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**Title: Factors related to length of stay, referral on discharge and hospital readmission  
for children and adolescents with Anorexia Nervosa**

**Title page**

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**Running title:** Hospital usage factors for Anorexia Nervosa

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### **Conflict of interest statement**

The authors have no conflict to declare.

### **Data availability statement**

The data that support the findings of this study require ethics approval. The data are not publicly available due to privacy or ethical restrictions.

### **Introduction**

Anorexia Nervosa (AN) is a severe mental illness that often presents with significant and enduring medical sequelae. AN has one of the highest mortality rates of any mental illness (Arcelus, Mitchell, Wales, & Nielsen, 2011). It is characterised by extreme food restriction, intense fear of gaining weight, abnormal body image, denial and an undue influence of body image on self-evaluation (American Psychiatric Association, 2013). AN onsets from six years of age with incidence peaking between 15 and 19 years in females (Smink, Van Hoeken, & Hoek, 2012). Co-occurring mental illnesses are common with up to 80% of individuals with AN experiencing anxiety disorders and up to 50% experiencing major mood disorders (Jordan et al., 2008; Madden, Morris, Zurynski, Kohn, & Elliott, 2008). Rates of hospital admission

and cost of treatment are amongst the highest in psychiatry (Agras, 2001; Striegel-Moore, Leslie, Petrill, Garvin, & Rosenheck, 2000).

Hospital intervention in AN is often required for the management of acute medical instability (e.g. hypothermia, hypotension, bradycardia, electrolyte abnormalities and cardiac arrhythmias) where it is essential in preventing morbidity and mortality (Golden et al., 2003; Katzman, 2005). Hospital may also be helpful in promoting weight gain at the commencement of treatment, or when weight gain has failed or become stagnant. However, a large Australian randomised control trial found similar outcomes between longer hospital stays and shorter stays when followed up with evidence-based outpatient care (Madden et al., 2015) and equivalent weight gain has also been shown between some inpatient and outpatient settings (Meads, Gold, & Burls, 2001), suggesting that hospitalisation followed by evidence-based outpatient care can achieve good outcomes and reduce time in hospital. Furthermore, protracted and repeated hospital admissions can disrupt the development of children and adolescents (C&A) and the functioning of the family, with outpatient care costs being approximately 10% the cost of inpatient care (Katzman, Golden, Neumark-Sztainer, Yager, & Strober, 2000).

Hence, it is important to understand factors contributing to longer length of admission, referral to post-hospital treatment, and risk of readmission following initial hospital care. Hospital length of stay (LOS) in AN have been found to be related to clinical factors at admission, including premorbid weight, Body Mass Index (BMI), length of illness and the number of previous inpatient admissions (Lievers et al., 2009; Maguire, Surgenor, Abraham, & Beumont,

2003; Nozoe et al., 1995). Longer LOS has been found to be associated with naso-gastric tube feeding and a therapeutic weight contract, while high caloric diet associated with a reduced LOS (Agostino, Erdstein, & Di Meglio, 2013; Golden, Keane-Miller, Sainani, & Kappahn, 2013; Lievers et al., 2009).

Community treatment following an acute inpatient episode relating to mental health should occur within 7 days of discharge from hospital. This continuity in care is linked to both improved symptoms and lower rates of readmission (House et al., 2012). Readmission to hospital within 28 days of discharge is one of the most widely used Key Performance Indicators in Australian mental health care (NSW Health, 2018). A few studies have examined the risk variables of rehospitalisation during a one-year follow-up period and identified weight gain during first admission, BMI at discharge, duration of target weight maintenance, eating disorder psychopathology, and family psychopathology as predictive factors (Castro, Gila, Puig, Rodriguez, & Toro, 2004; Lay, Jennen-Steinmetz, Reinhard, & Schmidt, 2002; Steinhausen, Grigoriu-Serbanescu, Boyadjieva, Neumärker, & Winkler Metzke, 2008). While readmission rates in AN have been reported to be high (Steinhausen et al., 2008), there has been little examination of them in the Australian context nor of the drivers of readmission rates more generally in AN.

The aim of the current study was to provide a comprehensive assessment of factors (sociodemographic, illness, treatment-related and hospital-related factors) associated with

LOS, reported referral on discharge, and readmission within 28 days of discharge for AN in non-specialist public hospital settings.

## **Methods**

Data was drawn from the New South Wales (NSW) Admitted Patient Data Collection (APDC), a state-wide administrative dataset for hospital admissions. The sample consisted of all C&A aged 9-18 years with AN or atypical AN as a primary or secondary diagnosis who were admitted to a public hospital in NSW (the most populated Australian state) between 1 January and 31 December 2017. A total of 289 admissions of 200 C&A were included. Diagnosis of AN and other illness conditions was based on the International Classification of Diseases tenth version (ICD-10). An alpha of 0.01 was applied to significance tests to account for the inflated family-wise error from multiple testing. The study was approved by NSW Population and Health Services Research Ethics Committee (AU RED Reference: HREC/18/CIPHS/35).

### *Length of Stay*

LOS was drawn from the APDC as the number of days the patient spent in hospital. Based on the NSW health service improvement measure (NSW Health, 2018), single day admissions or day cases (patients formally admitted for a medical procedure or surgery in the morning and discharged before the evening) were excluded. Because of the high skewness and kurtosis, the LOS was modelled using a median regression.

