 (100)
Male	17,822 (51)
Median (IQR) age, years	
At July 2005	38 (28-50)
At index admission	42 (32-54)
Median (IQR) length of stay at index admission, days	9 (2-21)
Remoteness Area	
Major Cities	26,468 (76)
Inner Regional	6,778(19)
Outer Regional/ Remote/ Very Remote	1,810 (5)
Index of Relative Socioeconomic Disadvantage (IRSD)	
1-2 most disadvantaged	5,686 (16)
3-4	5,655 (16)
5-6	8,644 (25)
7-8	7,332 (21)
9-10 least disadvantaged	7,739 (22)
Principle diagnoses at index admission	
Mood disorder	12,707 (36)
Schizophrenia and delusion	6,998 (20)
Disorder of adult personality and behavior	1,056 (3)
Drug and alcohol	5,070 (14)
Anxiety and stress related psychiatric disorder	7,363 (21)
Organic psychiatric disorder	667 (2)
Other psychiatric disorder	740 (2)
Not psychiatric disorder	455 (1)
Comorbidity	
Drug and Alcohol (for psychiatric admission)	6,475 (22)
Drug and alcohol (for ED endpoint)	13,858 (41)
Intellectual Disability	899 (3)

1 *Factors associated with ED presentations and psychiatric readmissions after the*
2 *index admission*

3 **ED presentation.** 12,826 (37%) individuals had at least one ED presentation in the 24
4 months after index admission. Of those, 3,608 (28%) had ED presentations in the first
5 month after the index admission with the median of 1 ED presentation per individual.
6 6,350 (50%) and 10,294 (80%) individuals had ED presentations in the intervals of 2-5
7 months and 6-24 months after the index admission with medians of 1 and 2 ED
8 presentations, respectively. Table 2 reports the percentiles of the number of ED
9 presentation in each interval. The median time (IQR) to an ED presentation after the
10 index admission was 107 (24-296) days.

11 Table 3 reports the odds ratios, confident intervals and p values of the factors
12 associated with ED presentations after the index separation in the three intervals. Males
13 were less likely to present to ED in the 2 to 5 months and 6 to 24 months intervals
14 compared to females. Compared to young adults (18–35 years), individuals who were
15 middle aged and older were both significantly less likely to present to an ED across all
16 intervals. Area of residence also showed a consistent association with ED presentation.
17 Compared to individuals who lived in major cities, individuals who lived in inner
18 regional areas had increased likelihood of ED presentation after the index separation
19 across all intervals. Individuals who lived in outer regional areas were more likely to
20 have ED presentations in the first month after the index separation compared to those

1 who lived in major cities. Area socioeconomic status had a considerable bearing on ED
2 presentation such that those who lived in the least socioeconomic disadvantaged areas
3 were less likely to present to an ED after the index separation than those who lived in
4 the most disadvantaged areas across all intervals.

5 The principle diagnosis given at the index psychiatric admission had a significant
6 association with ED presentations. Compared to mood disorders, disorders of adult
7 personality and behavior were consistently associated with elevated ED presentations
8 across the three intervals. Longer length of stay at index admission reduced the
9 likelihood of ED presentations across the study period.

10 Comorbidity had an incremental association with ED presentation after the index
11 separation. Comparing to individuals with no other physical illness (Charlson
12 comorbidity index score of 0) recorded, individuals with a Charlson comorbidity index
13 score of 1 to 3 were more likely to present to an ED across the 3 intervals. Having a
14 Charlson comorbidity index score above 4 was associated with greater likelihood of ED
15 presentation in the last 2 intervals. Intellectual disability had a consistent and robust
16 association with ED presentation across all intervals. The association between drug and
17 alcohol comorbidity and ED presentation increased as time progressed.

18 Non-psychiatric hospitalisations were associated with ED presentations across
19 all intervals; however, the strongest association was in the first month after the index
20 admission and the odds ratios decreased with time.

Table 2. Percentiles of the number of ED presentations by intervals

Percentile	0-1 month	2-5 months (4 months)	6-24 months (18 months)
25th percentile	1	1	1
50th percentile	1	1	2
75th percentile	2	3	4
99th percentile	7	13	27
Maximum	25	103	329

Table 3. Factors associated with ED presentation after the index admission.

Variable	One month (N =35,056)			Two to five months (N = 34,955)			Six months to twenty four months (N = 34,643)		
	Odds Ratio	95% CI	p-value	Odds Ratio	95% CI	p-value	Odds Ratio	95% CI	p-value
Gender									
Female	Ref			Ref			Ref		
Male	0.93	0.87-1.00	0.066	0.90	0.84-0.95	<0.001	0.95	0.90-1.00	0.047
Age category			<0.001			<0.001			<0.001
Young adults (18-35 years)	Ref			Ref			Ref		
Middle aged adults (36-55 years)	0.85	0.79-0.92	<0.001	0.87	0.81-0.93	<0.001	0.83	0.78-0.88	<0.001
Older adults (56+)	0.71	0.64-0.80	<0.001	0.71	0.65-0.78	<0.001	0.67	0.62-0.72	<0.001

Remoteness Area			<0.001			<0.001			0.113
Major cities	Ref			Ref			Ref		
Inner Regional	1.23	1.13-1.35	<0.001	1.38	1.28-1.48	<0.001	1.43	1.34-1.53	<0.001
Outer Regional/ Remote/ Very Remote	1.22	1.05-1.42	0.011	1.06	0.93-1.21	0.392	1.06	0.95-1.19	0.309
Index of Relative Socioeconomic Disadvantage (IRSD)			<0.001			<0.001			<0.001
1-2 Most Disadvantaged	Ref			Ref			Ref		
3-4	0.91	0.81-1.02	0.107	1.02	0.93-1.12	0.674	1.02	0.94-1.11	0.629
5-6	0.94	0.85-1.05	0.272	0.96	0.88-1.05	0.341	1.01	0.94-1.09	0.767
7-8	0.86	0.76-0.96	0.009	0.74	0.67-0.81	<0.001	0.77	0.71-0.83	<0.001
9-10 Least Disadvantaged	0.64	0.57-0.73	<0.001	0.52	0.47-0.58	<0.001	0.59	0.54-0.64	<0.001
Principle Psychiatric Diagnosis at Index Admission			<0.001			<0.001			<0.001
Mood disorder	Ref			Ref			Ref		
Schizophrenia and delusion	0.99	0.88-1.10	0.794	1.04	0.95-1.13	0.379	1.14	1.06-1.23	<0.001
Disorder of adult personality and behavior	1.41	1.18-1.69	<0.001	1.64	1.41-1.91	<0.001	1.50	1.30-1.72	<0.001
Drug and Alcohol related disorder	0.91	0.81-1.02	0.113	0.94	0.85-1.03	0.157	0.80	0.73-0.86	<0.001
Anxiety and stress related disorder	1.05	0.95-1.16	0.331	1.06	0.98-1.15	0.148	0.95	0.89-1.02	0.153
Organic psychiatric disorders	1.21	0.93-1.57	0.159	1.21	0.97-1.50	0.092	1.41	1.16-1.70	<0.001

18

Other psychiatric disorder	0.97	0.75-1.25	0.809	0.76	0.61-0.95	0.016	0.77	0.64-0.92	0.005
Not psychiatric disorder	0.02	0.00-0.14	<0.001	0.11	0.06-0.19	<0.001	0.11	0.07-0.17	<0.001
Length of stay at index admission	0.83	0.80-0.85	<0.001	0.87	0.85-0.89	<0.001	0.88	0.87-0.90	<0.001
Charlson comorbidity Index Score			<0.001			<0.001			<0.001
0	Ref			Ref			Ref		
1-3	2.38	1.82-3.13	<0.001	3.24	2.70-3.90	<0.001	2.34	2.05-2.67	<0.001
4-6	3.92	1.60-9.63	0.003	3.81	1.96-7.38	<0.001	2.88	1.97-4.22	<0.001
7+	0.95	0.33-2.78	0.927	2.50	1.44-4.34	0.001	2.14	1.52-3.00	<0.001
Other comorbidity									
Drug and Alcohol	1.76	1.61-1.91	<0.001	5.00	4.60-5.43	<0.001	5.49	5.11-5.90	<0.001
Intellectual Disability	3.03	2.56-3.58	<0.001	3.00	2.58-3.47	<0.001	2.94	2.54-3.40	<0.001
Non-psychiatric hospitalisation	2.87	2.53-3.26	<0.001	2.00	1.84-2.18	<0.001	1.65	1.55-1.75	<0.001

18

Psychiatric readmissions. In the study period, 14,153 (40%) individuals had at least one psychiatric readmission in the 24 months after the index admission. Of those, 6,808 (48%) individuals had readmissions in the first month (median of 1) readmission. 6,433 (45%) individuals had readmissions 2-5 months after the index admission (median of 2) and 7,649 (54%) had readmissions 6-24 months after the index admission (median of 2). Table 4 reports the percentiles of the number of readmissions in each interval. The median (IQR) time to a psychiatric readmission after the index admission was 36 (4-209) days.

Table 5 reports the odds ratios, confident intervals and *p* values of the factors associated with psychiatric readmissions. Males were consistently less likely to be readmitted to a psychiatric facility compared to females. Compared to young adults (18-35 years), older adults (56 years and above) and individuals aged between 35 and 55 were more likely to be readmitted in the first two intervals. Individuals who lived in the outer regional, remote, and very remote areas were less likely to have a psychiatric readmission after the index separation than individuals who lived in major cities. Individuals who lived in the least disadvantaged area were more likely to be readmitted to a psychiatric facility than individuals who lived in the most disadvantaged area.

Principle psychiatric diagnosis at index admission was associated with psychiatric readmission. Compared to mood disorders, both schizophrenia and delusion disorder and organic psychiatric disorder had a persistent association with psychiatric

1 readmission. Schizophrenia and delusion disorder was associated with lower likelihood
2 of readmission within the first six months but was associated with higher likelihood in
3 the last interval. Organic psychiatric disorder diagnosis was associated with lower
4 likelihood psychiatric readmissions across the study period. A principal diagnosis in the
5 drug and alcohol category was associated with greater likelihood psychiatric
6 readmission in the last 2 intervals. Anxiety and stress related psychiatric disorder were
7 significantly associated with reduced likelihood of readmission in the first and last
8 interval. Having a 'Not psychiatric diagnosis' at index admission increased the
9 likelihood of readmission in the first month and decreased the likelihood of readmission
10 in the last 2 intervals. Greater length of stay at index admission was associated with
11 lower likelihood of readmissions in the first interval, but with increased likelihood of
12 readmission in the last 2 intervals.

13 Higher Charlson comorbidity index scores were generally associated with a
14 lower likelihood of psychiatric readmissions. Intellectual disability was consistently
15 associated with higher rates of psychiatric readmissions across all intervals. There were
16 strong associations between and psychiatric readmissions and drug and alcohol
17 comorbidity. Drug and alcohol comorbidity significantly increased the likelihood of
18 readmission across all intervals.

1 Non-psychiatric hospitalisations were associated with decreased likelihood of
2 psychiatric readmissions in the first interval and increased likelihood of readmission in
3 the last two intervals.

For peer review only

Table 4. Percentiles of the number of psychiatric readmission by intervals

Psychiatric readmission	0-1 month	2-5 months (4 months)	6-24 months (18 months)
25th percentile	1	1	1
50th percentile	1	2	2
75th percentile	3	5	3
99th percentile	16	24	53
Maximum	23	94	157

Table 5. Factors associated with psychiatric readmission after the index admission.

