Original Article

Hospital psychosocial interventions for patients with brain functional impairment: A retrospective cohort study

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ABSTRACT: Psychosocial interventions could improve health and care outcomes, however, little is known about their use for patients with complex needs in the acute hospital care setting. This study aimed to evaluate factors associated with psychosocial intervention use when treating patients with brain functional impairment during their hospital care. The all-inclusive New South Wales (NSW) Admitted Patient Data were employed to identify patients with neurodevelopment disorders, brain degenerative disorders, or traumatic brain injuries admitted to NSW public hospitals for acute care from July 2001 to June 2014. We considered receipt of psychosocial interventions as the primary outcome, and used mixed effect logistic models to quantify factors in relation to outcome. Of important note, psychosocial intervention use was more common in principal hospitals, and amongst those receiving intensive care or having comorbid mental disorders in the study populations. Approximate 70.8% of patients with traumatic brain injuries did not receive psychosocial interventions, despite attempts to target those in need and an overall increasing trend in adoption. Continuing efforts are warranted to improve service delivery and uptake.

KEYWORDS: brain degenerative disorders, hospital psychiatry, neurodevelopment disorders, psychosocial intervention, traumatic brain injuries.

INTRODUCTION

People with neurodevelopment disorders (NDD) such as autism, intellectual learning disability and attention deficit disorders; brain degenerative disorders (BDD) such as Alzheimer disease and other degenerative diseases of the nervous system; or traumatic brain injuries (TBI), have a high disease burden due in part to impaired brain functioning, experience challenges in their life situations, and require urgent clinical care at times (Fecteau et al. 2013; Garvin & Mangat 2017; Ghroubi et al. 2016; Gutierrez et al. 2008; Howe 2008; Kopecky et al. 2013). Most of these patients experience neuropsychiatric symptoms such as depression and anxiety (Garvin & Mangat 2017; Howe 2008; Kopecky et al. 2013), as well as impaired self-efficacy (Ownsworth et al. 2010; Ponsford et al. 2016). Patients, who experience likely deterioration in their mental and social health, may also develop disruptive behaviours such as agitation, aggression, and resistance-to-care (Fecteau et al. 2013; Ghroubi et al. 2016). These secondary disorders and disruptive behaviours are associated with a decreased quality of care and an increased
risk of unintentional physical harm for hospitalised patients (Ghroubi et al. 2016; Gutierrez et al. 2008). Moreover, self-harm or suicidal attempts were reported during their acute hospital care, e.g., 27.3% of veterans with a TBI history were found to have self-harm behaviours or to have made a single or multiple suicide attempts during their hospitalisations (Gutierrez et al. 2008).

Needs for mental health care and support are frequently seen in patients with NDD, BDD, or TBI, however, conventional pharmaceutical interventions have not been found to achieve permanent successful results for these patients with their complex physical and psychosocial needs (Gallagher & Herrmann 2015; Leskovec et al. 2008; McConeghy et al. 2012; Mercken et al. 2011; Vandenberghhe et al. 2016). In addition to the lack of convincing evidence on efficacy, these pharmaceutical treatments are expensive and most have side effects that adversely impact physical function in these patients or require acute hospital care (Zhou et al. 2019).

To address mental health challenges and improve health and social outcomes in these patients, there is growing interest in psychosocial interventions, encompassing interpersonal or informational activities to improve mental health and social functioning, relieve existing deficits, and prevent future disorders (Bourbonnais et al. 2011; Chown 2015). These interventions demonstrate a greater reduction in mental health care burdens and achieve a greater gain in psychosocial function and quality of life compared with traditional therapeutic regimens, and are now recommended for patients with NDD, BDD, or TBI during their clinical care (Ballard Clive et al. 2009; Lerner et al. 2012; Ponsford et al. 2016).

The adoption of such psychosocial interventions for these patients during acute hospital care is largely unknown. We aim to evaluate factors associated with the use of psychosocial interventions and the variation in the adoption of psychosocial interventions during hospitalisation in patients with NDD, BDD, or TBI.