### *Reported referral upon hospital discharge*

Based on information on the treatment referred to upon discharge and the area identifier (i.e. the hospital/health service to which the patient was referred) in the APDC data, a hospital referral variable was created. The patient was recorded being referred to one of the six hospital referral categories at each discharge: no recorded referral, mental health/alcohol and other drugs outpatient services, outpatient services excluding mental health/alcohol and other drugs, medical practitioners (i.e. primary care physicians) other than private psychiatric services, outpatient specialty services for Eating Disorder treatment (i.e. Sydney Children's Hospitals Network), and other services (including private psychiatric services, mental health/alcohol and other drugs inpatient services and others). Reported referrals upon hospital discharge were modelled using a multinomial logistic regression.

#### *Hospital readmissions*

Readmission was defined as a binary variable that equals to one if one overnight admission was followed by another overnight admission within 28 days of discharge and zero otherwise. Given the binary nature of the dependent variable, readmission was modelled using a logistic regression.

#### *Risk factors*

The study considered sociodemographic, illness, treatment and hospital factors potentially associated with LOS, hospital referrals and readmission within 28 days. The specific variables are listed in Table 1. All estimations adjusted for the correlation of standard errors within individuals over time. The analyses were performed using Stata 14.2. Coefficients or average

marginal effects (AME) (defined as the average of individual marginal effects holding other variables at specific values) and p-values are presented.

TABLE 1 HERE

To note, facility type or hospital peer group classification was designed to characterise hospitals with similar characteristics by the NSW Government. Principal referral hospitals are characterised as having greater than 35,000 acute weighted separations; paediatric specialist hospitals were those with specialist paediatric roles, and other types of hospitals were defined as those with 35,000 or less acute weighted separations. Principal referral hospitals are located predominately in metropolitan areas, have larger capacity and provide a broad range of services including highly specialised services (NSW Health, 2016).

## **Results**

### *Study Sample*

Summary statistics are reported for all NSW public hospital admissions among C&A with AN during 2017 in Table 2. Summary statistics by referral upon discharge and readmission status within 28 days of discharge are presented in Appendix (Table A1 and A2). Among the 289 admissions of 200 C&A in 2017, 91.70% were females, 78.90% had AN or atypical AN as a primary diagnosis, 47.22% were admitted into hospital from the emergency department (ED) and 64.71% were treated in metropolitan areas. The average number of hospital admissions per patient was 1.49 over the 12-month period with a median of 1 and a range from 1 to 6. The

average number of co-occurring illnesses (both physical and mental health) per admission was 4.06 with a median of 3 and a range of 0 to 24. The LOS per admission had a mean of 19.99 days and a median of 17 days, ranging from 1 to 104 days, with on average 22.17 days in metropolitan areas and 15.99 days in rural or regional areas.

TABLE 2 HERE

*Primary and secondary diagnoses*

Table 3 presents the primary and secondary diagnoses at each admission for C&A with AN in 2017 in NSW. Among the 289 hospital admissions for AN, 228 (78.90%) were for AN as a primary diagnosis and 61 (21.11%) were for AN as a secondary diagnosis. The most common primary diagnoses, apart from AN, were major depressive disorder, followed by poisoning, low self-esteem, anxiety disorder, open wound, and type 1 diabetes mellitus (column 1, Table 3). Note that a patient can have only one primary diagnosis but more than one secondary diagnosis in the NSW APDC data. The more common secondary diagnoses, in addition to AN, were anxiety disorders, abnormal heartbeat, malnutrition, hypotension, depressive episode, constipation, volume depletion and obsessive-compulsive disorder (OCD) (column 2, Table 3). The table indicates that AN was generally accompanied by a number of co-occurring psychological disorders and related physical conditions, with 91.7% of patients having more than one co-occurring condition.

TABLE 3 HERE

### *Length of stay in hospital*

The estimated coefficients for factors associated with LOS from a median regression model are reported in Table 4. The results suggest that source of referral, and illness factors including AN as primary versus secondary diagnosis, and certain co-occurring illnesses (e.g. OCD and malnutrition) were the factors with most influence on LOS. Having AN as a primary diagnosis was associated with 8.941 more days being hospitalised ( $p < 0.001$ ), as compared to having it as a secondary diagnosis. Compared to other less common co-occurring illnesses, OCD and malnutrition were correlated with 10.264 ( $p = 0.006$ ) and 6.483 ( $p = 0.010$ ) more days in hospital. Additionally, being referred from relatives or patients themselves was associated with 8.433 ( $p = 0.010$ ) less days in hospital stay, compared to being referred from Emergency department or other sources.

TABLE 4 HERE

### *Referral upon discharge from hospital*

The AMEs from estimating a multinomial logit model for reported referral to various healthcare services upon hospital discharge are reported in Table 5. The vast majority of C&A (91.70%) admitted to hospital in 2017 had some sort of referral recorded at discharge. The most common referral recorded on discharge by some margin was to a medical practitioner (59.86%), as is common and best practice within the health care system. Unexpectedly, relatively small numbers of cases were recorded to be referred to mental health and specialist

treatment settings: 5.54% were reported to be referred to an outpatient mental health setting and 8.30% to an outpatient setting specialising in eating disorder treatment.