	One month (N =35,056)			Two to five months (N = 34,955)			Six months to twenty-four months (N = 34,634)		
Variable	Odds Ratio	95% CI	p-value	Odds Ratio	95% CI	p-value	Odds Ratio	95% CI	p-value
Gender									
Female	Ref			Ref			Ref		
Male	0.82	0.78-0.87	<0.001	0.84	0.79-0.90	<0.001	0.84	0.80-0.90	<0.001
Age category			<0.001			<0.001			<0.373
Young adults (18-35 years)	Ref			Ref			Ref		
Middle aged adults (36-55 years)	1.11	1.03-1.18	0.002	1.16	1.08-1.24	<0.001	1.05	0.98-1.12	0.174
Older adults (56+)	1.38	1.27-1.50	<0.001	1.21	1.11-1.32	<0.001	1.04	0.96-1.14	0.321
Remoteness Area			<0.001			<0.001			0.001
Major cities	Ref			Ref			Ref		
Inner Regional	0.70	0.64-0.77	<0.001	0.87	0.80-0.95	0.002	0.89	0.79-0.92	0.006
Outer Regional/ Remote/ Very Remote	0.74	0.63-0.87	<0.001	0.72	0.61-0.85	<0.001	0.81	0.70-0.94	0.004
Index of Relative Socioeconomic			<0.001			<0.001			0.030

1										
2										
3										
4										
5	Disadvantage (IRSD)									
6										
7	1-2 Most	Ref			Ref			Ref		
8	Disadvantaged									
9	3-4	0.94	0.84-1.06	0.326	1.08	0.96-1.22	0.193	1.12	1.01-1.24	0.031
10	5-6	1.25	1.13-1.38	<0.001	1.13	1.02-1.26	0.022	1.12	1.02-1.24	0.018
11	7-8	1.49	1.35-1.66	<0.001	1.25	1.12-1.39	<0.001	1.14	1.03-1.26	0.011
12	9-10 Least	2.42	2.18-2.68	<0.001	1.52	1.36-1.69	<0.001	1.17	1.06-1.30	0.002
13	Disadvantaged									
14										
15										
16										
17	Principle psychiatric			<0.001			<0.001			<0.001
18	diagnosis									
19	Mood disorder	Ref			Ref			Ref		
20	Schizophrenia and	0.70	0.64-0.77	<0.001	0.74	0.68-0.81	<0.001	1.25	1.15-1.35	<0.001
21	delusion disorder									
22	Disorder of adult	0.82	0.69-0.98	0.025	0.98	0.81-1.18	0.842	1.05	0.88-1.24	0.661
23	personality and									
24	behavior									
25	Drug and alcohol	0.92	0.84-1.06	0.055	0.74	0.67-0.82	<0.001	0.59	0.53-0.65	<0.001
26	related disorder									
27	Anxiety and stress	0.82	0.75-0.89	<0.001	0.94	0.86-1.02	0.155	0.79	0.73-0.86	<0.001
28	related disorder									
29	Organic psychiatric	0.51	0.39-0.68	<0.001	0.40	0.29-0.54	<0.001	0.47	0.35-0.63	<0.001
30	disorders									
31	Other psychiatric	1.39	1.15-1.67	0.001	0.94	0.76-1.15	0.549	0.88	0.72-1.08	0.231
32	Not psychiatric	1.82	1.48-2.24	<0.001	0.26	0.17-0.39	<0.001	0.19	0.11-0.35	<0.001
33	disorder									
34										
35	Length of stay at	0.75	0.73-0.77	<0.001	1.23	1.20-1.26	<0.001	1.22	1.19-1.25	<0.001
36	index admission									
37										
38										
39										
40										
41	23									
42										
43										
44										
45										
46										
47										

Charlson comorbidity Index Score			0.006			0.004			<0.001
0	Ref			Ref			Ref		
1-3	0.79	0.55-1.12	0.186	0.90	0.71-1.14	0.379	0.80	0.68-0.94	0.005
4-6	0.14	0.04-0.48	0.002	0.34	0.14-0.82	0.017	0.38	0.24-0.60	<0.001
7+	0.48	0.14-1.59	0.229	0.26	0.10-0.69	0.007	0.69	0.45-1.06	0.092
Other comorbid conditions									
Drug and Alcohol	18.25	16.29-20.45	<0.001	15.52	13.99-17.22	<0.001	11.58	10.65-12.60	<0.001
Intellectual Disability	1.63	1.37-1.94	<0.001	1.54	1.28-1.85	<0.001	1.75	1.49-2.07	<0.001
Non-psychiatric hospitalisation	0.57	0.50-0.67	<0.001	1.11	1.01-1.23	0.032	1.28	1.19-1.37	<0.001

Discussion

Our findings show that sociodemographic factors, principle psychiatric diagnoses at index admission, length of stay at index admission, comorbidities and non-psychiatric inpatient admissions were all significantly associated with ED presentation and psychiatric readmission. While some factors had a robust and consistent association across all time intervals, each interval also revealed a distinctive pattern of associations.

Age and sex had a significant association with ED presentations and psychiatric readmissions after the index admission which is similar to previous studies demonstrating that sociodemographic factors are associated with mental health service use^{35 36}. Consistent with previous population data¹², being young increased the likelihood of ED presentation. Similar to previous research that found females use more mental health services¹³, being male was associated with lower likelihood of psychiatric readmissions in our study. While low socioeconomic status and remoteness of the living area were associated with more ED presentations, they were associated with lower likelihood of psychiatric readmissions. Our findings are consistent with previous studies which found that individuals with higher education and income use more mental health services^{37 38} whereas individuals with lower socioeconomic status tend to use more crisis driven services such as ED^{39 40}. Emergency departments are widely distributed and freely available through a universal healthcare system in Australia, and are therefore accessible regardless of socioeconomic status. In contrast, inpatient psychiatric care is available in larger centres only, and is provided by both public and private providers, the latter of which are accessed only by those able to afford private health insurance and/or co-payment for services⁴¹. Together, these factors may explain the variable relationships of ED representation and readmissions with socioeconomic status and remoteness of living area.

1 Principle psychiatric diagnosis had a persistent impact on the service trajectory of an
2 individual. For example, the association between personality and behavioral disorder and ED
3 presentation after index separation may relate to symptoms associated with self-harm which
4 is a well-recognised reason for presentation to ED⁴². However, reflecting the emphasis on
5 enduring community based supports in its management, personality and behavioral disorder
6 was not associated with readmission. Compared to mood disorder diagnoses, schizophrenia
7 and delusion disorder were associated with lower likelihood of readmissions in the first six
8 months after the index admission. However, previous findings showed that schizophrenia as a
9 principle diagnosis was highly correlated to ED presentation and psychiatric readmission
10 within 30 days after index admission¹². This may be explained by the clustered code used in
11 this study which combined the most common psychiatric disorders such as depression and
12 bipolar disorder into one category-mood disorder and it represents 36% of the cohort.

13 The association between length of stay at index admission and ED presentations
14 differed from that observed with readmission, and may have related to the interaction of
15 initial severity/complexity of presentation (determining index admission length) and time-
16 dependent factors such as subsequent clinical pathways. For individuals experiencing first
17 psychiatric admission, subsequent allocation of community supports may be most cohesive
18 for those with higher levels of complexity, for which length of index admission may be a
19 proxy. This could have mitigated representation to ED and early rates of readmission. With
20 time, it is possible that community supports become less cohesive over time, and indeed a
21 weakening of the relationship between length of index admission and representation to ED
22 was noted over time. Whilst the same mitigation was initially apparent in the 1 month
23 readmission data, this appeared to be swamped in subsequent time periods by other factors.
24 Although this is harder to explain, it is possible that those individuals with greater complexity
25 may have subsequently been more likely to present directly to psychiatric inpatient facilities.

1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
16
17
18
19
20
21
22
23
24
25
26
27
28
29
30
31
32
33
34
35
36
37
38
39
40
41
42
43
44
45
46
47
48
49
50
51
52
53
54
55
56
57
58
59
60

1 Drug and alcohol related disorders as principle diagnoses was associated with lower
2 likelihood of psychiatric readmissions, and yet as a comorbid condition drug and alcohol
3 related diagnoses showed the highest association of all covariates with psychiatric
4 readmission and ED presentation across the time intervals. Only 14% of the cohort had a
5 principle drug and alcohol related diagnosis, whereas 41% of the cohort had a drug and
6 alcohol comorbidity in the ED data, suggesting that these two labels pick up different
7 presentations, in different contexts and with different clinical supports. The two highly
8 correlated diagnoses of drug and alcohol use and mental ill health are often referred to as dual
9 diagnosis in mental health care⁴³. It is understood that drug and alcohol comorbidity can lead
10 to reductions of compliance with psychiatric treatment, and as a result dual diagnosis are
11 often managed in inpatient mental health services³³. The strength of the association between
12 drug and alcohol comorbidity and ED presentation and psychiatric readmission suggests that
13 drug and alcohol intervention should not only occur early, but should be a sustained focus in
14 healthcare. Drug and alcohol comorbidity also had a stronger association with psychiatric
15 readmission than ED presentation; such a difference may be partially explained by the
16 proportion of individuals with complex needs being admitted to a psychiatric facility
17 bypassing ED. However, more research is needed to investigate the factors attributed to this
18 distinctive service utilisation pattern.

19 Previous studies¹⁵ reported a high prevalence of physical comorbidity among
20 individuals with mental illness and we found that the Charlson comorbidity index score had
21 an opposite impact on ED presentation and psychiatric readmission. The Charlson
22 comorbidity index score is often used to predict mortality rate within a year⁴⁴. Individuals
23 with more severe physical comorbidities were understandably more likely to present to ED
24 and less likely to be readmitted to a psychiatric facility. The current study was unable to
25 investigate whether physical health comorbidities were related to the index admission or the

onset of a psychiatric illness. The findings do however suggest that an emphasis on tailored and holistic healthcare is needed within both mental health services and primary healthcare settings.

The presence of ID was persistently and strongly associated with ED presentation and psychiatric readmission across the study period which is consistent with previous research³².

As reported elsewhere^{45 46}, the mental health system in Australia is not yet equipped to provide comprehensive mental health supports for individuals with ID. Consistent with a previous study¹⁴, the current study suggests that ID adds to complex support needs which have a direct bearing on ED and inpatient mental health service use, above and beyond that due to the mental illness alone. Unlike many physical conditions which an individual can acquire at any point in time, ID is a permanent disability that is often identified at an early stage in life. Our findings reaffirm that equipping mental health services to meet the mental health needs of people with ID is useful and may assist in buffering the impact of this disability on service use.

A commonly agreed definition of 'frequent users' is those with 3 or more visits per year for ED presentation⁴⁷. A quarter of the cohort had 3 or more ED presentations even within a short 2 to 5 months period after index admission. Past studies have found that frequent ED users tend to have complex healthcare needs and are frequent users of primary and acute health services^{48 49}. The current study also found that non-psychiatric admissions increased the likelihood of ED presentations and psychiatric readmission. These findings suggest that strong relationships exist between each component of acute healthcare services and are in keeping with past research⁵⁰ in which a small proportion of acute service users consumed intensive resources and were not optimally managed within the context of acute healthcare setting. Further research is needed to explore the characteristics of frequent service users in this cohort.

The change of direction of the association of principle diagnoses such as schizophrenia and delusion disorder and psychiatric readmission at different time intervals suggest that the service trajectories of individuals with different psychiatric disorders and symptoms can vary and that the 30 days readmission predictors may not capture such change. Further research should seek to explore in more detail the drivers and dynamics of fluctuations in service use over time.

Strengths and limitations

To our knowledge, it is the only cohort study internationally that has examined these associations at multiple time intervals. The current data-linkage study represents a large cohort and provides a comprehensive overview of factors associated with psychiatric readmissions and ED presentations. Our method of identifying index admissions may have inadvertently captured individuals who had admissions prior to July 2005. However, given that 60% of mental health service users in Australia had a mental health disorder lasting 12 months⁸ and a previous study⁵¹ found that 66% of mental health users readmitted to a psychiatric facility within a year; it is unlikely that this has affected the results.