METHODS

Data source

This multi-center retrospective cohort study employed routinely collected hospital administrative data from the NSW Admitted Patient Data Collection (APDC), which is a complete census of hospital separation records for all patients admitted to NSW public hospitals. For each de-identified record, age, sex, postcodes of usual residence, marital status, intensive care, insurance status, medical diagnoses, procedures, and disposition status were extracted from the APDC over a 13-year period from July 2001 to June 2014. We only considered cases for acute hospital care to reduce multiple counting of admissions. Medical diagnosis was coded at separation using the ICD-10 Australian Modification (National Centre for Classification in Health, 2010). The Australian National University Science & Medical Delegated Ethics Review Committee approved this study (#2016/030).

Study population

The study considered inpatients with NDD (including autism, intellectual learning disability and attention deficit disorder using diagnosis codes F70–98), BDD (including Alzheimers and other degenerative diseases of the nervous system using diagnosis codes G30–32), or TBI (diagnosis codes: S00.2, S02.1, S06), who were admitted to NSW public hospitals for acute care in an emergency situation during the study period.

Study outcome

The primary outcome was the use of psychosocial intervention during acute hospital care, categorised as yes or no, using the ICD-10-AM procedure codes (National Centre for Classification in Health, 2010). We also considered whether a patient was transferred at the end of care (yes or no) as the secondary outcome.

Sociodemographic and clinical variables

We considered sociodemographic variables and classified age into five groups in years (i.e., <18, 18–44, 45–64, 65–84, 85+) allowing for its possible non-linear relationship with the study outcome and its indication for healthcare resource allocation (e.g., pediatric or geriatric groups); socioeconomic status into five quintile groups (i.e., 1st as the most disadvantaged, 2nd, 3rd, 4th, or 5th as the most advantaged quintile using the Index of Relative Socio-Economic Disadvantage) (Australian Bureau of Statistics (ABS) 2006); sex as male or female; rurality of residence as ARIA+ based urban, or rural; private insurance as yes or no; marital status as partnered or single. A separate category of unknown was created for those with unclassifiable information.

We also considered clinical variables and classified the number of comorbid mental disorders into five
groups (i.e., none, 1, 2, 3 and ≥4 illnesses); severity of comorbidity using modified Charlson Index into three groups (i.e., minor if total score of 0, moderate if total score of 1 or 2, or severe if total score of ≥2) (Charlson et al. 1987); and determined whether receipt of intensive care; as well as whether being admitted to principal referral hospitals (with >20 000 separations, and regional hospitals with >16 000 separations per annum), based on the Australian Institute of Health and Welfare classification system (Australian Institute of Health and Welfare (AIHW) 2014). Financial year of separation was treated as continuous.

Statistical analysis

Stata version 14.0 was used for all data analysis. Numbers and proportions of NDD, BDD, and TBI patients who received a psychosocial intervention in each hospital were calculated. Mixed-effect logistic regressions were used to explore receipt of psychosocial intervention in association with demographic and clinical variables. A model-derived intraclass correlation coefficient (ICC) was used to estimate to what extent hospital variability contributed to the total variation of use. Additional modelling was conducted to examine whether being transferred at the end of care was associated with the receipt of psychosocial interventions adjusting for the same set of demographic and clinical characteristics used. Box and whiskers plots with the 1.5× Interquartile Range rule were also created to visualise variation in the use of psychosocial interventions across different hospitals. A sensitivity analysis was conducted excluding patients with coexisting NDD, BDD, or TBI.

RESULTS

Patients with NDD

For people with NDD, receiving psychosocial intervention was observed in nearly 43.2% (n = 15 769) of the study population, showing an increase of 8% per annum during the study period (Table 1, Fig. 1). Approximate 15.7% of these 36 537 patients (n = 5729) were transferred at the end of acute care. There were more male patients (59.1%, n = 21 601), and those aged 0–17 (n = 12 117) or 18–44 years (n = 12 259) accounted for the majority, with 38.6% and 48.0% receiving psychosocial interventions, respectively (Table 1).