Regarding a referral to an outpatient service (excluding mental health facilities), one-year increase in age was associated with a 3.4% ( $p < 0.001$ ) increase in the probability of being referred to an outpatient service. More socioeconomically advantaged areas (AME=0.074,  $p=0.012$ ), and longer hospital stay (AME=0.002,  $p=0.007$ ) were also associated with being referred to an outpatient service. Regarding a referral to a medical practitioner, admissions involving patients from less socioeconomically advantaged areas (AME=-0.196,  $p=0.001$ ) was more likely to be associated with a referral to medical practitioners. Moreover, an additional hospital admission during the 12-month period was correlated with a 3.3% ( $p=0.003$ ) increase in the probability of not having a reported referral to any of the treatment services.

TABLE 5 HERE

#### ***Readmission rates to hospital***

About 7.61% (22) of first hospital admissions during 2017 were followed by a hospital readmission within 28 days of discharge in the same calendar year. Results from estimating a logistic model for hospital readmission in Table 6 indicate that gender, area socioeconomic status, illness factors, and hospital type were significant predictors for the probability of readmission within 28 days of discharge. The probability of readmission was significantly higher among hospital admissions involving patients who were male (AME=0.137,  $p=0.010$ ),

from the most socioeconomically disadvantaged areas (AME=-0.278/-0.279,  $p=0.003/0.003$ ), and located at rural or remote areas (AME=-0.178,  $p=0.009$ ). One additional admission over the year was associated with an 8.9% ( $p<0.001$ ) increase in the probability of readmission. The diagnoses of reaction to stress and adjustment disorders and viral infection of unspecified site were associated with 15.2% ( $p=0.006$ ) and 25.0% ( $p=0.001$ ) increases in the probability of readmission.

TABELE 6 HERE

### **Discussion**

The current study examined the potential impact of sociodemographic, illness, treatment and hospital-related factors on key indicators of the effectiveness of hospital care for AN in C&A in public hospital settings in Australia. Using an administrative health dataset in a large health jurisdiction in Australia, a sample of 289 admissions by 200 C&A with AN as a primary or secondary diagnosis who were admitted to public hospitals in 2017 was examined, finding that sociodemographic, illness, treatment and hospital-related factors had significant associations with variation in hospital care usage and reported referral pathways after hospitalisation.

Hospital care for AN remains one of the most common care settings and certainly the most expensive. Understanding use of this care pathway and factors affecting its efficacy and duration can drive system and outcome improvements. This study found that inpatient treatment in this large jurisdictional area of Australia was predominately accessed by females

(91.70%), 78.9% were admissions for a primary diagnosis of AN, 64.71% of admissions occurred in metropolitan areas, and the majority came from higher socio-economic groupings. AN is an illness that more often affects females, with paediatric surveillance studies suggesting the female to male ratio is somewhere between 12:1 and 6:1 (Nicholls, Lynn, & Viner, 2011; Pinhas, Morris, Crosby, & Katzman, 2011), suggesting that the rates of female to male admissions in this cohort fall within that expected spectrum. There seems to be a high rate of co-occurring illnesses at admission: only a small percent (8.3%) of the sample had no reported co-occurring illnesses at admission, and the remaining 91.7% had between 1 and 24 with an average of 4.06 physical and mental co-occurring illnesses. Comorbidities in AN and their treatment in hospital as well as other care settings have received scant attention. The findings of this study support clinical reports that comorbidity is the rule rather than exception in AN, and treatment needs to account for them from the outset.

The disruption hospital causes to both the family and developmental stage of the young person, along with the significant costs, renders length of time in hospital an important treatment characteristic to understand and minimise. In this sample, a longer period of hospitalisation was associated with AN as a primary diagnosis, and a higher number of co-occurring physical and mental illnesses such as OCD and malnutrition. Complementing previous studies on co-occurring mental illnesses (Lievers et al., 2009; Nozoe et al., 1995), the study demonstrated the positive association of LOS with several physical and psychiatric comorbidities, confirming the need to account for comorbidities in treatment design.

To reduce readmission to hospital and to deliver the evidence based therapies for AN (outpatient therapies), adequate community follow-up is essential. While most C&A admitted to hospital in this jurisdiction in 2017 had some sort of referral on discharge from hospital, a relatively small number were referred to mental health treatment settings: 5.54% were reported to be referred to an outpatient mental health setting and 8.30% to an outpatient setting specialising in eating disorder treatment. These types of referrals did not appear to be influenced by any of factors measured in our study, which could be due to the small numbers in each of these groups. It is also possible that the finding is affected by the way the discharge information was recorded and will therefore require further investigation. The largest service for Australian C&A with an eating disorder provides co-located inpatient and outpatient care where outpatient care is essentially a continuation of the admission. Also of note is the finding that patients who had no reported referral on discharge were more likely to be those with more admissions over the year. It is possible that this cohort of patients are the most in need of community treatment to prevent further hospitalisations, and yet are less likely to receive this care. Alternatively, it is possible that these frequently admitted patients had an established care team in place that were not recorded in the discharge variable at the conclusion of hospitalisation.

Readmission to hospital in this cohort was driven by a number of factors. Patients with repeated admissions had higher rates of persistent psychopathological conditions and poor long-term psychosocial and psychiatric outcomes (Steinhausen et al., 2008). A higher probability of readmission within 28 days after discharge was associated with being male, from

socioeconomically disadvantaged areas, having more admissions over the year, the presence of some co-occurring physical and mental illnesses such as viral infection and reaction to severe stress and adjustment disorders, and being treated in rural or remote areas.

