Title Page

Receipt of Mental Health Treatment in People Living with Stroke: Associated Factors and Long-term Outcomes

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Abstract

Background: Untreated post-stroke mood problems may influence long-term outcomes. We aimed to investigate factors associated with receiving mental health treatment following stroke and impacts on long-term outcomes.

Methods: Observational cohort study derived from the Australian Stroke Clinical Registry (AuSCR; Queensland and Victorian registrants: 2012-2016) linked with hospital, primary care billing and pharmaceutical dispensing claims data. Data from registrants who completed the AuSCR 3-6 month follow-up survey containing a question on anxiety/depression were analysed. We assessed exposures at 6-18 months and outcomes at 18-30 months. Factors associated with receiving treatment were determined using staged multivariable multilevel logistic regression models. Cox proportional hazards regression models were used to assess the impact of treatment on outcomes.

Results: Among 7,214 eligible individuals, 39% reported anxiety/depression at 3 to 6 months following stroke. Of these, 54% received treatment (88% antidepressant medication). Notable factors associated with any mental health treatment receipt included pre-stroke psychological support (odds ratio [OR] 1.80 [95% CI, 1.37-2.38]) or medication (OR 17.58 [95% CI, 15.05-20.55]), self-reported anxiety/depression (OR 2.55 [95% CI, 2.24-2.90]), younger age (OR 0.98 [95% CI, 0.97-0.98]), and being female (OR 1.30 [95% CI, 1.13-1.48]). Those who required interpreter services (OR 0.49 [95% CI, 0.25-0.95]), used a health benefits card (OR 0.73 [95% CI, 0.59-0.92]), or had continuity of primary care visits (i.e., with a consistent physician) (OR 0.78 [95% CI, 0.62-0.99]) were less likely to access mental health services. Among those who reported anxiety/depression, those who received mental health treatment had an increased risk of presenting to hospital (hazard ratio, 1.06 [95% CI, 1.01-1.11]) but no difference in survival (hazard ratio, 0.86 [95% CI, 0.58-1.27]).

Conclusions: Nearly half of people living with mood problems following stroke did not receive mental health treatment. We have highlighted subgroups who may benefit from targeted mood screening and factors that may improve treatment access.

Key words: anxiety, data linkage, depression, epidemiology, outcomes research, stroke, treatment

Non-standard Abbreviations and Acronyms

ED: emergency department

EQ-5D-3L: European Quality of Life 5 Dimensions 3 Levels

OR: odds ratio

AuSCR: Australian Stroke Clinical Registry

Introduction

Approximately one-third of people living with stroke experience depression at some point in their recovery, while an estimated 18-24% experience anxiety.[1,2] The two conditions are comorbid and associated with caregiver burden.[3,4] Unresolved depression or anxiety may affect a range of post-stroke outcomes, including recovery in activities of daily living and long-term survival.[5–7] Individuals who experience post-stroke depression have been shown to have increased hospitalisations and outpatient visits relative to those without a mental health diagnosis, even after accounting for pre-stroke medical utilisation, stroke severity, and mental health-related visits.[8]

Pharmacotherapy is often the first-line treatment for depression after stroke, but may be associated with side effects and risks especially in those with multiple comorbidities and polypharmacy.[9–11] Psychological treatment has been used to alleviate symptoms of post-stroke depression or anxiety without adverse impacts.[10] For depression, psychological interventions delivered in conjunction with medication appear to be more effective than either treatment alone.[12,13] Clinical guidelines for the treatment and prevention of post-stroke mood problems include antidepressant medications, exercise programs, and psychological therapies.[14] Despite evidence of treatment effectiveness, more than two-thirds of people living with stroke reported that their psychological needs were not fully met.[15–17] Most Australians with a neurological disorder reported at least one barrier to receiving mental health treatment,[18] and treatment access may be complicated by physical, cognitive and communication limitations.[19] Our earlier research, one of the first to investigate this in people with stroke, identified older age, not feeling socially isolated, having no previous mental health treatment, no medical diagnosis of anxiety/depression, and no multidisciplinary team care arrangement plan as barriers. [20] Although this study provided novel insights, the

restriction of the cohort to registry participants who completed a project-specific survey may not have been reflective of the broader population. Further investigation was warranted to confirm these results at a population level and to clarify whether receipt of mental health treatment influences long-term outcomes.