A limitation of the current study is the use of data collected for administrative rather than clinical purposes, therefore we lack potentially important clinical information. We were unable to examine the severity of symptoms when admitted to the hospital and its association with readmissions and ED presentation. As APDC data are collected on separation from the hospital, we were also unable to identify the very small percentage of individuals who had an index admission during the study period and yet remained in the facility throughout the study period.

ID had a robust and persistent impact on both ED presentation and psychiatric readmission; however, due to the limitation of the research scope of this study, we did not further examine sub-groups of people with ID. The results of the current study are a strong

indicator of the unmet needs of the ID population. Further research that examines sub-populations such as individuals with Autism, Down syndrome and FAS within the ID population is needed to understand their needs. We also acknowledge that a small proportion of individuals with borderline and mild ID may not be identified in the ID cohort if they did not receive disability services previously.

Conclusions

We propose the following recommendations to improve service integration: a stronger public health approach to address the impact of social determinants on service utilisation, early intervention programs for dual diagnosis of mental illness and drug and alcohol comorbidity, an urgent response to address the unmet needs of individuals with ID and mental illness and a more holistic care approach to address comorbidity in the inpatient setting. In addition, more research is needed to understand the service trajectories of individuals with different psychiatric conditions beyond the commonly used 30 days interval.

Acknowledgements

We would like to acknowledge all investigators and partner organisations contributing to the project: Chief Investigators: Julian Trollor, Eric Emerson, Rhoshel Lenroot, Karen Fisher, Kimberlie Dean, Leanne Dowse

Associate Investigators: Eileen Baldry, Tony Florio, Grant Sara, Phillip Snoyman, Les White,

Project Staff and Students: Angela Dew, Preeyaporn Srasuebkul, Erin Whittle, Simone Reppermund, Xue Li, Bronwyn Newman, Theresa Heintze

Partner Organisations: Agency for Clinical Innovation – Intellectual Disability Network, NSW Department of Family & Community Services - Ageing, Disability and Home Care, NSW Department of Education, NSW Department of Justice - Corrective Services NSW,

1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
16
17
18
19
20
21
22
23
24
25
26
27
28
29
30
31
32
33
34
35
36
37
38
39
40
41
42
43
44
45
46
47
48
49
50
51
52
53
54
55
56
57
58
59
60

1 NSW Ministry of Health – Justice Health & Forensic Mental Health Network, Mental Health
2 Commission of NSW, NSW Ministry of Health – Mental Health & Drug & Alcohol Office,
3 NSW Ministry of Health - InforMH, Mental Health Review Tribunal, National and NSW
4 Council for Intellectual Disability, National Disability Services, NSW Office of the Public
5 Guardian, NSW Ombudsman.

6 **Contributorship statement**

7 JNT, PS, SR and XL participated in the conceptual design of the study. XL wrote the first
8 draft of the manuscript. PS performed the analyses. All authors critically revised the
9 manuscript and contributed to interpretation of the data. All authors read and approved the
10 final version of the manuscript.

11 **Funding**

12 This study was funded by a National Health and Medical Research Council Australia funded
13 Partnerships for Better Health grant (ID: APP1056128; Title: Improving the Mental Health
14 Outcomes of People with an Intellectual Disability).

15 **Competing interests:** None declared.

16 **Patient consent:** No.

17 **Ethics approval**

18 Ethics approval was obtained from the NSW Population and Health Services Research Ethics
19 Committee (AU RED Study Reference Number: HREC/13/CIPHS/7; CINSW Reference
20 Number: 2013/02/446), and access to the data sets was granted by relevant data custodians.

21 **Provenance and peer review:** Not commissioned; externally peer reviewed.

22
23 **Data sharing statement:** Direct access to the data and analytical files is not permitted
24 without the expressed permission of the approving human research ethics committees and
25 data custodians. Researchers interested in collaboration should contact the corresponding
26 author with their expression of interest.

Reference

1. Jacobi F, Wittchen H, Holting C, et al. Prevalence, co-morbidity and correlates of mental disorders in the general population: results from the German Health Interview and Examination Survey (GHS). *Psychological Medicine* 2004;34(4):597-611.
2. Whiteford H, Degenhardt L, Rehm J, et al. Global burden of disease attributable to mental and substance use disorders: findings from the Global Burden of Disease Study 2010. *Lancet* 2013;382(9904):1575-86. doi: 10.1016/S0140-6736(13)61611-6
3. Kalucy R, Thomas L, King D. Changing demand for mental health services in the emergency department of a public hospital. *Aust N Z J Psych* 2005;39(1-2):74-80.
4. Whiteford HA. Australia's national mental health policy. *Hospital & community psychiatry* 1993;44(10):963.
5. Whiteford H, Buckingham W. Ten years of mental health service reform in Australia: are we getting it right? *Medical Journal of Australia* 2005;182(8):396-400.
6. Allison S, Bastiampillai T. Mental health services reach the tipping point in Australian acute hospitals: The OECD warns about Australia's low psychiatric bed numbers. *Medical Journal of Australia* 2015;203(11):432-34. doi: 10.5694/mja15.00782
7. Jaramillo-Gonzalez L, Sanchez-Pedraza R, Herazo M. The frequency of rehospitalization and associated factors in Colombian psychiatric patients: a cohort study. *BMC Psychiatry* 2014;14 doi: 10.1186/1471-244X-14-161
8. Slade T JA, Teesson M, Whiteford H, Burgess P, Pirkis J, and Saw S. . The Mental Health of Australians 2. Report on the 2007 National Survey of Mental Health and Wellbeing. In: Ageing DoHa, ed. Canberra, 2009.
9. Lorine K, Schmidt K, Goenjian AK, et al. Risk factors associated with psychiatric readmission. *Journal of Nervous and Mental Disease* 2015;203(6):425-30. doi: 10.1097/NMD.0000000000000305
10. Régis Eric Maia B, João Mazzoncini de Azevedo M, Isabela Panzeri C, et al. Short admission in an emergency psychiatry unit can prevent prolonged lengths of stay in a psychiatric institution Internação breve em unidade de emergência psiquiátrica pode prevenir permanência prolongada em instituições psiquiátricas. *Revista Brasileira de Psiquiatria* 2010;32(2):145-51.
11. Loch AA. Stigma and higher rates of psychiatric re-hospitalization: Sao Paulo public mental health system. *Revista Brasileira de Psiquiatria* 2012;34(2):185-92.
12. Smith M, Stocks C, Santora P. Hospital Readmission Rates and Emergency Department Visits for Mental Health and Substance Abuse Conditions. *Community Mental Health Journal* 2015;51(2):190-97. doi: 10.1007/s10597-014-9784-x
13. Raudino A, Carr V, Bush R, et al. Patterns of service utilisation in psychosis: findings of the 2010 Australian National Survey of Psychosis. *Australian and New Zealand Journal of Psychiatry* 2014;48(4):341-51. doi: 10.1177/0004867413511996
14. Lunskey Y, Lin E, Balogh R, et al. Emergency Department Visits and Use of Outpatient Physician Services by Adults With Developmental Disability and Psychiatric Disorder. *Can J Psychiat-Rev Can Psychiat* 2012;57(10):601-07.
15. Parslow RA, Jorm AF. Who uses mental health services in Australia? An analysis of data from the National Survey of Mental Health and Wellbeing. *Australian and New Zealand Journal of Psychiatry* 2000;34(6):997-1008. doi: 10.1046/j.1440-1614.2000.00839.x
16. Billings J, Blunt I, Steventon A, et al. Development of a predictive model to identify inpatients at risk of re-admission within 30 days of discharge (PARR-30). *BMJ Open* 2012;2(4):e001667. doi: 10.1136/bmjopen-2012-001667
17. McGorry P. Early intervention in psychosis. *Aust N Z J Psych* 2006;40:A109-A09.

1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
16
17
18
19
20
21
22
23
24
25
26
27
28
29
30
31
32
33
34
35
36
37
38
39
40
41
42
43
44
45
46
47
48
49
50
51
52
53
54
55
56
57
58
59
60

18. Shadmi E, Flaks-Manov N, Hoshen M, et al. Predicting 30-day readmissions with preadmission electronic health record data. *Medical Care* 2015;53(3):283-89.

19. van Walraven C, Dhalla I, Bell C, et al. Derivation and validation of an index to predict early death or unplanned readmission after discharge from hospital to the community. *Canadian Medical Association Journal* 2010;182(6):551-57. doi: 10.1503/cmaj.091117

20. Shadmi E, Flaks-Manov N, Hoshen M, et al. Predicting 30-Day Readmissions With Preadmission Electronic Health Record Data. *Med Care* 2015;53(3):283-89.

21. Lin C, Chen W, Lin CM, et al. Predictors of psychiatric readmissions in the short- and long-term: a population-based study in taiwan. *Clinics* 2010;65(5):481-89. doi: 10.1590/S1807-59322010000500005

22. Kadam UT, Lawson CA, Moody DK, et al. Consumer segmentation and time interval between types of hospital admission: a clinical linkage database study. *Journal of Public Health* 2017;1-9. doi: 10.1093/pubmed/idx028

23. Librero J, Peiró S, Ordinana R. Chronic Comorbidity and Outcomes of Hospital Care: Length of Stay, Mortality, and Readmission at 30 and 365 Days. *Journal of Clinical Epidemiology* 1999;52(3):171-79. doi: [https://doi.org/10.1016/S0895-4356\(98\)00160-7](https://doi.org/10.1016/S0895-4356(98)00160-7)

24. Tsao CI, Chou NK, Chi NH, et al. Unplanned Readmission Within 1 Year After Heart Transplantation in Taiwan. *Transplantation Proceedings* 2010;42(3):946-47. doi: <https://doi.org/10.1016/j.transproceed.2010.02.053>

25. Ono T, Tamai A, Takeuchi D, et al. Factors related to readmission to a ward for dementia patients: Sex differences. *Psychiatry Clin Neurosci* 2011;65(5):490-98. doi: 10.1111/j.1440-1819.2011.02251.x

26. The Centre for Health Record Linkage (CHeReL). How record linkage works 2016 [Available from: <http://www.cherel.org.au/how-record-linkage-works> accessed 26 October 2017.

27. World Health Organization. The ICD-10 Classification of Mental and Behavioural Disorders: Clinical Descriptions and Diagnostic Guidelines. Geneva: World Health Organization 1992.

28. Australian Bureau of Statistics. Socio-Economic Index for Areas: Australian Bureau of Statistics, 2013.

29. Charlson ME, Pompei P, Ales KA, et al. A new method of classifying prognostic comorbidity in longitudinal studies: Development and validation. *Journal of Chronic Diseases* 1987;40(5):373-83.

30. Australian Institute of Health and Welfare. Principal Diagnosis data cubes 2017 [Available from: <https://www.aihw.gov.au/reports/hospitals/principal-diagnosis-data-cubes/contents/data-cubes> accessed October 2017.

31. Quan HD, Sundararajan V, Halfon P, et al. Coding algorithms for defining comorbidities in ICD-9-CM and ICD-10 administrative data. *Medical Care* 2005;43(11):1130-39.

32. Lunskey Y, Balogh R, Cairney J. Predictors of emergency department visits by persons with intellectual disability experiencing a psychiatric crisis. *Psychiatric Services* 2012;63(3):287-90.

33. Regier D, Farmer M, Rae D, et al. Comorbidity of Mental Disorders with Alcohol and Other Drug Abuse: Results from the Epidemiologic Catchment Area (ECA) Study. *JAMA* 1990;264(19):2511.