The results have significant policy implications for improving assessment at admission, treatment planning, and relapse-prevention pathways for C&A with AN. First, improvement in the efficiency and effectiveness of care and treatment can be made through recognising and treating physical co-occurring illnesses at presentation to the health system. Co-occurring physical illness at admission emerged as being associated with both LOS and readmission within 28 days. The health system has historically not dealt particularly well with the co-occurring nature of physical and mental disorder (Druss, 2007; Lawrence & Kisely, 2010), which is the hallmark of AN. System improvements may be able to be implemented for inpatient treatment services through identifying co-occurring illness at admission, which will enable better management of physical and psychiatric complications in AN during hospitalisations. Additionally, this will enable more appropriate referrals on discharge to be made, so that readmissions to hospital can be reduced and outcomes for patients improved.

Second, significant associations between socioeconomic status, referral on discharge, and readmission in this study suggest there may be some degree of inequality in access to care and health outcomes. Patients from socioeconomically disadvantaged areas were more likely to be readmitted and have their reported discharge referral made to a medical practitioner, who generally are focused on only delivering medical monitoring of eating disorders. While medical

practitioners serve a key role in the oversight of community care for all disorders, there is much data to suggest that they do not make referral arrangements for people with eating disorders as often as is required (Demmler, Brophy, Marchant, John, & Tan, 2020; Maguire, Li, Cunich, & Maloney, 2019). The apparent lack of access to specialist outpatient services and poorer hospital-based outcomes among the most socioeconomically disadvantaged patients emphasises the need for addressing inequalities upfront, which may involve developing more targeted efforts within service pathways.

Furthermore, the results indicate the difference in the risk of readmission between metropolitan and rural or remote areas. Being treated in rural or remote areas was associated higher risks of readmission within 28 days. It has been recognised that there was a lack of access to specialist mental health services in rural and regional areas of Australia (Aisbett, Boyd, Francis, & Newnham, 2007; Maguire et al., 2019). Readmission rates often reflect the effectiveness of the inpatient and/or community care and carry risk for poor long-term psychiatric and physical outcomes (Steinhausen et al., 2008). Therefore, ensuring provision of treatment and service in rural or remote areas could improve care delivery and health outcomes for C&A with AN in regional areas.

This study also has implications for the recording of information in the health system databases. As we move increasingly to data driven funding, electronic medical records and linked data analysis of health system pathways, the reliance on accurate and meaningful data entry to determine our understanding, funding and future development of the health system will become

complete. There is a need to provide training and adequate data entry support as well as regular feedback mechanisms to drive accurate and clinically meaningful data entry at the point of care.

The strengths of the study include the use of a sizable micro-dataset that comprised an entire cohort of AN patients treated in the public hospital system across a large health jurisdiction in a full calendar year, hence providing a complete snapshot of service provision for the illness group and allowing a comprehensive assessment of factors associated with hospital stay, referral and readmission. Limitations include some of those commonly associated with administrative health data, such as gaps in data entry and quality of data entry which cannot be controlled for as well as some factors may be limited in detail due to pre-set definitions. In particular, the findings reported in regards to referral should be considered as provisional, to be re-examined in further studies that use other relevant data sources. Further, the low model fitting statistics for hospital referrals in this study suggest that other variables should be considered in future studies to improve predictability. Finally, the dataset was a snapshot of a single year and contained no historical information such as the date when first diagnosis for AN prior to any hospital presentations occurring in 2017. Tracking patients over a longer time period will enable a more complete picture of treatment pathways for C&A with AN in the public health system, and assessment of the contribution of other determinants of care provision and health outcomes.

## **Conclusion**

The identification of risk factors for prolonged hospitalisation, lack of a referral or a referral inconsistent with clinical practice guidelines, and readmission within 28 days of discharge, is crucial for improving care pathways for C&A with AN. LOS was longer among patients with AN as a primary diagnosis, and more co-occurring physical and mental illnesses; and readmission was higher among patients who were male, from socioeconomically disadvantaged areas, had more co-occurring physical and mental illnesses, and were treated in rural or remote areas. Longer LOS and more readmissions led to worse health outcomes and higher treatment costs. Therefore, targeted interventions should be considered to be put in place, such as recognising and treating physical co-occurring illnesses at presentation to the health system, ensuring appropriate referral to community services, and providing services in socioeconomically disadvantaged and rural or remote areas. Understanding the factors associated with the utilisation of health services during and after hospitalisation can help optimise and customise inpatient treatment and guide the development of effective and quality community treatment on referral post-discharge, ultimately improving care delivery and health outcomes for C&A with AN.

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Author Manuscript

**Title: Factors related to length of stay, referral on discharge and hospital readmission for children and adolescents with Anorexia Nervosa**

**Abstract**

**Objective:** This study examined factors related to hospital length of stay (LOS), reported referral on discharge, and hospital readmission, for children and adolescents (C&A) admitted to public hospitals for anorexia nervosa (AN), in a large health jurisdiction in Australia.

**Method:** Sociodemographic, illness, treatment, and hospital factors associated with LOS, reported referral to post-hospital treatment, and readmission within 28 days were analysed for C&A with AN admitted to all New South Wales public hospitals in 2017, using median, multinomial logit and logit models. The sample comprised 289 admissions by 200 C&A aged 9-18 years with a primary or secondary diagnosis of AN.