The objectives of this study were to: (i) identify demographic, clinical and structural factors associated with receipt of mental health treatment following stroke or transient ischaemic attack in a population cohort; and (ii) investigate the association between receipt of mental health treatment in the 6 to 18 months following stroke and long-term outcomes, including survival and hospital utilisation.

Materials and Methods

Ethics and Data Availability

This project was approved by the Monash University Human Research Ethics Committee (MUHREC/12301) and the Australian Institute of Health and Welfare ethics committee (EO2018/2/449). Approvals were also obtained from the Australian Stroke Clinical Registry (AuSCR) Research Task Group and relevant data custodians for each of the linked datasets. The AuSCR has ethics approval to use opt-out consent, whereby patients are automatically included in the registry unless they subsequently decline (opt out rate ~3%). Due to ethical and legal restrictions, patient-level data from this study cannot be shared. However, aggregated data outputs and coding that support the findings of this study are available on reasonable request from the corresponding author, following approval from the relevant data custodians.

Design and Setting

This is a sub-study of the PRECISE project,[21] an observational cohort study using linked population data. The cohort was derived from the AuSCR (a national clinical quality registry designed to monitor and improve stroke care) and linked to a range of administrative datasets to obtain exposure and outcome variables not routinely collected within the AuSCR. Data were linked by accredited state and commonwealth data linkage units using probabilistic and deterministic methods. This manuscript follows STROBE reporting guidelines[22] (Table S1).

Eligibility

Registrants eligible for this study were those aged 18 years and older who were admitted to participating hospitals (n = 45 hospitals) between 2012 and 2016 with a diagnosis of stroke or transient ischaemic attack and completed the 90-180 day AuSCR follow-up survey. We restricted the analysis to registrants admitted to hospitals in Victoria and Queensland, as these states have government support for participation in the registry resulting in high coverage. We also excluded registrants who, during the first 18 months post-stroke/transient ischaemic attack, either died, did not have a Medicare-subsidised visit with a primary care physician, or resided in permanent residential aged care or palliative care.

Data Sources

The linked dataset in PRECISE[21] comprises information from the following sources:

1. ***AuSCR*** registrants have a clinical diagnosis of stroke, and information on clinical processes of care and health outcomes are prospectively collected. Between 90-180 days post-stroke, eligible registrants are followed up and administered a survey which includes the European Quality of Life 5 Dimensions 3 Levels (EQ-5D-3L)[23] (a scale assessing subjective quality of life that includes a question on current presence of anxiety or depression).

2. ***Medicare*** is the Australian government's universal healthcare system that includes rebates for primary care visits and mental health-related services.[24] Rebates are available for assessment and formulation of mental health treatment plans by primary care physicians, as well as referral to and treatment sessions with appropriate specialists. Table S2 contains descriptions of Medicare items included.
3. ***Pharmaceutical Benefits Scheme*** provides subsidised and affordable access to the majority of medications prescribed in Australia, including mental health-related prescriptions.[25]
4. ***National Death Index*** lists all deaths that have occurred in Australia since 1980.
5. ***Hospital admission data*** informs inpatient separations, including formal separations from the facility (i.e., discharges, transfers, deaths) and changes in principal clinical intent within the same period of stay. Primary and secondary admission related diagnoses are coded using standardised International Statistical Classification of Diseases and Related Health Problems, 10th revision, Australian Modification (ICD-10-AM) and Australian Classification of Health Interventions.
6. ***Emergency department*** (ED) data informs presentations to public EDs, and contains variables on triage category, type of visit, discharge destination and primary diagnosis.

Exposures

Our exposure variable was the receipt of mental health treatment following stroke, as indicated by Medicare claims and pharmaceutical dispensations of mental health-related medications (ATC codes commencing with N05 and N06, excluding drugs for dementia and sleep disorders). Medicare claimable mental health services may be provided by psychiatrists, psychologists, primary care physicians, and allied mental health workers (Table S2). The exposure period was defined as the 6-18 months following stroke. By 6 months most people

with stroke have completed their hospital treatments and are in the care of their primary care physician. This timeframe also aligns with the AuSCR follow-up period.