<p>| TABLE 1: Associations between characteristics and use of psychosocial intervention for NDD patients |</p>
<table>
<thead>
<tr>
<th>Characteristics</th>
<th>Number</th>
<th>Use (%)</th>
<th>Adjusted OR (95% CI)</th>
<th>P-value</th>
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<tbody>
<tr>
<td>Age group (years)</td>
<td></td>
<td></td>
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<tr>
<td>0–17</td>
<td>12 117</td>
<td>38.6</td>
<td></td>
<td></td>
</tr>
<tr>
<td>18–44</td>
<td>12 259</td>
<td>48.0</td>
<td>0.77 (0.72, 0.82)</td>
<td>&lt;0.001</td>
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<tr>
<td>45–64</td>
<td>7483</td>
<td>41.8</td>
<td>0.73 (0.67, 0.80)</td>
<td>&lt;0.001</td>
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<tr>
<td>65–84</td>
<td>3949</td>
<td>42.8</td>
<td>0.74 (0.67, 0.82)</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>85+</td>
<td>729</td>
<td>52.7</td>
<td>0.78 (0.65, 0.93)</td>
<td>0.005</td>
</tr>
<tr>
<td>Sex</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Male</td>
<td>21 601</td>
<td>41.6</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Female</td>
<td>14 936</td>
<td>45.5</td>
<td>1.21 (1.15, 1.27)</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>Rurality of Residence†</td>
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<td></td>
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<tr>
<td>Urban</td>
<td>34 136</td>
<td>43.1</td>
<td></td>
<td></td>
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<tr>
<td>Rural</td>
<td>1584</td>
<td>30.7</td>
<td>1.12 (0.96, 1.31)</td>
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<tr>
<td>No</td>
<td>31 916</td>
<td>44.2</td>
<td></td>
<td></td>
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<tr>
<td>Yes</td>
<td>4621</td>
<td>36.0</td>
<td>0.72 (0.67, 0.78)</td>
<td>&lt;0.001</td>
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<td>Socioeconomic status†</td>
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<tr>
<td>1st (most disadvantaged)</td>
<td>8,926</td>
<td>42.1</td>
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<tr>
<td>2nd</td>
<td>7,517</td>
<td>41.1</td>
<td>0.94 (0.87, 1.02)</td>
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<tr>
<td>3rd</td>
<td>8,592</td>
<td>41.0</td>
<td>0.92 (0.85, 0.99)</td>
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<tr>
<td>4th</td>
<td>6,625</td>
<td>45.2</td>
<td>0.91 (0.84, 0.99)</td>
<td>0.020</td>
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<tr>
<td>5th (most advantaged)</td>
<td>4,057</td>
<td>45.3</td>
<td>0.91 (0.82, 1.00)</td>
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<td>Intensive care</td>
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<tr>
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<td>42.6</td>
<td></td>
<td></td>
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<tr>
<td>Yes</td>
<td>2493</td>
<td>50.2</td>
<td>1.74 (1.59, 1.90)</td>
<td>&lt;0.001</td>
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<td>Severity of comorbidities</td>
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<td>Minor</td>
<td>28 404</td>
<td>42.8</td>
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<tr>
<td>Moderate</td>
<td>6079</td>
<td>43.2</td>
<td>1.04 (0.98, 1.11)</td>
<td>0.204</td>
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<tr>
<td>Severe</td>
<td>2054</td>
<td>48.6</td>
<td>1.50 (1.35, 1.66)</td>
<td>&lt;0.001</td>
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<td>Number of comorbid mental disorders</td>
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<td></td>
<td></td>
</tr>
<tr>
<td>1</td>
<td>21 312</td>
<td>30.7</td>
<td></td>
<td></td>
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<tr>
<td>2</td>
<td>9870</td>
<td>57.0</td>
<td>2.60 (2.46, 2.75)</td>
<td>&lt;0.001</td>
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<td>3</td>
<td>4106</td>
<td>65.7</td>
<td>3.54 (3.27, 3.83)</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>&gt;4</td>
<td>1249</td>
<td>72.1</td>
<td>4.60 (4.01, 5.28)</td>
<td>&lt;0.001</td>
</tr>
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<td>Principal referral hospital</td>
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<tr>
<td>No</td>
<td>9515</td>
<td>44.5</td>
<td></td>
<td></td>
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<tr>
<td>Yes</td>
<td>27 022</td>
<td>42.7</td>
<td>2.72 (1.81, 4.11)</td>
<td>&lt;0.001</td>
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<tr>
<td>Marital status†</td>
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<tr>
<td>Partnered</td>
<td>2801</td>
<td>52.5</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Single</td>
<td>32 736</td>
<td>42.1</td>
<td>0.75 (0.69, 0.82)</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>Financial year</td>
<td>36 537</td>
<td>43.2</td>
<td>1.08 (1.07, 1.09)</td>
<td>&lt;0.001</td>
</tr>
</tbody>
</table>

†Results for unknown category were not presented.