**Results:** AN as a primary diagnosis and the presence of some physical and mental co-occurring conditions (e.g. malnutrition and obsessive-compulsive disorders) conferred a longer LOS. The majority of admissions were recorded being referred to primary care physicians (59.86%) and relatively small numbers to outpatient mental health services (5.54%) or outpatient eating disorder services (8.30%), with age, area socioeconomic status, and illness factors related to referral type. Male, low socioeconomic status, the presence of some co-occurring illnesses (e.g. adjustment disorder and viral infection), and rural or remote locations increased the likelihood of readmission.

**Discussion:** The findings have implications for service design, in particular the pathway to care from hospital into community for AN. Targeted interventions should consider recognising and treating physical co-occurring illnesses at presentation to the health system, ensuring appropriate referral to community services, and providing services in socioeconomically disadvantaged and rural or remote areas.

## Keywords

Anorexia nervosa, eating disorder, children and adolescents, risk factors, length of stay, hospital referrals on discharge, readmission, socioeconomic status, co-occurring illnesses

## Abbreviations

AN	Anorexia Nervosa
AME	Average marginal effects
APDC	Admitted Patient Data Collection
BMI	Body Mass Index
C&A	Children and adolescents
ED	Emergency Department
ICD	International Classification of Diseases
LOS	Length of stay
NSW	New South Wales
OCD	Obsessive-compulsive disorder
SEIFA	Socio-Economic Indexes for Areas

Table 1. Risk factors considered in the study

<b>Demographic factors</b>	<ul style="list-style-type: none"> <li>• Age</li> <li>• Gender</li> </ul>
<b>Socioeconomic factors</b>	<ul style="list-style-type: none"> <li>• The index of relative socioeconomic advantage and disadvantage for areas (Socio-Economic Indexes for Areas [SEIFA]) in quartiles, i.e. area socioeconomic rank in quartiles</li> <li>• Whether the patient had health insurance cover</li> </ul>
<b>Illness factors</b>	<ul style="list-style-type: none"> <li>• The total number of co-occurring physical and mental illnesses the patient was diagnosed in the admission</li> <li>• Whether AN was a primary or secondary diagnosis in the admission</li> <li>• The specific main co-occurring mental illnesses (anxiety, depressive episode, obsessive-compulsive disorder, bulimia nervosa, reaction to severe stress and adjustment disorders)</li> <li>• The specific main co-occurring physical illness (abnormal heartbeat, malnutrition, volume depletion, fluid and electrolyte disorders, infectious gastroenteritis and colitis, viral intestinal infections, and viral infection of unspecified site)</li> </ul>
<b>Hospital factors</b>	<ul style="list-style-type: none"> <li>• Facility type or hospital peer group classification (principle referral, paediatric specialist and others)</li> <li>• Area remoteness (metropolitan and rural or regional areas).</li> </ul>
<b>Source of referral</b>	<ul style="list-style-type: none"> <li>• Emergency department, medical practitioner, relative or self-referred, and others.</li> </ul>
<b>Treatment factors</b>	<ul style="list-style-type: none"> <li>• The number of total admissions over the year for a patient</li> <li>• Whether the patient was an involuntary patient within the psychiatric unit</li> </ul>

Table 2. Summary statistics for AN admissions in NSW public hospitals in 2017

	<b>All hospital admissions (N=289)</b>
<b>Age, Mean (SD)</b>	15.42 (1.74)
<b>Sex</b>	
Female, No. (%)	265 (91.70%)
Male, No. (%)	24 (8.30%)
<b>Area socioeconomic rank, Mean (SD)</b>	71.68 (23.63)
Lowest quartile, No. (%)	9 (3.11%)
2nd quartile, No. (%)	41 (14.19%)
3rd quartile, No. (%)	106 (36.68%)
Highest quartile, No. (%)	133 (46.02%)
<b>Private Health insurance</b>	
No, No. (%)	139 (48.10%)
Yes, No. (%)	150 (51.90%)
<b>No. co-occurring illnesses, Mean (SD)</b>	4.06 (3.44)
0, No. (%)	24 (8.30%)
1-2, No. (%)	80 (27.68%)
3-5, No. (%)	120 (41.52%)
6-9, No. (%)	43 (14.88%)
≥10, No. (%)	22 (7.61%)
<b>Specific co-occurring illness</b>	
Anxiety, No. (%)	104 (36.33%)
Depressive episode, No. (%)	49 (16.96%)
Obsessive-compulsive disorder, No. (%)	20 (6.92%)
Abnormal heartbeat, No. (%)	84 (29.07%)
Bulimia, No. (%)	6 (1.73%)
Reaction to severe stress disorder, No. (%)	9 (2.77%)
Malnutrition, No. (%)	81 (28.03%)
Volume depletion, No. (%)	26 (8.99%)
Fluid & electrolyte disorders, No. (%)	9 (3.46%)
Infectious gastroenteritis & colitis, No. (%)	9 (3.46%)
Viral intestinal infections, No. (%)	3 (1.38%)
Viral infection unspecified site, No. (%)	6 (2.08%)
<b>AN or atypical AN diagnosis</b>	
Primary, No. (%)	228 (78.90%)
Secondary, No. (%)	61 (21.11%)
<b>No. admissions, Mean (SD)</b>	1.49 (0.87)
1, No. (%)	69.20%
2-3, No. (%)	26.99%
≥4, No. (%)	3.81%
<b>Length of stay, Mean (SD)</b>	19.99 (16.03)
Metropolitan areas, Mean (SD)	22.17 (16.29)
Rural or regional areas, Mean (SD)	15.99 (14.79)
<b>Involuntary stay in psychiatric unit</b>	
Yes, No. (%)	12 (4.50%)
No, No. (%)	277 (95.50%)
<b>Source of referral</b>	
Emergency department, No. (%)	135 (47.22%)
Medical practitioner, No. (%)	46 (15.97%)
Relative/Self, No. (%)	17 (5.90%)
Other, No. (%)	89 (30.90%)
<b>Facility Type</b>	
Principal referral hospital, No. (%)	105 (36.33%)
Paediatric specialist hospital, No. (%)	111 (38.41%)
Other classifications, No. (%)	73 (25.26%)
<b>Residential area</b>	
Metropolitan, No. (%)	188 (64.71%)
Rural or regional, No. (%)	101 (35.29%)