Factors Investigated for Association with Mental Health Treatment Receipt

Variables are detailed in Table S3 and included: *Demographic factors* such as sex, age at stroke and living situation; *Clinical factors* such as stroke severity (ability to walk on admission as a reliable proxy marker of minor stroke[26,27]) and type of stroke; and *Structural factors* such as regularity and continuity of visits to a primary care physician.

On the EQ-5D-3L, participants may respond *Not/Moderately/Extremely* to the question of whether they currently have anxiety or depression. Those who selected *Moderately* or *Extremely* were categorised as having self-reported anxiety/depression. This has been shown to have moderate concordance with the Hospital Anxiety and Depression Scale, which assesses feelings of anxiety and depression over the past week.[28] While this is a brief measure that compounds two distinct constructs and does not confer a diagnosis, it is considered suitable for population-level screening of mood problems. [28] Comorbidities were determined using hospital ICD-10-AM coded data from all hospital utilisation (ED and admission) in the five years prior to and including the stroke event.[29] Derived measures included: socioeconomic status using the Index of Relative Socioeconomic Advantage and Disadvantage divided into 5 predetermined quintiles; primary care physician regularity defined as at least once every six months; and continuity of visits using a weighted measure where a score of >80% indicated continuity with the same primary care physician.[30]

Outcomes

Outcomes examined were survival status and hospital utilisation during the 18-30 months following stroke. Hospital utilisation included planned (e.g., arranged by primary care physician) and unplanned admissions, as well as ED presentations that did not results in a hospital admission. Cumulative rates of hospital utilisation were calculated per 1,000 person-years to account for the competing risk of death.

Statistical Analyses

Completeness was assessed and missing data in primary datasets were imputed with data from another dataset. Multivariable logistic regressions were used to determine factors associated with receipt of mental health treatment. We used a staged approach to explore the relative contribution of the different categories of variables: (i) demographic covariates only, (ii) demographic and clinical covariates, and (iii) demographic, clinical and structural covariates. This was undertaken for both forms of treatment combined as well as Medicare claims and pharmaceutical dispensing separately. Models were assessed for multicollinearity (a Variance Inflation Factor <10 indicating low multicollinearity), goodness-of-fit (χ^2 and Bayesian Information Criterion) and percentage of variance accounted for at each stage. A sensitivity analysis was conducted, in which those with a history of mental health treatment pre-stroke were excluded from these analyses.

Multilevel mixed-effects Cox proportional hazards regression models[31] (with level defined as patient and health region) were used to examine the association between mental health treatment and long-term outcomes. To minimize confounding by indication, 49 baseline variables were balanced using propensity score methods to derive Inverse Probability of Treatment Weights. This method ensured an even distribution of measured covariates between those who did and did not receive mental health treatment to determine the average

treatment effect across the population (Table S4 contains full list of variables). Baseline covariates between those who did and did not receive mental health treatment were compared in the weighted sample for balance. An absolute standardised difference <0.1 was defined as negligible imbalance.

Results

Of the 28,775 AuSCR registrants eligible for data linkage, 27,435 (95.3%) were successfully linked with the administrative datasets. Of these, 12,368 were included in the final PRECISE cohort and 7,214 (58%) provided EQ-5D-3L data and were included in this study (refer to Figure S1 for flowchart). A further 316 (4%) were excluded from the multivariable analyses due to missing data. Comparison of characteristics between those who did and did not provide EQ-5D-3L can be found in Table S5. Those who completed the EQ-5D-3L were less likely to be socially disadvantaged, less likely to have had a history of mental health treatment, and more likely to have private health insurance. The majority of participants were born in Australia (99%) and 42% were female. The median age at stroke was 71.3 years (Q1 61.5, Q3 79.2). Participant demographic and clinical characteristics are shown in Table 1.