Bold values indicate the results of statistical significance at significance level of 0.5%.

Receiving psychosocial intervention was positively associated with being under 18 years, female, without private insurance, having a partner, receiving intensive care, with increasing number of comorbid mental disorders (Table 1). Admission to principal referral hospitals was associated with greater adoption of psychosocial interventions (OR: 2.72, 95%CI: 1.81–4.11).
These principal hospitals had a much higher NDD patient volume on average (mean: 1,454; standard deviation: 5.78) than their counterparts (424; 3.00). Compared with patients who did not receive psychosocial interventions, patients receiving psychosocial interventions were more likely to be transferred (OR: 1.22, 1.14–1.31).

Amongst a total of 98 hospitals providing acute care for patients with NDD, most hospitals (n = 86) adopted psychosocial interventions, however, patients from non-principal hospitals with low volume were less likely to receive psychosocial interventions than their counterparts from principal hospitals with high volume (Fig. 2). The hospital-level difference (ICC) contributed to 39.6% total variation in the receipt of psychosocial interventions.

Patients with BDD

For people with BDD, receiving psychosocial intervention was observed in approximately 48.1% (n = 24,454) of the study population with an increase of 3% per annum during the study period (Table 2, Fig. 1). Older patients with BDD (aged 65 + years) accounted for 90.2% of the total patients (Table 2). Patients with BDD (n = 1573) living in rural areas were less likely to receive psychosocial interventions than their urban counterparts (OR:0.81, 0.66–0.99) (Table 2). Receipt of psychosocial interventions was more likely for males, those without private insurance, having a partner, receiving intensive care, and with an increasing number of comorbid mental disorders (Table 2). Admission to principal referral hospitals in comparison with non-principal hospitals was associated with more use of psychosocial interventions (OR: 5.03, 2.33–10.86). These principal hospitals had a much higher BDD patient volume on average (mean: 2,117; standard deviation: 6.26) than their non-principal counterparts (536; 3.69). Patients receiving psychosocial interventions were more likely to be transferred compared with those who did not receive any psychosocial interventions (OR: 1.56, 1.50–1.62).

Amongst a total of 121 hospitals, a quarter of them (26.4%) did not provide psychosocial interventions for people with BDD. Patients from non-principal hospitals with low volume were less likely to receive psychosocial interventions than their counterparts from principal hospitals with high volume (Fig. 2). Between-hospital difference accounted for 48.8% of total variation in use of psychosocial interventions.

Patients with TBI

For people with TBI, receiving psychosocial intervention was observed in approximately 29.2% (n = 20,440) of the study population, with an increase of 6% per annum during the study period (Table 3, Fig. 1). Patients living in rural areas accounted for 19.7% of the TBI group, who were more likely to receive psychosocial interventions than their urban counterparts (OR:1.22, 1.10–1.35) (Table 3). Use of psychosocial interventions was more likely in those with older age, female, being single, without private insurance, receiving intensive care, and with an increasing number of mental disorders (Table 3). Admissions to principal referral hospitals were associated with greater adoption of psychosocial interventions (OR: 10.19, 6.28–16.55). These principal hospitals had a much higher TBI...
patient volume on average (mean: 3,298; standard deviation: 7.52) than their non-principal counterparts (392; 2.87). Compared with patients who did not receive psychosocial interventions, those who received psychosocial interventions were more likely to be transferred (OR: 1.39, 1.33–1.45).

Amongst a total of 120 hospitals, 40 hospitals (33.3%) did not provide psychosocial interventions for TBI patients during their urgent care. It was rare for low volume hospitals to adopt psychosocial interventions (Fig. 2). Between-hospital difference accounted for 48.1% of total variation in use of psychosocial interventions.