Source: NSW Admitted Patient Data Collection (APDC), 2017. Notes: The sample comprised C&A with AN or atypical AN as a primary or secondary diagnosis who were discharged from a public hospital.

Table 3. Primary and secondary diagnoses for hospital admissions of C&A with AN

<b>Primary diagnosis</b>			
<b>Mental illness</b>	<b>Admissions</b>	<b>Physical illness</b>	<b>Admissions</b>
<u>Anorexia nervosa</u>	228	Poisoning	9
Major depressive disorder	11	Open wound	4
Emotional state symptoms (low self-esteem)	4	Type 1 diabetes mellitus	3
Anxiety disorder	4	Abdominal and pelvic pain	2
Obsessive-compulsive disorder	2	Other protozoal intestinal diseases	1
Personality disorders	2	Iron deficiency anemia	1
Delirium due to known physiological condition	1	Severe protein-calorie malnutrition	1
Bipolar disorder	1	Disorders of pancreatic internal secretion	1
Reaction to severe stress & adjustment disorders	1	Volume depletion	1
Conversion disorder	1	Hypokalemia	1
Conduct disorders	1	Mononeuropathies of lower limb	1
Irritability and anger	1	Cardiac arrhythmia	1
Other symptoms and signs involving cognitive functions and awareness	1	Cellulitis of other parts of limb	1
		Bradycardia	1
		Other and unspecified abdominal pain	1
		Dizziness and giddiness	1
<b>Top 30 secondary diagnoses</b>			
<b>Mental illness</b>	<b>Admissions</b>	<b>Physical illness</b>	<b>Admissions</b>
<u>Anorexia nervosa</u>	61	Abnormalities of heartbeat	83
Anxiety disorder	101	Malnutrition	80
Depressive episode	38	Hypotension	42
Obsessive-compulsive disorder (OCD)	18	Constipation	38
Emotional state symptoms	9	Volume depletion	25
Personality disorders	8	Absent, scanty and rare menstruation	18
Reaction to severe stress & adjustment disorders	8	Acute upper respiratory infections	14
Bulimia nervosa	5	Infectious gastroenteritis and colitis	10
Emotional disorders with onset specific to childhood	3	Open wound	10
		Absent, scanty and rare menstruation	18
		Acute upper respiratory infections	14
		Infectious gastroenteritis and colitis	10
		Open wound	10
		Deficiency of other nutrient elements	8
		Disorders of pancreatic internal secretion	8
		Nausea and vomiting	7
		Syncope and collapse	6
		Viral infection of unspecified site	6
		Iron deficiency anemia	5
		Viral & other specified intestinal infections	4
		Poisoning	3
		Type 1 diabetes mellitus	2

Source: NSW Admitted Patient Data Collection (APDC), 2017. Note: The sample comprised C&A with AN or atypical AN as a primary or secondary diagnosis who were discharged from a public hospital.

Table 4. Factors affecting LOS

Variable	Coef. (p-value)	Variable	Coef. (p-value)
<b>Demographic factors</b>		<b>Illness factors</b>	
Age	-0.371 (p=0.424)	No. co-occurring illnesses	0.672 (p=0.068)
Male	-2.731 (p=0.502)	AN primary diagnosis	<b>8.941</b> (p<0.001)
<b>Socioeconomic factors</b>		Anxiety	1.611 (p=0.405)
Socioeconomics rank 2nd quartile	-4.605 (p=0.078)	Depressive	1.877 (p=0.524)
Socioeconomics rank 3rd quartile	-3.171 (p=0.156)	OCD	<b>10.264</b> (p=0.006)
Socioeconomics rank highest quartile	-5.063 (p=0.039)	Abnormal heart beat	1.923 (p=0.364)
Basic/Full cover	-1.706 (p=0.293)	Bulimia	-5.625 (p=0.209)
<b>Hospital factors</b>		Reaction to severe stress	0.762 (p=0.794)
Principal referral	-1.805 (p=0.490)	Malnutrition	<b>6.483</b> (p=0.010)
Paediatric specialist	2.572 (p=0.516)	Volume depletion	-2.910 (p=0.373)
Metropolitan	2.710 (p=0.409)	Fluid & electrolyte disorders	5.297 (p=0.186)
<b>Source of referral</b>		Infectious gastroenteritis & colitis	8.369 (p=0.064)
Emergency department	-0.466 (p=0.793)	Viral intestinal infections	10.929 (p=0.035)
Medical practitioner	-5.544 (p=0.022)	Viral infection unspecified	9.512 (p=0.032)
Relative/Self	<b>-8.433</b> (p=0.010)		
<b>Treatment factors</b>			
No. total admissions	-1.210 (p=0.066)		
Involuntary stay in psychiatric unit	14.281 (p=0.232)		
No. observations			288
Pseudo R <sup>2</sup>			0.197

Note: Coefficients and p-values from a median model are reported. The reference group was patients who were female, with no health insurance, had AN or atypical AN as a secondary diagnosis, had other co-occurring illnesses, did not stay in a psychiatric unit, were referred from other sources, stayed in other hospital peer groups and lived in rural or regional regions. Bold estimates indicate significance at the 1% level.