34. Reppermund S, Srasuebku P, Heintze T, et al. Cohort profile: a data linkage cohort to examine health service profiles of people with intellectual disability in New South Wales, Australia. *BMJ Open* 2017;7(4)

35. Turrell G, Oldenburg B, Harris E, et al. Utilisation of general practitioner services by socio-economic disadvantage and geographic remoteness. *Australian and New Zealand Journal of Public Health* 2004;28(2):152-58.
36. Narrow W, Regier D, Norquist G, et al. Mental health service use by Americans with severe mental illnesses. *Social Psychiatry and Psychiatric Epidemiology* 2000;35(4):147-55.
37. Alegria M, Bijl R, Lin E, et al. Income differences in persons seeking outpatient treatment for mental disorders - a comparison of the United States with Ontario and the Netherlands. *Archives of General Psychiatry* 2000;57(4):383-91.
38. Vasiliadis H-M, Lesage A, Adair C, et al. Do Canada and the United States differ in prevalence of depression and utilization of services? *Psychiatric Services* 2007;58(1):63-71.
39. Australian Institute of Health and Welfare. Australian hospital statistics 2007-08 Canberra: AIHW; 2009 [updated 12 January 2017; cited 2017 12 January]. Available from: <http://www.aihw.gov.au/publication-detail/?id=6442468249> accessed 02 February 2017.
40. Hadley J. Insurance coverage, medical care use, and short-term health changes following an unintentional injury or the onset of a chronic condition. *JAMA* 2007;297(10):1073-84.
41. Wilks CM, Browne M, Jenner B. Attracting psychiatrists to a rural area - 10 years on. *Rural Remote Health* 2008;8(1):824.
42. Haq Su, Subramanyam D, Agius M. Assessment of self harm in an accident and emergency service - the development of a proforma to assess suicide intent and mental state in those presenting to the emergency department with self harm. *Psychiatria Danubina* 2010;22 Suppl 1:S26-32. [published Online First: 2011/02/08]
43. Donald M, Dower J, Kavanagh D. Integrated versus non-integrated management and care for clients with co-occurring mental health and substance use disorders: A qualitative systematic review of randomised controlled trials. *Social Science and Medicine* 2005;60(6):1371-83. doi: 10.1016/j.socscimed.2004.06.052
44. Quan H, Li B, Couris CM, et al. Updating and Validating the Charlson Comorbidity Index and Score for Risk Adjustment in Hospital Discharge Abstracts Using Data From 6 Countries. *American Journal of Epidemiology* 2011;173(6):676-82. doi: 10.1093/aje/kwq433
45. Howlett S, Florio T, Xu H, et al. Ambulatory mental health data demonstrates the high needs of people with an intellectual disability: results from the New South Wales intellectual disability and mental health data linkage project. *Australian and New Zealand Journal of Psychiatry* 2015;49(2):137-44. doi: 10.1177/0004867414536933
46. Chaplin R. Mental health services for people with intellectual disabilities. *Current Opinion in Psychiatry* 2011;24(5):372-6.
47. Grover CA, Close RJ. Frequent users of the emergency department: risky business. *The western journal of emergency medicine* 2009;10(3):193.
48. Soril LJJ, Leggett LE, Lorenzetti DL, et al. Reducing frequent visits to the emergency department: A systematic review of interventions. *PLoS ONE* 2015;10(4) . doi: 10.1371/journal.pone.0123660
49. Hansagi H, Olsson M, Sjöberg S, et al. Frequent use of the hospital emergency department is indicative of high use of other health care services. *Annals of Emergency Medicine* 2001;37(6):561-67. doi: 10.1067/mem.2001.111762
50. Keene J. Clients with complex needs : interprofessional practice. Oxford: Oxford : Blackwell Science, 2001.

1
2
3 1 51. Wheeler A, Moyle S, Jansen C, et al. Five-year follow-up of an acute psychiatric
4 2 admission cohort in Auckland, New Zealand. *New Zealand Medical Journal*
5 3 2011;124(1336).
6 4
7 5
8 6
9
10
11
12
13
14
15
16
17
18
19
20
21
22
23
24
25
26
27
28
29
30
31
32
33
34
35
36
37
38
39
40
41
42
43
44
45
46
47
48
49
50
51
52
53
54
55
56
57
58
59
60

BMJ Open

Emergency department presentation and readmission after index psychiatric admission: a data linkage study

Journal:	<i>BMJ Open</i>
Manuscript ID	bmjopen-2017-018613.R3
Article Type:	Research
Date Submitted by the Author:	07-Jan-2018
Complete List of Authors:	Li, Xue; UNSW Australia, Department of Developmental Disability Neuropsychiatry Srasuebkul, Preeyaporn; UNSW Australia, Department of Developmental Disability Neuropsychiatry Reppermund, Simone; UNSW Australia, Department of Developmental Disability Neuropsychiatry Trollor, Julian; University of New South Wales, Department of Developmental Disability Neuropsychiatry
Primary Subject Heading:	Health services research
Secondary Subject Heading:	Mental health
Keywords:	Psychiatric admission, readmission, emergency department presentation, mental health service, data linkage

SCHOLARONE™
Manuscripts

Only

TITLE:

Emergency department presentation and readmission after index psychiatric admission:
a data linkage study

RUNNING TITLE:

Acute care re-presentations following index mental health admission

AUTHORS

Xue Li¹, Preeyaporn Srasuebkul¹, Simone Reppermund^{1,2}, Julian Trollor^{1,2}

¹ Department of Developmental Disability Neuropsychiatry, School of Psychiatry,
UNSW Sydney, Australia

² Centre for Healthy Brain Ageing, School of Psychiatry, UNSW Sydney, Australia

CORRESPONDING AUTHOR:

Professor Julian Trollor, Department of Developmental Disability Neuropsychiatry,
School of Psychiatry, 34 Botany Street, UNSW Sydney, Sydney NSW 2052, Australia.
Email: j.trollor@unsw.edu.au

Abstract

Objective: To use linked administrative datasets to assess factors associated with Emergency Department (ED) presentation and psychiatric readmission in three distinctive time intervals after the index psychiatric admission.

Design: A retrospective data-linkage study.

Setting: Cohort study using four linked government minimum datasets including acute hospital care from July 2005 to June 2012 in New South Wales, Australia.

Participants: People who were alive and aged ≥ 18 years on 01 July 2005 and who had their index admission to a psychiatric ward from 01 July 2007 to 30 June 2010.

Outcome measures: Odds ratios of factors associated with psychiatric admission and ED presentation were calculated for three intervals: 0-1 month, 2-5 months, and 6-24 months after index separation.

Results:

Index admission was identified in 35,056 individuals (51% males) with a median age of 42 years. A total of 12,826 (37%) individuals had at least one ED presentation in the 24 months after index admission. Of those, 3,608 (28%) presented within 0-1 month, 6,350 (50%) within 2-5 months and 10,294 (80%) within 6-24 months after index admission. A total of 14,153 (40%) individuals had at least one psychiatric readmission in the first 24 months. Of those, 6,808 (48%) were admitted within 0-1 month, 6,433 (45%) within 2-5 months and 7,649 (54%) within 6-24 months after index admission. Principle diagnoses and length of stay at index admission, sociodemographic factors, Charlson comorbidity index score, drug and alcohol comorbidity, intellectual disability and other inpatient service utilisation were significantly associated with ED presentations and

1 Introduction

Mental illness is one of the leading cause of disability in developed countries^{1 2}. Building a mental health system that cohesively supports individuals with severe mental illness is a challenge for mental health services. Despite enhancements in community psychiatric supports, demand for acute services for people with mental ill health remains high, as evidenced by escalating use of Emergency Departments (ED)³ and high demand for acute psychiatric inpatient services⁴⁻⁶. Most acute psychiatric episodes of care are by repeat users^{7 8}. Thus, the development of a clear understanding of the drivers of ED utilisation and psychiatric readmission for those with mental illness is of potential benefit to mental health consumers, service providers and health service administrators.

Administrative data can provide substantial insights into factors associated with mental health service use. Factors such as sociodemographic factors, specific psychiatric conditions, comorbidities, and characteristics of previous hospital admissions all have significant impacts on mental health related service use⁹⁻¹². For example, the 2010 Australian National Survey of Psychosis¹³ revealed that being younger, having high severity of psychotic symptoms, and poor social functioning were associated with greater mental health service use. Another US study found among individuals with a mental health or substance abuse diagnosis psychiatric conditions such as schizophrenia and affective disorders not only increase the likelihood of psychiatric readmission, they were also found to be predictors of ED presentations¹². Other strong predictors with a robust and reciprocal impact on both ED use and psychiatric service use are comorbid conditions including physical and psychiatric comorbidity, cognitive and psychiatric comorbidity, intellectual disability (ID) and drug

1 service trajectory of a cohort^{21 23-25}. It is likely that sociodemographic factors and
2 physical and mental health comorbidities may interact to produce increasing complexity
3 over time, with associated increases in the likelihood of re-presentation to acute
4 services. Thus, examination of the factors associated with acute mental health service
5 use over several intervals, and for a substantial time period, is an important step in
6 development of comprehensive understanding of the drivers of service use.

7 Population health administrative records in Australia provide an opportunity to
8 examine acute health services use and their determinants. The current study aims to
9 identify the factors associated with acute care service use following index psychiatric
10 admission. Doing so will provide an opportunity to understand drivers of acute service
11 use in this context, and to better plan services and policy responses which underpin
12 recovery from an initial mental health episode. To understand the dynamics of acute
13 service use, it is important to examine the factors associated with ED presentation and
14 psychiatric readmissions over multiple intervals in the 24 months after index separation.
15 We hypothesised that the principle psychiatric diagnoses at index admission,
16 sociodemographic factors, comorbid conditions and non-psychiatric admissions would
17 have a significant association with ED presentations and psychiatric readmissions and
18 that predictors of these may vary over time.

1 The potential study population was people in the APDC with at least one recorded
2 psychiatric occurring before June 30, 2012 and who were alive at 1st July 2005. From
3 this group, we excluded people aged <18 years on 01 July 2005. Further, to determine
4 those likely to be experiencing their 'index' or first ever psychiatric admission in our
5 observation period, we applied a 2-year look back period and excluded from the final
6 cohort those who were admitted to a psychiatric ward before 01 July 2007. In order
7 ensure a 2-year minimum follow up period we also excluded those with first admission
8 after 30 June 2010. Information regarding admission and separation from a psychiatric
9 ward was obtained from the APDC record. Index admission was therefore a psychiatric
10 admission occurring between 01 July 2007 and 30 June 2010, following a 2-year,
11 admission free look back period. The index admission started at the date of the first
12 admission to the psychiatric facility and ended when the index separation was noted.

13 Three different intervals were used in the study: i) 0-1 Month: this interval
14 started at the date of the index separation to the 29th day after the index separation date;
15 ii) 2-5 months: this interval started on the 30th day after the index separation to the 29th
16 day of month 5; iii) 6-24 months: this interval started at the 30th day of the 5th month
17 after the index separation date to the 29th day of month 23.

18 ***Outcome measures***

19 There were two outcomes in this study, ED presentations and readmission to a
20 psychiatric facility after the index separation. We considered patients who had any
21 records of being admitted to a psychiatric facility after the index separation in each time
22 interval as having a readmission to a psychiatric facility in the specific period.
23 Similarly, patients who had any records of ED presentations after the index separation
24 in each time interval were considered as having an ED presentation outcome. An

comorbidities, drug and alcohol and intellectual disability status, which were known to be highly associated with psychiatric readmissions or ED presentations^{32 33}.