### Variation in use for different patient groups

The observed variability in use of psychosocial interventions for patients with BDD or TBI was less than those with NDD, with the rate of use for patients with TBI being the lowest (Fig. 2). Despite the increase in use over time, the majority of patients with NDD (56.8%), BDD (51.9%) or TBI (70.8%) did not receive psychosocial interventions.

### Sensitivity analysis

After excluding patients with coexisting of NDD, BDD, or TBI, there were no significant changes to the ICC estimates (NDD: 39.6%, BDD: 48.8%, and TBI: 48.1%), and the use of psychosocial interventions in relation to demographic and clinical factors as well as the likelihood of being transferred.

### DISCUSSION

This study demonstrates an increase over time in the use of hospital based psychosocial interventions for patients with brain functional impairment, reflecting the acceptance of psychosocial interventions as an alternative non-pharmacological therapy (Bracher 2012). Psychosocial interventions have demonstrated clear advantages when compared with conventional therapies such as developing positive behaviors, reducing mental disorders and increasing quality of life (Ownsworth et al. 2010; Ponsford et al. 2016).

Variation between different hospitals for NDD, BDD and TBI patients receiving psychosocial...
interventions were substantial, which might be partly attributable to access, service delivery, and policy implementation in place. Patients admitted to principal referral hospitals had greater access to psychosocial interventions as principal referral hospitals with high patient volume offer more specialised psychiatric services when compared with their counterparts (South Western Sydney Local Health District 2016; Australian Institute of Health and Welfare (AIHW) 2018), which

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may explain the observed positive association between admission to principal referral hospitals and use of psychosocial interventions for all three patient groups. In addition, lack of access to psychosocial services was reported in rural areas (Murphy & Ruble 2012), which might contribute to the observed variation in this study, for example, fewer patients with brain functional impairment received psychosocial interventions in rural areas compared with their counterparts in urban areas. Although telehealth approaches demonstrated feasibility to delivery psychosocial interventions in access-limited environment (Hepburn et al. 2016), robust evaluation of population-based effectiveness was lacking and the usability of such new technology was somewhat problematic during implementation. In the absence of effective countermeasures to eliminate practical barriers, increasing universal access to psychosocial services in patients with brain function impairment remains a challenge.

In this study, use of psychosocial interventions increased in association with receiving intensive care or having comorbid mental illnesses. While these groups were more likely to receive psychosocial interventions compared with their counterparts, there were still a large number of patients who received intensive care (49.8% of NDD patients, 53.3% of BDD patients, and 43.3% of TBI patients) or who were diagnosed with comorbid mental illnesses (56.8% of NDD patients, 51.8% of BDD patients, 61.2% of TBI patients) did not receive any psychosocial interventions. This service gap indicates a clear need for psychosocial support, with whereby the possible focus is on offering interventions to patients who receive intensive care or who have comorbid mental illnesses. This specific finding suggests it would be beneficial to establish mental health evaluation programs in hospitals and incorporate psychosocial interventions into routine hospital care for patients with NDD, BDD, or TBI, especially those with comorbid mental illnesses or patients who receive intensive care.

Currently, the Australian government authorities have funded very few hospital based programs designed to benefit inpatients with complex needs (Australian Government Department of Health, 2017; Victorian Government Department of Health, 2013), despite a strong focus on provision of primary mental health care. We found NDD and TBI patients with public insurance, during their acute hospital care, were more likely to receive psychosocial interventions than patients with private insurance, indicating a heavy reliance on psychological programs funded by the government. Given comorbid mental disorders are common in patients with NDD (Khan et al. 2012), BDD (Espiritu et al. 2001) or TBI (Corrigan & Deutschle 2008) and they were admitted to hospitals with anxiety about their physical conditions as well as family and financial matters, additional mental health training and support becomes more necessary for hospital clinicians and nurses to comprehend these psychosocial needs and uphold the whole-person approach for better care and better outcomes. Future initiative to bridge primary and tertiary healthcare as well as private and public schemes would likely encourage the use of psychosocial interventions to aid patients' recovery.