Table 5. Factors affecting referral on discharge

Variable/AME (p-value)	Outpatients mental health n=16 (5.54%)	Outpatients exc mental health n=21 (7.27%)	Outpatients specialty n=24 (8.3%)	Medical practitioner n=173 (59.86%)	Other n=31 (10.73%)	No referrals n=24 (8.3%)
<b>Demographic factors</b>						
Age	0.010 (p=0.150)	<b>0.034</b> (p<0.001)	-0.012 (p=0.111)	-0.013 (p=0.383)	-0.010 (p=0.288)	-0.009 (p=0.332)
<b>Socioeconomic factors</b>						
Socioeconomics rank highest quartile	0.013 (p=0.630)	0.074 (p=0.012)	0.024 (p=0.489)	<b>-0.196</b> (p=0.001)	0.056 (p=0.170)	0.029 (p=0.345)
Basic/Full insurance cover	-0.038 (p=0.181)	-0.064 (p=0.053)	0.016 (p=0.667)	0.037 (p=0.573)	0.025 (p=0.590)	0.024 (p=0.501)
<b>Illness factors</b>						
No. total admissions	-0.038 (p=0.087)	-0.024 (p=0.037)	0.018 (p=0.200)	0.006 (p=0.811)	0.005 (p=0.719)	<b>0.033</b> (p=0.003)
No. co-occurring illness	0.002 (p=0.379)	-0.000 (p=0.956)	0.005 (p=0.275)	-0.015 (p=0.048)	0.005 (p=0.215)	0.003 (p=0.617)
Length of stay	0.001 (p=0.114)	<b>0.002</b> (p=0.007)	0.001 (p=0.603)	-0.004 (p=0.047)	0.000 (p=0.985)	0.000 (p=0.834)
<b>Source of referral</b>						
Emergency department	-0.006 (p=0.805)	0.056 (p=0.046)	0.007 (p=0.825)	-0.019 (p=0.714)	-0.038 (p=0.225)	0.000 (p=0.999)
No. observations				288		
Log pseudo-likelihood				-338.290		
Pseudo R <sup>2</sup>				0.101		

Note: AMEs and p-values from a multinomial logit model are reported. The reference group was patients from 1<sup>st</sup>-3<sup>rd</sup> quartiles of area socioeconomic rank, with no health insurance cover, and not referred from emergency department. Outpatients specialty refers to Sydney Children's Hospital Network. Categorical variables that perfectly predicted the referral types (i.e. only associated with some referral types) could not be stably modelled and thus were not included. Bold estimates indicate significance at the 1% level.

Table 6. Factors affecting readmission

Variable	AME (p-value)	Variable	AME (p-value)
<b>Demographic factors</b>		<b>Illness factors</b>	
Age	0.016 (p=0.206)	No. comorbidities	0.008 (p=0.193)
Male	<b>0.137</b> (p=0.010)	AN primary diagnosis	0.074 (p=0.129)
<b>Socioeconomic factors</b>		Anxiety	-0.036 (p=0.436)
Socioeconomics rank 2nd quartile	<b>-0.278</b> (p=0.003)	Depressive	-0.077 (p=0.133)
Socioeconomics rank 3rd quartile	<b>-0.279</b> (p=0.003)	Abnormal heart beat	0.073 (p=0.050)
Socioeconomics rank highest quartile	-0.201 (p=0.036)	Reaction to severe stress	<b>0.152</b> (p=0.006)
Basic/Full insurance cover	0.032 (p=0.401)	Malnutrition	-0.081 (p=0.129)
<b>Treatment factors</b>		Volume depletion	0.058 (p=0.366)
No. total admissions	<b>0.089</b> (p<0.001)	Fluid & electrolyte disorders	0.070 (p=0.298)
Involuntary stay in psychiatric unit	-0.053 (p=0.527)	Infectious gastroenteritis & colitis	-0.004 (p=0.939)
Length of stay	-0.002 (p=0.337)	Viral infection unspecified	<b>0.250</b> (p=0.001)
<b>Hospital factors</b>		<b>Source of referral</b>	
Principal referral	0.121 (p=0.040)	Emergency department	-0.022 (p=0.703)
Paediatric specialist	0.078 (p=0.414)	Medical practitioner	-0.048 (p=0.400)
Metropolitan	<b>-0.178</b> (p=0.009)	Relative/Self	0.058 (p=0.200)
No. observations		259	
Log pseudo-likelihood		-46.949	
Pseudo R <sup>2</sup>		0.376	

Note: AMEs and p-values from a logit model are reported. The reference group was patients who were female, in lowest area socioeconomics quartile, with no health insurance, had AN as a secondary diagnosis, had other co-occurring illnesses, did not stay in a psychiatric unit, were referred from other sources, stayed in a non-principal referral peer group and lived in rural or regional regions. Some variables were dropped as they perfectly predicted outcome. Bold estimates indicate significance at the 1% level.