Based on responses to the EQ-5D-3L anxiety/depression domain obtained at the AuSCR 90-180 day follow-up assessment, 39% of respondents were categorised as self-reporting anxiety/depression. Thirty-seven percent of all participants received mental health treatment, while 54% of participants who reported anxiety/depression received mental health treatment. The breakdown of the type of treatment received is reported in Table 2, with antidepressants being the most common treatment type.

Factors Associated with Receiving Mental Health Treatment

In the staged logistic regression (Table 3), demographic factors accounted for 2% of the variance in model 1 ($\chi^2[13] = 168.75$, $p < 0.001$), the addition of clinical factors (model 2) accounted for an additional 28% ($\chi^2[9] = 2594.48$, $p < 0.001$), and the addition of structural factors (full model) accounted for an additional 2% of the variance ($\chi^2[6] = 130.73$, $p < 0.001$). In the full model, the 23 predictor variables explained 32% of the variance in receiving mental health treatment ($\chi^2[28] = 2893.96$, $p < 0.001$).

In the full multivariable model (Table 3), having mental health-related pharmaceutical dispensing or Medicare claims prior to stroke were most associated with receiving post-stroke mental health treatment. Other factors associated with receiving mental health treatment following stroke included: having self-reported anxiety/depression, being female, living in a regional area, having a chronic disease management plan, having private health insurance, and more primary care visits pre-stroke. Older age at stroke onset and having less severe stroke were associated with not receiving mental health treatment. Those who had ischaemic stroke or a TIA were less likely to receive mental health treatment than those with intracerebral haemorrhage.

Sensitivity analyses excluding participants who had a history of mental health treatment (via Medicare or pharmaceutical dispensing) yielded similar results (Table S6). However, those who had continuity of primary care visits were less likely to receive mental health treatment (OR, 0.81 [95% CI, 0.67-0.97]).

When Medicare and pharmaceutical dispensing claims were examined separately, results were similar with the exception of: those who required interpreter services, held a health benefits card (concession card in Australia), and had continuity of primary care visits were

less likely to receive mental health treatment through Medicare. Having a greater number of comorbid health conditions was associated with receiving mental health-related medications through pharmaceutical dispensing (Table 4).

Outcomes Associated with Receipt of Mental Health Treatment

A total of 279 individuals (4%) died in the 18-30 months following their stroke and 9,499 hospital presentations were observed: 3,800 (40%) planned admissions, 3,855 (41%) unplanned admissions, 1,844 (19%) non-admitted ED presentations. In the multivariable analyses (Table 5) there was no significant survival benefit observed in those who received mental health treatment compared to those who did not (hazard ratio, 1.06 [95% CI, 0.82-1.38]). Results were similar when stratified by reported anxiety/depression in the 90-180 days post-stroke.

There was no significant difference in hospital utilisation in those who received mental health treatment compared to those who did not (hazard ratio, 1.04 [95% CI, 1.00-1.09]). However, there was a significant difference when the analysis was stratified for those who reported anxiety/depression in the 90-180 days post-stroke (hazard ratio, 1.06 [95% CI, 1.01-1.11]).

Discussion

Our study provides population-level evidence of how commonwealth government funded mental health treatments are used following stroke. Thirty nine percent of participants reported anxiety/depression at 3-6 months post-stroke. Among them, just over half received mental health treatment, predominantly antidepressant medication. Only 13% received a combination of psychological management and mood medication. Notable factors associated with treatment receipt included pre-stroke mental health treatment, self-reported

anxiety/depression, younger age at stroke, and being female. Clinical factors explained the largest amount of variance in treatment receipt. Having a claim for a chronic disease management plan and more primary care visits pre-stroke also contributed. Receiving mental health treatments did not appear to reduce mortality or hospital utilisation.

In line with previous research, we identified men, older adults, and those who had not previously received mental health treatment as potentially underserviced populations.[32] Provision of information during early rehabilitation and consultation sessions may improve insight into mood problems and awareness of support options. Consistent with our earlier study on a smaller survey-based cohort, these population-level results highlight the pivotal role of primary care physicians in the pathway to mental health care.[20] Our results suggest that access to Medicare-funded chronic disease management plans,[33] designed to support collaborative care based on the patient's needs and goals, may facilitate mental health treatment. The holistic approach of these policies may provide opportunities to discuss mental health problems and develop appropriate action plans to manage identified needs.