Drug and alcohol comorbidity coding was derived differently for the analyses of psychiatric readmission and ED presentation outcomes. For ED presentation outcomes, drug and alcohol comorbidity codes were derived from the APDC and were obtained by hospital episodes where drug and alcohol appeared in one of the diagnoses regardless of the admission type. However, for psychiatric readmission outcomes, to avoid conflation with the primary reason for psychiatric admission, we excluded drug and alcohol comorbidity diagnoses when these were the primary reason for admission to the psychiatric facility. Consistent with our previous approach, we identified ID with codes including: childhood disintegrative and overactive disorders associated with mental retardation; intellectual development delay; mild through profound mental retardation; Down syndrome and other chromosomal anomalies associated with mental retardation; Fragile X syndrome and congenital malformation syndromes due to known exogenous causes³⁴. The value of the ID flag was set to 1 throughout the study period for everyone who had any records with the relevant codes and set to 0 for everyone who did not have such a record. We also defined a binary variable representing any non-psychiatric hospital episodes for each individual using the APDC dataset. All other variables including age, sex, IRSD, and remoteness were identified through the patient record from DS MDS, APDC, and EDDC. Age was a time dependent variable, it was recalculated at each time interval and was categorised into three groups: young adults (18-35 years); middle aged adults (36-55 years); older adults (56+).

1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
16
17
18
19
20
21
22
23
24
25
26
27
28
29
30
31
32
33
34
35
36
37
38
39
40
41
42
43
44
45
46
47
48
49
50
51
52
53
54
55
56
57
58
59
60

1 All statistical analyses were completed with STATA, version 14.0. Odds ratios
2 (ORs) with 95% confidence intervals (CI) were reported, and the threshold for statistical
3 significance was set at $p < .05$.

4 **Ethics approval**

5 Ethics approval was obtained from the NSW Population and Health Services Research
6 Ethics Committee (PHSREC) (CINSW Reference Number 2013/02/446).

Results

Cohort characteristics

There were 114,095 individuals with at least one psychiatric admission from July 1, 2005 to June 30, 2012 and who were alive at 1st July 2005. Of these, a total of 35,056 individuals met inclusion criteria for the study. Of the 79,039 excluded individuals, 13,116 were excluded due to being under the age of 18 years on 01 July 2005; 65,812 were excluded for not having their first record admission between 01 July 2007 and 30 June 2010 and 111 were excluded for having an unknown area of residence and/or IRSD. For those meeting inclusion criteria, half of the population was male with the median and Interquartile Range (IQR) of age at the beginning of the study period of 38 years (28–50 years) and at index admission, 42 years (32–54 years). The majority of people in our cohort lived in the major cities (76%), 16% lived in the most disadvantaged area and 22% lived in the least disadvantaged area. Mood disorders accounted for over a third of principle diagnoses for the index admission (36%); followed by anxiety and stress related psychiatric disorder (21%), while disorders of adult personality and behavior accounted for 3%. One percent of people in our cohort were coded as not having a psychiatric disorder. The median (IQR) length of stay at index admission was 9 days (2–21 days). Percentages of drug and alcohol use were 41% and 22% for the ED presentation outcome and psychiatric readmission, respectively. People with intellectual disability represented 3% of the cohort (Table 1).

1 **Table 1.** Cohort characteristics. N (%) unless otherwise stated.

	Total
Number of people	35,056 (100)
Male	17,822 (51)
Median (IQR) age, years	
At July 2005	38 (28-50)
At index admission	42 (32-54)
Median (IQR) length of stay at index admission, days	9 (2-21)
Remoteness Area	
Major Cities	26,468 (76)
Inner Regional	6,778(19)
Outer Regional/ Remote/ Very Remote	1,810 (5)
Index of Relative Socioeconomic Disadvantage (IRSD)	
1-2 most disadvantaged	5,686 (16)
3-4	5,655 (16)
5-6	8,644 (25)
7-8	7,332 (21)
9-10 least disadvantaged	7,739 (22)
Principle diagnoses at index admission	
Mood disorder	12,707 (36)
Schizophrenia and delusion	6,998 (20)
Disorder of adult personality and behavior	1,056 (3)
Drug and alcohol	5,070 (14)
Anxiety and stress related psychiatric disorder	7,363 (21)
Organic psychiatric disorder	667 (2)
Other psychiatric disorder	740 (2)
Not psychiatric disorder	455 (1)
Comorbidity	
Drug and Alcohol (for psychiatric admission)	6,475 (22)
Drug and alcohol (for ED endpoint)	13,858 (41)
Intellectual Disability	899 (3)

1 ***Factors associated with ED presentations and psychiatric readmissions after the***
2 ***index admission***

3 ***ED presentation.*** 12,826 (37%) individuals had at least one ED presentation in the 24
4 months after index admission. Of those, 3,608 (28%) had ED presentations in the first
5 month after the index admission with the median of 1 ED presentation per individual.
6 6,350 (50%) and 10,294 (80%) individuals had ED presentations in the intervals of 2-5
7 months and 6-24 months after the index admission with medians of 1 and 2 ED
8 presentations, respectively. Table 2 reports the percentiles of the number of ED
9 presentation in each interval. The median time (IQR) to an ED presentation after the
10 index admission was 107 (24-296) days.

11 Table 3 reports the odds ratios, confident intervals and p values of the factors
12 associated with ED presentations after the index separation in the three intervals. Males
13 were less likely than females to present to ED in the 2 to 5 months and 6 to 24 months
14 intervals. Compared to young adults (18–35 years), individuals who were middle aged
15 and older were both significantly less likely to present to an ED across all intervals.
16 Area of residence also showed a consistent association with ED presentation. Compared
17 to individuals who lived in major cities, individuals who lived in inner regional areas
18 had increased likelihood of ED presentation after the index separation across all
19 intervals. Individuals who lived in outer regional areas were more likely to have ED
20 presentations in the first month after the index separation compared to those who lived

1 in major cities. Area socioeconomic status had a considerable bearing on ED
2 presentation such that those who lived in the least socioeconomic disadvantaged areas
3 were less likely to present to an ED after the index separation than those who lived in
4 the most disadvantaged areas across all intervals.

5 The principle diagnosis given at the index psychiatric admission had a significant
6 association with ED presentations. Compared to mood disorders, disorders of adult
7 personality and behavior were consistently associated with elevated ED presentations
8 across the three intervals. Longer length of stay at index admission reduced the
9 likelihood of ED presentations across the study period.

10 Comorbidity had an incremental association with ED presentation after the index
11 separation. Comparing to individuals with no other physical illness (Charlson
12 comorbidity index score of 0) recorded, individuals with a Charlson comorbidity index
13 score of 1 to 3 were more likely to present to an ED across the 3 intervals. Having a
14 Charlson comorbidity index score above 4 was associated with greater likelihood of ED
15 presentation in the last 2 intervals. Intellectual disability had a consistent and robust
16 association with ED presentation across all intervals. The association between drug and
17 alcohol comorbidity and ED presentation increased as time progressed.

18 Non-psychiatric hospitalisations were associated with ED presentations across
19 all intervals; however, the strongest association was in the first month after the index
20 admission and the odds ratios decreased with time.

Table 2. Percentiles of the number of ED presentations by intervals

Percentile	0-1 month	2-5 months (4 months)	6-24 months (18 months)
25th percentile	1	1	1
50th percentile	1	1	2
75th percentile	2	3	4
99th percentile	7	13	27
Maximum	25	103	329

Table 3. Factors associated with ED presentation after the index admission.

Variable	One month (N =35,056)			Two to five months (N = 34,955)			Six months to twenty four months (N = 34,643)		
	Odds Ratio	95% CI	p-value	Odds Ratio	95% CI	p-value	Odds Ratio	95% CI	p-value
Gender									
Female	Ref			Ref			Ref		
Male	0.93	0.87-1.00	0.066	0.90	0.84-0.95	<0.001	0.95	0.90-1.00	0.047
Age category			<0.001			<0.001			<0.001
Young adults (18-35 years)	Ref			Ref			Ref		
Middle aged adults (36-55 years)	0.85	0.79-0.92	<0.001	0.87	0.81-0.93	<0.001	0.83	0.78-0.88	<0.001
Older adults (56+)	0.71	0.64-0.80	<0.001	0.71	0.65-0.78	<0.001	0.67	0.62-0.72	<0.001

1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
16
17
18
19
20
21
22
23
24
25
26
27
28
29
30
31
32
33
34
35
36
37
38
39
40
41
42
43
44
45
46
47

Remoteness Area			<0.001			<0.001			0.113
Major cities	Ref			Ref			Ref		
Inner Regional	1.23	1.13-1.35	<0.001	1.38	1.28-1.48	<0.001	1.43	1.34-1.53	<0.001
Outer Regional/ Remote/ Very Remote	1.22	1.05-1.42	0.011	1.06	0.93-1.21	0.392	1.06	0.95-1.19	0.309
Index of Relative Socioeconomic Disadvantage (IRSD)			<0.001			<0.001			<0.001
1-2 Most Disadvantaged	Ref			Ref			Ref		
3-4	0.91	0.81-1.02	0.107	1.02	0.93-1.12	0.674	1.02	0.94-1.11	0.629
5-6	0.94	0.85-1.05	0.272	0.96	0.88-1.05	0.341	1.01	0.94-1.09	0.767
7-8	0.86	0.76-0.96	0.009	0.74	0.67-0.81	<0.001	0.77	0.71-0.83	<0.001
9-10 Least Disadvantaged	0.64	0.57-0.73	<0.001	0.52	0.47-0.58	<0.001	0.59	0.54-0.64	<0.001
Principle Psychiatric Diagnosis at Index Admission			<0.001			<0.001			<0.001
Mood disorder	Ref			Ref			Ref		
Schizophrenia and delusion	0.99	0.88-1.10	0.794	1.04	0.95-1.13	0.379	1.14	1.06-1.23	<0.001
Disorder of adult personality and behavior	1.41	1.18-1.69	<0.001	1.64	1.41-1.91	<0.001	1.50	1.30-1.72	<0.001
Drug and Alcohol related disorder	0.91	0.81-1.02	0.113	0.94	0.85-1.03	0.157	0.80	0.73-0.86	<0.001
Anxiety and stress related disorder	1.05	0.95-1.16	0.331	1.06	0.98-1.15	0.148	0.95	0.89-1.02	0.153
Organic psychiatric disorders	1.21	0.93-1.57	0.159	1.21	0.97-1.50	0.092	1.41	1.16-1.70	<0.001

18

Other psychiatric disorder	0.97	0.75-1.25	0.809	0.76	0.61-0.95	0.016	0.77	0.64-0.92	0.005
Not psychiatric disorder	0.02	0.00-0.14	<0.001	0.11	0.06-0.19	<0.001	0.11	0.07-0.17	<0.001
Length of stay at index admission	0.83	0.80-0.85	<0.001	0.87	0.85-0.89	<0.001	0.88	0.87-0.90	<0.001
Charlson comorbidity Index Score			<0.001			<0.001			<0.001
0	Ref			Ref			Ref		
1-3	2.38	1.82-3.13	<0.001	3.24	2.70-3.90	<0.001	2.34	2.05-2.67	<0.001
4-6	3.92	1.60-9.63	0.003	3.81	1.96-7.38	<0.001	2.88	1.97-4.22	<0.001
7+	0.95	0.33-2.78	0.927	2.50	1.44-4.34	0.001	2.14	1.52-3.00	<0.001
Other comorbidity									
Drug and Alcohol	1.76	1.61-1.91	<0.001	5.00	4.60-5.43	<0.001	5.49	5.11-5.90	<0.001
Intellectual Disability	3.03	2.56-3.58	<0.001	3.00	2.58-3.47	<0.001	2.94	2.54-3.40	<0.001
Non-psychiatric hospitalisation	2.87	2.53-3.26	<0.001	2.00	1.84-2.18	<0.001	1.65	1.55-1.75	<0.001

18

Psychiatric readmissions. In the study period, 14,153 (40%) individuals had at least one psychiatric readmission in the 24 months after the index admission. Of those, 6,808 (48%) individuals had readmissions in the first month (median of 1) readmission. 6,433 (45%) individuals had readmissions 2-5 months after the index admission (median of 2) and 7,649 (54%) had readmissions 6-24 months after the index admission (median of 2). Table 4 reports the percentiles of the number of readmissions in each interval. The median (IQR) time to a psychiatric readmission after the index admission was 36 (4-209) days.