Other sociodemographic factors associated with greater use of psychosocial interventions were identified as age (0–17 years for NDD patients; >18 years for TBI patients; 45–84 years for BDD patients) and being socioeconomically advantaged. Although these groups had a higher rate of receiving of psychosocial interventions compared with their counterparts, it should be noted that over 50% of all patients did not receive any psychosocial interventions, perhaps because of the barrier created by the economic burden. Furthermore, we are unable to determine whether there are cultural barriers or language barriers preventing patients from receiving psychosocial interventions due to a lack of causal data, such as ethnic background or type of the first language spoken. In this case, future research is recommended that focuses on contextual information about hospital based mental health care, which is essential to encourage the provision of services by hospitals and governments.

In the current study setting, compared with patients who did not receive psychosocial interventions, patients who underwent psychosocial interventions were more likely to be transferred. Recently, patients with TBI demonstrated the need for continuing rehabilitation after they had been stabilised and transferred to general mental health institutes or long-term care facilities (Takada et al. 2017). However, identifiers for receiving facilities were unavailable, and therefore it was difficult to determine whether patients were transferred for rehabilitation or for other reasons.

In this situation, we were unable to determine whether the use of psychosocial interventions contributed to a better recovery outcome. Being transferred is perhaps a proxy measure of a psychosocial therapy failure in those who requiring more specialised care at the receiving mental health hospital. Several articles mention that typical psychosocial interventions are not always effective (Green et al. 2015; Wittenberg 2016). Further research with a focus on the effectiveness of psychosocial interventions for hospitalised
patients with brain functional impairment is necessary if we are to encourage the provision of psychosocial interventions by hospitals and governments.

LIMITATIONS

Although the dataset in this study includes a large sample size over a long period, these data were lacking narrative descriptions of clinical status, mental health status, pharmacotherapy with psychotropic medications, and psychosocial modalities for these patients with complex needs as these data were routinely collected for administrative purposes only. Compared with coded data, narrative information may assist in identifying more detailed psychosocial intervention strategies. For example, investigation of patient’s progress notes might enhance our understanding of the relative contribution of different psychosocial therapies towards the amelioration of symptoms and improvement in resilience and wellbeing in patients with these chronic conditions.

Also an issue was the ambiguity of coding of some demographic variables as unclassifiable. Nearly 1,000 observations have unclassifiable values for marital status, so there might be certain biases in this regard. Although we repeated the analysis by excluding these unclassifiable observations and observed little changes in effect estimates, results should be interpreted with caution. Another limitation is that of attributed to confounding, possibly due to the existence of unmeasured risk factors, which might influence the results concluded in this study. For example, active engagement with patients’ families may play an important role in improving uptake of evidence based services (Masi et al. 2003; Snell-Johns et al. 2004). At a certain point throughout their episodes of acute care, patients might have received motivational family coping support strategies or services, which was unfortunately lacking in the data collection. Nevertheless, when treating people with brain functional impairment, healthcare providers are encouraged to keep their families actively engaged in mental health services. Moreover, the effectiveness of psychosocial interventions is not verified in this study setting, and therefore further research is recommended to examine whether psychosocial interventions assist patients’ recovery.

IMPLICATIONS FOR PRACTICE

Although increasing trends of receipt of psychosocial interventions for hospitalised patients with brain functional impairment were observed in this study, there was still significant variation in the use of these interventions between different hospitals. In this case, continuing effort is best focused on narrowing the variations in the use of psychosocial interventions between different hospitals (e.g., increasing access to psychiatric care, improving services delivery and planning, or encouraging more publicly available psychosocial programs). However, unwarranted variation in this study highlights the need for further investigation.

RELEVANCE STATEMENT

The findings from this study provide important evidence to support future initiatives to improve targeted mental health care in patients with brain functional impairment during acute hospital care. Reduction of the unwarranted variation in the use of psychosocial interventions is urgently needed to improve outcomes in these patients with complex needs during their acute hospital care.

ACKNOWLEDGEMENTS

We appreciate the NSW Health Department for providing the APDC data. The study sponsors had no further role in the study design, data collection, analyses, interpretation of results, writing of the article, or the decision to submit it for publication.

ETHICAL STATEMENTS

Ethics approval was sought from the Institution Science & Medical Delegated Ethics Review Committee (#2016/030).

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