## Appendix

Table A1. Summary statistics by type of reported hospital discharge, C&A with AN

	Outpatient MH n=16	Outpatient exc MH n=21	Outpatient specialty n=24	Medical practitioner n=173	Others n=31	None n=24
<b>Age</b>	16.09	16.62	15.09	15.33	15.24	15.12
<b>Sex assigned at birth</b>						
Female	94%	95%	100%	92%	81%	92%
Male	6%	5%	0%	8%	19%	8%
<b>Area socioeconomic rank</b>						
Lowest quartile	13%	0%	0%	3%	3%	0%
2 nd quartile	6%	0%	17%	17%	10%	13%
3 rd quartile	31%	33%	25%	42%	26%	29%
Highest quartile	50%	67%	58%	37%	61%	58%
<b>Health insurance</b>						
Basic or full cover	38%	43%	54%	47%	55%	50%
No cover	62%	57%	46%	53%	45%	50%
<b>No. total admissions</b>	1.13	1.19	1.54	1.52	1.52	1.71
<b>No. co-occurring illnesses</b>	5.06	4.57	4.83	3.61	4.81	4.38
<b>Specific co-occurring illness</b>						
Anxiety	50%	24%	33%	36%	42%	38%
Depressive episode	50%	14%	13%	16%	23%	0%
OCD	25%	10%	4%	3%	6%	21%
Abnormal heartbeat	0%	52%	50%	28%	26%	21%
Bulimia	6%	0%	0%	2%	3%	0%
Reaction to severe stress disorder	6%	0%	4%	3%	0%	0%
Malnutrition	19%	86%	8%	32%	6%	4%
Volume depletion	25%	5%	13%	9%	6%	4%
Fluid & electrolyte disorders	6%	5%	0%	3%	3%	4%
Infectious gastroenteritis & colitis	0%	10%	8%	3%	0%	4%
Viral intestinal infections	0%	0%	0%	2%	3%	0%
Viral infection unspecified site	6%	0%	0%	1%	3%	8%
<b>AN diagnosis</b>						
Primary	38%	100%	71%	82%	74%	83%
Secondary	63%	0%	29%	18%	26%	17%
<b>Length of stay</b>	29.31	27.52	22.21	17.7	21.03	20.13
<b>Psychiatric unit stay</b>						
Yes	13%	0%	0%	6%	3%	0%
No	88%	100%	100%	94%	97%	100%
<b>Source of referral</b>						
Emergency department	44%	67%	48%	47%	39%	46%
Medical practitioner	13%	29%	4%	20%	6%	4%
Relative or self	6%	0%	13%	5%	16%	0%
Other	38%	5%	35%	29%	39%	50%
<b>Hospital type</b>						
Principal referral	50%	90%	0%	40%	23%	8%
Paediatric specialist	0%	0%	100%	28%	61%	79%
Others	50%	10%	0%	32%	16%	13%
<b>Residential area</b>						
Metropolitan	56%	95%	100%	51%	87%	79%
Rural or regional	44%	5%	0%	49%	13%	21%

Source: NSW Admitted Patient Data Collection (APDC), 2017. Notes: The sample comprised C&A with AN as a primary or secondary diagnosis who were discharged from a public hospital.

Table A2. Summary statistics by hospital readmission status, C&amp;A with AN

	Hospital Readmission $\leq$ 28 days n=22	Hospital Readmission $\geq$ 28 days n=267
<b>Age</b>	15.41	15.42
<b>Sex</b>		
Female	91%	92%
Male	9%	8%
<b>Area socioeconomics rank</b>		
Lowest quartile	5%	3%
2 nd quartile	9%	15%
3 rd quartile	41%	36%
Highest quartile	45%	46%
<b>Health insurance</b>		
Basic or full cover	41%	49%
No cover	59%	51%
<b>No. total admissions</b>	2.64	1.40
<b>No. co-occurring illnesses</b>	3.95	4.06
<b>Specific co-occurring illness</b>		
Anxiety	14%	38%
Depressive episode	5%	18%
OCD	0%	7%
Abnormal heartbeat	36%	28%
Bulimia	0%	2%
Reaction to severe stress disorder	9%	2%
Malnutrition	14%	29%
Volume depletion	18%	8%
Fluid & electrolyte disorders	5%	3%
Infectious gastroenteritis & colitis	9%	3%
Viral intestinal infections	0%	1%
Viral infection unspecified site	5%	2%
<b>AN diagnosis</b>		
Primary	77%	79%
Secondary	23%	21%
<b>Length of stay</b>	13.59	20.52
<b>Psychiatric unit stay</b>		
Yes	5%	4%
No	95%	96%
<b>Source of referral</b>		
Emergency department	45%	47%
Medical practitioner	14%	16%
Relative or self	9%	6%
Other	32%	31%
<b>Hospital type</b>		
Principal referral	32%	37%
Paediatric specialist	41%	38%
Others	27%	25%
<b>Residential area</b>		
Metropolitan	50%	66%
Rural or regional	50%	34%

Source: NSW Admitted Patient Data Collection (APDC), 2017. Notes: The sample comprised C&A with AN as a primary or secondary diagnosis who were discharged from a public hospital.

## **Title page**

**Title:** Factors related to length of stay, referral on discharge, and hospital readmission for children and adolescents with Anorexia Nervosa

**Running title:** Hospital usage factors for Anorexia Nervosa

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**Conflict of interest statement**

The authors have no conflict to declare.

**Data availability statement**

The data that support the findings of this study require ethics approval. The data are not publicly available due to privacy or ethical restrictions.