Table 5 reports the odds ratios, confident intervals and *p* values of the factors associated with psychiatric readmissions. Males were consistently less likely to be readmitted to a psychiatric facility compared to females. Compared to young adults (18-35 years), older adults (56 years and above) and individuals aged between 35 and 55 were more likely to be readmitted in the first two intervals. Individuals who lived in the outer regional, remote, and very remote areas were less likely to have a psychiatric readmission after the index separation than individuals who lived in major cities. Individuals who lived in the least disadvantaged area were more likely to be readmitted to a psychiatric facility than individuals who lived in the most disadvantaged area.

Principle psychiatric diagnosis at index admission was associated with psychiatric readmission. Compared to mood disorders, both schizophrenia and delusion disorder and organic psychiatric disorder had a persistent association with psychiatric

1 readmission. Schizophrenia and delusion disorder was associated with lower likelihood
2 of readmission within the first six months but was associated with higher likelihood in
3 the last interval. Organic psychiatric disorder diagnosis was associated with lower
4 likelihood psychiatric readmissions across the study period. A principal diagnosis in the
5 drug and alcohol category was associated with greater likelihood psychiatric
6 readmission in the last 2 intervals. Anxiety and stress related psychiatric disorder were
7 significantly associated with reduced likelihood of readmission in the first and last
8 interval. Having a 'Not psychiatric diagnosis' at index admission increased the
9 likelihood of readmission in the first month and decreased the likelihood of readmission
10 in the last 2 intervals. Greater length of stay at index admission was associated with
11 lower likelihood of readmissions in the first interval, but with increased likelihood of
12 readmission in the last 2 intervals.

13 Higher Charlson comorbidity index scores were generally associated with a
14 lower likelihood of psychiatric readmissions. Intellectual disability was consistently
15 associated with higher rates of psychiatric readmissions across all intervals. There were
16 strong associations between and psychiatric readmissions and drug and alcohol
17 comorbidity. Drug and alcohol comorbidity significantly increased the likelihood of
18 readmission across all intervals.

1 Non-psychiatric hospitalisations were associated with decreased likelihood of
2 psychiatric readmissions in the first interval and increased likelihood of readmission in
3 the last two intervals.

For peer review only

Table 4. Percentiles of the number of psychiatric readmission by intervals

Psychiatric readmission	0-1 month	2-5 months (4 months)	6-24 months (18 months)
25th percentile	1	1	1
50th percentile	1	2	2
75th percentile	3	5	3
99th percentile	16	24	53
Maximum	23	94	157

Table 5. Factors associated with psychiatric readmission after the index admission.

	One month (N =35,056)			Two to five months (N = 34,955)			Six months to twenty-four months (N = 34,634)		
Variable	Odds Ratio	95% CI	p-value	Odds Ratio	95% CI	p-value	Odds Ratio	95% CI	p-value
Gender									
Female	Ref			Ref			Ref		
Male	0.82	0.78-0.87	<0.001	0.84	0.79-0.90	<0.001	0.84	0.80-0.90	<0.001
Age category			<0.001			<0.001			<0.373
Young adults (18-35 years)	Ref			Ref			Ref		
Middle aged adults (36-55 years)	1.11	1.03-1.18	0.002	1.16	1.08-1.24	<0.001	1.05	0.98-1.12	0.174
Older adults (56+)	1.38	1.27-1.50	<0.001	1.21	1.11-1.32	<0.001	1.04	0.96-1.14	0.321
Remoteness Area			<0.001			<0.001			0.001
Major cities	Ref			Ref			Ref		
Inner Regional	0.70	0.64-0.77	<0.001	0.87	0.80-0.95	0.002	0.89	0.79-0.92	0.006
Outer Regional/ Remote/ Very Remote	0.74	0.63-0.87	<0.001	0.72	0.61-0.85	<0.001	0.81	0.70-0.94	0.004
Index of Relative Socioeconomic			<0.001			<0.001			0.030

1										
2										
3										
4										
5	Disadvantage (IRSD)									
6										
7	1-2 Most	Ref			Ref			Ref		
8	Disadvantaged									
9	3-4	0.94	0.84-1.06	0.326	1.08	0.96-1.22	0.193	1.12	1.01-1.24	0.031
10	5-6	1.25	1.13-1.38	<0.001	1.13	1.02-1.26	0.022	1.12	1.02-1.24	0.018
11	7-8	1.49	1.35-1.66	<0.001	1.25	1.12-1.39	<0.001	1.14	1.03-1.26	0.011
12	9-10 Least	2.42	2.18-2.68	<0.001	1.52	1.36-1.69	<0.001	1.17	1.06-1.30	0.002
13	Disadvantaged									
14										
15										
16										
17	Principle psychiatric			<0.001			<0.001			<0.001
18	diagnosis									
19	Mood disorder	Ref			Ref			Ref		
20	Schizophrenia and	0.70	0.64-0.77	<0.001	0.74	0.68-0.81	<0.001	1.25	1.15-1.35	<0.001
21	delusion disorder									
22	Disorder of adult	0.82	0.69-0.98	0.025	0.98	0.81-1.18	0.842	1.05	0.88-1.24	0.661
23	personality and									
24	behavior									
25	Drug and alcohol	0.92	0.84-1.06	0.055	0.74	0.67-0.82	<0.001	0.59	0.53-0.65	<0.001
26	related disorder									
27	Anxiety and stress	0.82	0.75-0.89	<0.001	0.94	0.86-1.02	0.155	0.79	0.73-0.86	<0.001
28	related disorder									
29	Organic psychiatric	0.51	0.39-0.68	<0.001	0.40	0.29-0.54	<0.001	0.47	0.35-0.63	<0.001
30	disorders									
31	Other psychiatric	1.39	1.15-1.67	0.001	0.94	0.76-1.15	0.549	0.88	0.72-1.08	0.231
32	Not psychiatric	1.82	1.48-2.24	<0.001	0.26	0.17-0.39	<0.001	0.19	0.11-0.35	<0.001
33	disorder									
34										
35	Length of stay at	0.75	0.73-0.77	<0.001	1.23	1.20-1.26	<0.001	1.22	1.19-1.25	<0.001
36	index admission									
37										
38										
39										
40										
41										
42										
43										
44										
45										
46										
47										

Charlson comorbidity Index Score			0.006			0.004			<0.001
0	Ref			Ref			Ref		
1-3	0.79	0.55-1.12	0.186	0.90	0.71-1.14	0.379	0.80	0.68-0.94	0.005
4-6	0.14	0.04-0.48	0.002	0.34	0.14-0.82	0.017	0.38	0.24-0.60	<0.001
7+	0.48	0.14-1.59	0.229	0.26	0.10-0.69	0.007	0.69	0.45-1.06	0.092
Other comorbid conditions									
Drug and Alcohol	18.25	16.29-20.45	<0.001	15.52	13.99-17.22	<0.001	11.58	10.65-12.60	<0.001
Intellectual Disability	1.63	1.37-1.94	<0.001	1.54	1.28-1.85	<0.001	1.75	1.49-2.07	<0.001
Non-psychiatric hospitalisation	0.57	0.50-0.67	<0.001	1.11	1.01-1.23	0.032	1.28	1.19-1.37	<0.001

Discussion

Sociodemographic factors, principle psychiatric diagnoses at index admission, length of stay at index admission, comorbidities and non-psychiatric inpatient admissions were all significantly associated with ED presentation and psychiatric readmission. While some factors had a robust and consistent association across all time intervals, each interval revealed a distinctive pattern for some of these associations.

Similar to previous studies demonstrating a relationship between sociodemographic and mental health service use^{35 36}, this study found that age and sex had a significant association with ED presentations and psychiatric readmissions after the index admission. Extending previously documented associations between sex and mental health service use¹³, being male was associated with lower likelihood of psychiatric readmissions in our study. Consistent with previous population data¹², being younger increased the likelihood of ED presentation, but was associated with a reduced likelihood of readmission in the short to medium term.

While low socioeconomic status and remoteness of the living area were associated with more ED presentations, they were associated with lower likelihood of psychiatric readmissions. Our findings are consistent with previous studies which found that individuals with higher education and income use more mental health services^{37 38} whereas individuals with lower socioeconomic status tend to use more crisis driven services such as ED^{39 40}. Emergency departments are widely distributed and freely available through a universal healthcare system in Australia. Attendance at ED is patient or carer initiated, and is available regardless of socioeconomic status. In contrast, inpatient psychiatric care is available in larger centres only, and is provided by both public and private providers, the latter of which are accessed only by those able to afford private health insurance and/or co-payment for services⁴¹. Further, the decision to admit to inpatient psychiatric care is typically made on the

1 basis of a comprehensive assessment of clinical needs. Together, these factors may explain
2 the variable relationships of ED representation and readmissions with socioeconomic status
3 and remoteness of living area.

4 Principle psychiatric diagnosis had a persistent impact on the service trajectory of an
5 individual. For example, the association between personality and behavioral disorder and ED
6 presentation after index separation may relate to symptoms associated with self-harm which
7 is a well-recognised reason for presentation to ED⁴². However, reflecting the emphasis on
8 enduring community based supports in its management, personality and behavioral disorder
9 was not associated with readmission. Compared to mood disorder diagnoses, schizophrenia
10 and delusion disorder were associated with lower likelihood of readmissions in the first six
11 months after the index admission. However, previous findings showed that schizophrenia as a
12 principle diagnosis was highly correlated to ED presentation and psychiatric readmission
13 within 30 days after index admission¹². This may be explained by the clustered code used in
14 this study which combined the most common psychiatric disorders such as depression and
15 bipolar disorder into one category-mood disorder and it represents 36% of the cohort.

16 The association between length of stay at index admission and ED presentations
17 differed from that observed with readmission, and may have related to the interaction of
18 initial severity/complexity of presentation (determining index admission length) and time-
19 dependent factors such as subsequent clinical pathways. For individuals experiencing first
20 psychiatric admission, subsequent allocation of community supports may be most cohesive
21 for those with higher levels of complexity, for which length of index admission may be a
22 proxy. This could have mitigated representation to ED and early rates of readmission. With
23 time, it is possible that community supports become less cohesive over time, and indeed a
24 weakening of the relationship between length of index admission and representation to ED
25 was noted over time. Whilst the same mitigation was initially apparent in the 1 month

1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
16
17
18
19
20
21
22
23
24
25
26
27
28
29
30
31
32
33
34
35
36
37
38
39
40
41
42
43
44
45
46
47
48
49
50
51
52
53
54
55
56
57
58
59
60

1 readmission data, this appeared to be swamped in subsequent time periods by other factors.
2 Although this is harder to explain, it is possible that those individuals with greater complexity
3 may have subsequently been more likely to present directly to psychiatric inpatient facilities.

4 Drug and alcohol related disorders as principle diagnoses was associated with lower
5 likelihood of psychiatric readmissions, and yet as a comorbid condition drug and alcohol
6 related diagnoses showed the highest association of all covariates with psychiatric
7 readmission and ED presentation across the time intervals. Only 14% of the cohort had a
8 principle drug and alcohol related diagnosis, whereas 41% of the cohort had a drug and
9 alcohol comorbidity in the ED data, suggesting that these two labels pick up different
10 presentations, in different contexts and with different clinical supports. The two highly
11 correlated diagnoses of drug and alcohol use and mental ill health are often referred to as dual
12 diagnosis in mental health care⁴³. It is understood that drug and alcohol comorbidity can lead
13 to reductions of compliance with psychiatric treatment, and as a result dual diagnosis are
14 often managed in inpatient mental health services³³. The strength of the association between
15 drug and alcohol comorbidity and ED presentation and psychiatric readmission suggests that
16 drug and alcohol intervention should not only occur early, but should be a sustained focus in
17 healthcare. Drug and alcohol comorbidity also had a stronger association with psychiatric
18 readmission than ED presentation; such a difference may be partially explained by the
19 proportion of individuals with complex needs being admitted to a psychiatric facility
20 bypassing ED. However, more research is needed to investigate the factors attributed to this
21 distinctive service utilisation pattern.

22 Previous studies¹⁵ reported a high prevalence of physical comorbidity among
23 individuals with mental illness and we found that the Charlson comorbidity index score had
24 an opposite impact on ED presentation and psychiatric readmission. The Charlson
25 comorbidity index score is often used to predict mortality rate within a year⁴⁴. Individuals

with more severe physical comorbidities were understandably more likely to present to ED and less likely to be readmitted to a psychiatric facility. The current study was unable to investigate whether physical health comorbidities were related to the index admission or the onset of a psychiatric illness. The findings do however suggest that an emphasis on tailored and holistic healthcare is needed within both mental health services and primary healthcare settings.

The presence of ID was persistently and strongly associated with ED presentation and psychiatric readmission across the study period which is consistent with previous research³². As reported elsewhere^{45 46}, the mental health system in Australia is not yet equipped to provide comprehensive mental health supports for individuals with ID. Consistent with a previous study¹⁴, the current study suggests that ID adds to complex support needs which have a direct bearing on ED and inpatient mental health service use, above and beyond that due to the mental illness alone. Unlike many physical conditions which an individual can acquire at any point in time, ID is a permanent disability that is often identified at an early stage in life. Our findings reaffirm that equipping mental health services to meet the mental health needs of people with ID is useful and may assist in buffering the impact of this disability on service use.

A commonly agreed definition of 'frequent users' is those with 3 or more visits per year for ED presentation⁴⁷. A quarter of the cohort had 3 or more ED presentations even within a short 2 to 5 months period after index admission. Past studies have found that frequent ED users tend to have complex healthcare needs and are frequent users of primary and acute health services^{48 49}. The current study also found that non-psychiatric admissions increased the likelihood of ED presentations and psychiatric readmission. These findings suggest that strong relationships exist between each component of acute healthcare services and are in keeping with past research⁵⁰ in which a small proportion of acute service users

1 consumed intensive resources and were not optimally managed within the context of acute
2 healthcare setting. Further research is needed to explore the characteristics of frequent service
3 users in this cohort.

4 The change of direction of the association of principle diagnoses such as schizophrenia
5 and delusion disorder and psychiatric readmission at different time intervals suggest that the
6 service trajectories of individuals with different psychiatric disorders and symptoms can vary
7 and that the 30 days readmission predictors may not capture such change. Further research
8 should seek to explore in more detail the drivers and dynamics of fluctuations in service use
9 over time.

10 **Strengths and limitations**

11 To our knowledge, it is the only cohort study internationally that has examined these
12 associations at multiple time intervals. The current data-linkage study represents a large
13 cohort and provides a comprehensive overview of factors associated with psychiatric
14 readmissions and ED presentations. Our method of identifying index admissions may have
15 inadvertently captured individuals who had admissions prior to July 2005. However, given
16 that 60% of mental health service users in Australia had a mental health disorder lasting 12
17 months⁸ and a previous study⁵¹ found that 66% of mental health users readmitted to a
18 psychiatric facility within a year; it is unlikely that this has affected the results.

19 A limitation of the current study is the use of data collected for administrative rather
20 than clinical purposes, therefore we lack potentially important clinical information. We were
21 unable to examine the severity of symptoms when admitted to the hospital and its association
22 with readmissions and ED presentation. As APDC data are collected on separation from the
23 hospital, we were also unable to identify the very small percentage of individuals who had an
24 index admission during the study period and yet remained in the facility throughout the study
25 period.

ID had a robust and persistent impact on both ED presentation and psychiatric readmission; however, due to the limitation of the research scope of this study, we did not further examine sub-groups of people with ID. The results of the current study are a strong indicator of the unmet needs of the ID population. Further research that examines sub-populations such as individuals with Autism, Down syndrome and FAS within the ID population is needed to understand their needs. We also acknowledge that a small proportion of individuals with borderline and mild ID may not be identified in the ID cohort if they did not receive disability services previously.

Conclusions

We propose the following recommendations to improve service integration: a stronger public health approach to address the impact of social determinants on service utilisation, early intervention programs for dual diagnosis of mental illness and drug and alcohol comorbidity, an urgent response to address the unmet needs of individuals with ID and mental illness and a more holistic care approach to address comorbidity in the inpatient setting. In addition, more research is needed to understand the service trajectories of individuals with different psychiatric conditions beyond the commonly used 30 days interval.

Acknowledgements

We would like to acknowledge all investigators and partner organisations contributing to the project: Chief Investigators: Julian Trollor, Eric Emerson, Rhoshel Lenroot, Karen Fisher, Kimberlie Dean, Leanne Dowse

Associate Investigators: Eileen Baldry, Tony Florio, Grant Sara, Phillip Snoyman, Les White,

Project Staff and Students: Angela Dew, Preeyaporn Srasuebkul, Erin Whittle, Simone Reppermund, Xue Li, Bronwyn Newman, Theresa Heintze

1 Partner Organisations: Agency for Clinical Innovation – Intellectual Disability Network,
2 NSW Department of Family & Community Services - Ageing, Disability and Home Care,
3 NSW Department of Education, NSW Department of Justice - Corrective Services NSW,
4 NSW Ministry of Health – Justice Health & Forensic Mental Health Network, Mental Health
5 Commission of NSW, NSW Ministry of Health – Mental Health & Drug & Alcohol Office,
6 NSW Ministry of Health - InforMH, Mental Health Review Tribunal, National and NSW
7 Council for Intellectual Disability, National Disability Services, NSW Office of the Public
8 Guardian, NSW Ombudsman.

9 **Contributorship statement**

10 JNT, PS, SR and XL participated in the conceptual design of the study. XL wrote the first
11 draft of the manuscript. PS performed the analyses. All authors critically revised the
12 manuscript and contributed to interpretation of the data. All authors read and approved the
13 final version of the manuscript.

14 **Funding**

15 This study was funded by a National Health and Medical Research Council Australia funded
16 Partnerships for Better Health grant (ID: APP1056128; Title: Improving the Mental Health
17 Outcomes of People with an Intellectual Disability).

18 **Competing interests:** None declared.

19 **Patient consent:** No.

20 **Ethics approval**

21 Ethics approval was obtained from the NSW Population and Health Services Research Ethics
22 Committee (AU RED Study Reference Number: HREC/13/CIPHS/7; CINSW Reference
23 Number: 2013/02/446), and access to the data sets was granted by relevant data custodians.

24 **Provenance and peer review:** Not commissioned; externally peer reviewed.
25

Data sharing statement: Direct access to the data and analytical files is not permitted without the expressed permission of the approving human research ethics committees and data custodians. Researchers interested in collaboration should contact the corresponding author with their expression of interest.

For peer review only

Reference

1. Jacobi F, Wittchen H, Holting C, et al. Prevalence, co-morbidity and correlates of mental disorders in the general population: results from the German Health Interview and Examination Survey (GHS). *Psychological Medicine* 2004;34(4):597-611.

2. Whiteford H, Degenhardt L, Rehm J, et al. Global burden of disease attributable to mental and substance use disorders: findings from the Global Burden of Disease Study 2010. *Lancet* 2013;382(9904):1575-86. doi: 10.1016/S0140-6736(13)61611-6

3. Kalucy R, Thomas L, King D. Changing demand for mental health services in the emergency department of a public hospital. *Aust N Z J Psych* 2005;39(1-2):74-80.

4. Whiteford HA. Australia's national mental health policy. *Hospital & community psychiatry* 1993;44(10):963.

5. Whiteford H, Buckingham W. Ten years of mental health service reform in Australia: are we getting it right? *Medical Journal of Australia* 2005;182(8):396-400.

6. Allison S, Bastiampillai T. Mental health services reach the tipping point in Australian acute hospitals: The OECD warns about Australia's low psychiatric bed numbers. *Medical Journal of Australia* 2015;203(11):432-34. doi: 10.5694/mja15.00782

7. Jaramillo-Gonzalez L, Sanchez-Pedraza R, Herazo M. The frequency of rehospitalization and associated factors in Colombian psychiatric patients: a cohort study. *BMC Psychiatry* 2014;14 doi: 10.1186/1471-244X-14-161

8. Slade T JA, Teesson M, Whiteford H, Burgess P, Pirkis J, and Saw S. . The Mental Health of Australians 2. Report on the 2007 National Survey of Mental Health and Wellbeing. In: Ageing DoHa, ed. Canberra, 2009.

9. Lorine K, Schmidt K, Goenjian AK, et al. Risk factors associated with psychiatric readmission. *Journal of Nervous and Mental Disease* 2015;203(6):425-30. doi: 10.1097/NMD.0000000000000305

10. Régis Eric Maia B, João Mazzoncini de Azevedo M, Isabela Panzeri C, et al. Short admission in an emergency psychiatry unit can prevent prolonged lengths of stay in a psychiatric institution Internação breve em unidade de emergência psiquiátrica pode prevenir permanência prolongada em instituições psiquiátricas. *Revista Brasileira de Psiquiatria* 2010;32(2):145-51.

11. Loch AA. Stigma and higher rates of psychiatric re-hospitalization: Sao Paulo public mental health system. *Revista Brasileira de Psiquiatria* 2012;34(2):185-92.

12. Smith M, Stocks C, Santora P. Hospital Readmission Rates and Emergency Department Visits for Mental Health and Substance Abuse Conditions. *Community Mental Health Journal* 2015;51(2):190-97. doi: 10.1007/s10597-014-9784-x

13. Raudino A, Carr V, Bush R, et al. Patterns of service utilisation in psychosis: findings of the 2010 Australian National Survey of Psychosis. *Australian and New Zealand Journal of Psychiatry* 2014;48(4):341-51. doi: 10.1177/0004867413511996

14. Lunskey Y, Lin E, Balogh R, et al. Emergency Department Visits and Use of Outpatient Physician Services by Adults With Developmental Disability and Psychiatric Disorder. *Can J Psychiat-Rev Can Psychiat* 2012;57(10):601-07.

15. Parslow RA, Jorm AF. Who uses mental health services in Australia? An analysis of data from the National Survey of Mental Health and Wellbeing. *Australian and New Zealand Journal of Psychiatry* 2000;34(6):997-1008. doi: 10.1046/j.1440-1614.2000.00839.x

16. Billings J, Blunt I, Steventon A, et al. Development of a predictive model to identify inpatients at risk of re-admission within 30 days of discharge (PARR-30). *BMJ Open* 2012;2(4):e001667. doi: 10.1136/bmjopen-2012-001667

17. McGorry P. Early intervention in psychosis. *Aust N Z J Psych* 2006;40:A109-A09.

18. Shadmi E, Flaks-Manov N, Hoshen M, et al. Predicting 30-day readmissions with preadmission electronic health record data. *Medical Care* 2015;53(3):283-89.
19. van Walraven C, Dhalla I, Bell C, et al. Derivation and validation of an index to predict early death or unplanned readmission after discharge from hospital to the community. *Canadian Medical Association Journal* 2010;182(6):551-57. doi: 10.1503/cmaj.091117
20. Shadmi E, Flaks-Manov N, Hoshen M, et al. Predicting 30-Day Readmissions With Preadmission Electronic Health Record Data. *Med Care* 2015;53(3):283-89.
21. Lin C, Chen W, Lin CM, et al. Predictors of psychiatric readmissions in the short- and long-term: a population-based study in taiwan. *Clinics* 2010;65(5):481-89. doi: 10.1590/S1807-59322010000500005
22. Kadam UT, Lawson CA, Moody DK, et al. Consumer segmentation and time interval between types of hospital admission: a clinical linkage database study. *Journal of Public Health* 2017;1-9. doi: 10.1093/pubmed/fox028
23. Librero J, Peiró S, Ordinaña R. Chronic Comorbidity and Outcomes of Hospital Care: Length of Stay, Mortality, and Readmission at 30 and 365 Days. *Journal of Clinical Epidemiology* 1999;52(3):171-79. doi: [https://doi.org/10.1016/S0895-4356\(98\)00160-7](https://doi.org/10.1016/S0895-4356(98)00160-7)
24. Tsao CI, Chou NK, Chi NH, et al. Unplanned Readmission Within 1 Year After Heart Transplantation in Taiwan. *Transplantation Proceedings* 2010;42(3):946-47. doi: <https://doi.org/10.1016/j.transproceed.2010.02.053>
25. Ono T, Tamai A, Takeuchi D, et al. Factors related to readmission to a ward for dementia patients: Sex differences. *Psychiatry Clin Neurosci* 2011;65(5):490-98. doi: 10.1111/j.1440-1819.2011.02251.x
26. The Centre for Health Record Linkage (CHeReL). How record linkage works 2016 [Available from: <http://www.cherel.org.au/how-record-linkage-works> accessed 26 October 2017.
27. World Health Organization. The ICD-10 Classification of Mental and Behavioural Disorders: Clinical Descriptions and Diagnostic Guidelines. Geneva: World Health Organization 1992.
28. Australian Bureau of Statistics. Socio-Economic Index for Areas: Australian Bureau of Statistics, 2013.
29. Charlson ME, Pompei P, Ales KA, et al. A new method of classifying prognostic comorbidity in longitudinal studies: Development and validation. *Journal of Chronic Diseases* 1987;40(5):373-83.
30. Australian Institute of Health and Welfare. Principal Diagnosis data cubes 2017 [Available from: <https://www.aihw.gov.au/reports/hospitals/principal-diagnosis-data-cubes/contents/data-cubes> accessed October 2017.
31. Quan HD, Sundararajan V, Halfon P, et al. Coding algorithms for defining comorbidities in ICD-9-CM and ICD-10 administrative data. *Medical Care* 2005;43(11):1130-39.
32. Lunskey Y, Balogh R, Cairney J. Predictors of emergency department visits by persons with intellectual disability experiencing a psychiatric crisis. *Psychiatric Services* 2012;63(3):287-90.
33. Regier D, Farmer M, Rae D, et al. Comorbidity of Mental Disorders with Alcohol and Other Drug Abuse: Results from the Epidemiologic Catchment Area (ECA) Study. *JAMA* 1990;264(19):2511.
34. Reppermund S, Srasuebku P, Heintze T, et al. Cohort profile: a data linkage cohort to examine health service profiles of people with intellectual disability in New South Wales, Australia. *BMJ Open* 2017;7(4)

1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
16
17
18
19
20
21
22
23
24
25
26
27
28
29
30
31
32
33
34
35
36
37
38
39
40
41
42
43
44
45
46
47
48
49
50
51
52
53
54
55
56
57
58
59
60

35. Turrell G, Oldenburg B, Harris E, et al. Utilisation of general practitioner services by socio-economic disadvantage and geographic remoteness. *Australian and New Zealand Journal of Public Health* 2004;28(2):152-58.

36. Narrow W, Regier D, Norquist G, et al. Mental health service use by Americans with severe mental illnesses. *Social Psychiatry and Psychiatric Epidemiology* 2000;35(4):147-55.

37. Alegria M, Bijl R, Lin E, et al. Income differences in persons seeking outpatient treatment for mental disorders - a comparison of the United States with Ontario and the Netherlands. *Archives of General Psychiatry* 2000;57(4):383-91.

38. Vasiliadis H-M, Lesage A, Adair C, et al. Do Canada and the United States differ in prevalence of depression and utilization of services? *Psychiatric Services* 2007;58(1):63-71.

39. Australian Institute of Health and Welfare. Australian hospital statistics 2007-08 Canberra: AIHW; 2009 [updated 12 January 2017; cited 2017 12 January]. Available from: <http://www.aihw.gov.au/publication-detail/?id=6442468249> accessed 02 February 2017.

40. Hadley J. Insurance coverage, medical care use, and short-term health changes following an unintentional injury or the onset of a chronic condition. *JAMA* 2007;297(10):1073-84.

41. Wilks CM, Browne M, Jenner B. Attracting psychiatrists to a rural area - 10 years on. *Rural Remote Health* 2008;8(1):824.

42. Haq Su, Subramanyam D, Agius M. Assessment of self harm in an accident and emergency service - the development of a proforma to assess suicide intent and mental state in those presenting to the emergency department with self harm. *Psychiatria Danubina* 2010;22 Suppl 1:S26-32. [published Online First: 2011/02/08]

43. Donald M, Dower J, Kavanagh D. Integrated versus non-integrated management and care for clients with co-occurring mental health and substance use disorders: A qualitative systematic review of randomised controlled trials. *Social Science and Medicine* 2005;60(6):1371-83. doi: 10.1016/j.socscimed.2004.06.052

44. Quan H, Li B, Couris CM, et al. Updating and Validating the Charlson Comorbidity Index and Score for Risk Adjustment in Hospital Discharge Abstracts Using Data From 6 Countries. *American Journal of Epidemiology* 2011;173(6):676-82. doi: 10.1093/aje/kwq433

45. Howlett S, Florio T, Xu H, et al. Ambulatory mental health data demonstrates the high needs of people with an intellectual disability: results from the New South Wales intellectual disability and mental health data linkage project. *Australian and New Zealand Journal of Psychiatry* 2015;49(2):137-44. doi: 10.1177/0004867414536933

46. Chaplin R. Mental health services for people with intellectual disabilities. *Current Opinion in Psychiatry* 2011;24(5):372-6.

47. Grover CA, Close RJ. Frequent users of the emergency department: risky business. *The western journal of emergency medicine* 2009;10(3):193.

48. Soril LJJ, Leggett LE, Lorenzetti DL, et al. Reducing frequent visits to the emergency department: A systematic review of interventions. *PLoS ONE* 2015;10(4) . doi: 10.1371/journal.pone.0123660

49. Hansagi H, Olsson M, Sjöberg S, et al. Frequent use of the hospital emergency department is indicative of high use of other health care services. *Annals of Emergency Medicine* 2001;37(6):561-67. doi: 10.1067/mem.2001.111762

50. Keene J. Clients with complex needs : interprofessional practice. Oxford: Oxford : Blackwell Science, 2001.

- 1 51. Wheeler A, Moyle S, Jansen C, et al. Five-year follow-up of an acute psychiatric
2 admission cohort in Auckland, New Zealand. *New Zealand Medical Journal*
3 2011;124(1336).
4
5
6
7
8
9
10
11
12
13
14
15
16
17
18
19
20
21
22
23
24
25
26
27
28
29
30
31
32
33
34
35
36
37
38
39
40
41
42
43
44
45
46
47
48
49
50
51
52
53
54
55
56
57
58
59
60

STROBE 2007 (v4) checklist of items to be included in reports of observational studies in epidemiology*
Checklist for cohort, case-control, and cross-sectional studies (combined)

Section/Topic	Item #	Recommendation	Reported on page #
Title and abstract	1	(a) Indicate the study’s design with a commonly used term in the title or the abstract	2
		(b) Provide in the abstract an informative and balanced summary of what was done and what was found	2
Introduction			
Background/rationale	2	Explain the scientific background and rationale for the investigation being reported	4,5
Objectives	3	State specific objectives, including any pre-specified hypotheses	5,6
Methods			
Study design	4	Present key elements of study design early in the paper	7
Setting	5	Describe the setting, locations, and relevant dates, including periods of recruitment, exposure, follow-up, and data collection	8
Participants	6	(a) Cohort study—Give the eligibility criteria, and the sources and methods of selection of participants. Describe methods of follow-up Case-control study—Give the eligibility criteria, and the sources and methods of case ascertainment and control selection. Give the rationale for the choice of cases and controls Cross-sectional study—Give the eligibility criteria, and the sources and methods of selection of participants	8,9
		(b) Cohort study—For matched studies, give matching criteria and number of exposed and unexposed Case-control study—For matched studies, give matching criteria and the number of controls per case	8,9
Variables	7	Clearly define all outcomes, exposures, predictors, potential confounders, and effect modifiers. Give diagnostic criteria, if applicable	8,9
Data sources/ measurement	8*	For each variable of interest, give sources of data and details of methods of assessment (measurement). Describe comparability of assessment methods if there is more than one group	10,11
Bias	9	Describe any efforts to address potential sources of bias	10
Study size	10	Explain how the study size was arrived at	9
Quantitative variables	11	Explain how quantitative variables were handled in the analyses. If applicable, describe which groupings were chosen and why	10
Statistical methods	12	(a) Describe all statistical methods, including those used to control for confounding	10
		(b) Describe any methods used to examine subgroups and interactions	11
		(c) Explain how missing data were addressed	
		(d) Cohort study—If applicable, explain how loss to follow-up was addressed Case-control study—If applicable, explain how matching of cases and controls was addressed	

		<i>Cross-sectional study</i> —If applicable, describe analytical methods taking account of sampling strategy	
		(e) Describe any sensitivity analyses	
Results			
Participants	13*	(a) Report numbers of individuals at each stage of study—eg numbers potentially eligible, examined for eligibility, confirmed eligible, included in the study, completing follow-up, and analysed	12
		(b) Give reasons for non-participation at each stage	12
		(c) Consider use of a flow diagram	
Descriptive data	14*	(a) Give characteristics of study participants (eg demographic, clinical, social) and information on exposures and potential confounders	12-13
		(b) Indicate number of participants with missing data for each variable of interest	12
		(c) <i>Cohort study</i> —Summarise follow-up time (eg, average and total amount)	
Outcome data	15*	<i>Cohort study</i> —Report numbers of outcome events or summary measures over time	14-24
		<i>Case-control study</i> —Report numbers in each exposure category, or summary measures of exposure	
		<i>Cross-sectional study</i> —Report numbers of outcome events or summary measures	
Main results	16	(a) Give unadjusted estimates and, if applicable, confounder-adjusted estimates and their precision (eg, 95% confidence interval). Make clear which confounders were adjusted for and why they were included	12-24
		(b) Report category boundaries when continuous variables were categorized	
		(c) If relevant, consider translating estimates of relative risk into absolute risk for a meaningful time period	
Other analyses	17	Report other analyses done—eg analyses of subgroups and interactions, and sensitivity analyses	
Discussion			
Key results	18	Summarise key results with reference to study objectives	25-29
Limitations	19	Discuss limitations of the study, taking into account sources of potential bias or imprecision. Discuss both direction and magnitude of any potential bias	29
Interpretation	20	Give a cautious overall interpretation of results considering objectives, limitations, multiplicity of analyses, results from similar studies, and other relevant evidence	25-29
Generalisability	21	Discuss the generalisability (external validity) of the study results	25-30
Other information			
Funding	22	Give the source of funding and the role of the funders for the present study and, if applicable, for the original study on which the present article is based	31

*Give information separately for cases and controls in case-control studies and, if applicable, for exposed and unexposed groups in cohort and cross-sectional studies.

Note: An Explanation and Elaboration article discusses each checklist item and gives methodological background and published examples of transparent reporting. The STROBE checklist is best used in conjunction with this article (freely available on the Web sites of PLoS Medicine at <http://www.plosmedicine.org/>, Annals of Internal Medicine at <http://www.annals.org/>, and Epidemiology at <http://www.epidem.com/>). Information on the STROBE Initiative is available at www.strobe-statement.org.