The main barriers specific to having a claim for Medicare-funded psychological support, independent of medication prescribing, include requiring interpreter services and having a health benefits card. Verbal communication is important for accurate identification and treatment of mental health needs during primary care visits. There is a consistent and clear association between limited language proficiency and underutilisation of mental health services.[34] Poor communication may explain why depressive symptoms tend to be underdiagnosed and undertreated in culturally and linguistically diverse groups, despite equal quality of care for the primary medical concern.[35] Additionally, psychological therapy can be

costly and may not be fully covered by Medicare, therefore, less accessible to those who require a health benefits card.

Untreated mental health problems may affect a range of long-term outcomes following stroke (e.g., mortality, activity limitations), but appropriate treatment may alleviate the effect of depression on functional recovery.[5-8,36,37] In our outcome analyses, treatment claims did not improve survival or reduce hospital utilisation. We did not have follow-up data related to functional recovery or quality of life, which may have provided a better indication of effectiveness for these types of treatment. Another study found that people with depression following stroke had poorer recovery in activities of daily living and mobility, relative to those without depression, despite comparable stroke severity and being on antidepressant medication.[38] Hospital utilisation may also be indicative of severity of other medical comorbidities.

A strength of this study was the large sample size and the broad range of objective and reliable population information obtained through data linkage. Limitations include the use of EQ-5D-3L to indicate anxiety/depression, which is self-reported and not a validated measure although it has shown moderate concordance with the Hospital Anxiety and Depression Scale.[28] Selection bias, due to EQ-5D-3L completion rates, may have impacted results. Variables that could be investigated in the multivariable model were restricted based on available datasets. This meant that some factors specific to mental health treatment, such as stigma within certain groups[39,40] or access to privately funded services, was not able to be accounted for. Although we accounted for confounding using Inverse Probability of Treatment Weights including 49 variables known to be associated with outcomes following stroke, we cannot discount residual confounding. Due to custodial and ethical constraints, we

were unable to report and discuss whether Aboriginal and Torres Strait Islander status was associated with treatment receipt. Having a functional, quality of life, or psychological outcome measure may have provided a more sensitive and specific measure of mental health treatment effectiveness.

Conclusion

Our results indicate that approximately one in two people living with stroke with self-reported anxiety/depression are not receiving mental health treatment, and those who do are mostly receiving medication only. Health professionals should screen for mental health problems and introduce treatment options, with particular attention to individuals who are at risk of not receiving treatment. Future studies should investigate the lived experience of people with stroke with regards to receiving mental health treatment, which may inform practical ways to facilitate treatment receipt and improve rehabilitation and care more broadly.

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Disclosures

Prof Cadilhac is the current Data Custodian for the Australian Stroke Clinical Registry (AuSCR). Prof Cadilhac, Prof Lannin, and A/Prof Kilkenny are members of the AuSCR

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Supplemental Materials

Tables S1-S6

Figure S1

Supplemental Acknowledgements

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Table 1: Baseline Characteristics of Participants Who Did and Did Not Receive Mental Health Treatment

	Did Not Receive Mental Health Treatment *N* = 4,539 *n* (%)	**Received Mental Health Treatment** *N* = 2,675 *n* (%)	***p* value**
Demographic			
Median age at stroke admission, years (Q1, Q3)*	72.4 (62.6, 79.8)	69.6 (59.4, 78.3)	**<0.001**
Female*	1,713 (38)	1,331 (50)	**<0.001**
Born in Australia*	4,469 (98)	2,646 (99)	0.106
English as first language*	3,869 (85)	2,307 (86)	0.241
Needed an interpreter*	157 (3)	77 (3)	0.179
Socioeconomic position*			0.391
Most disadvantaged	770 (17)	474 (18)	
Second most disadvantaged	764 (17)	454 (17)	
Third most disadvantaged	981 (22)	606 (23)	
Fourth most disadvantaged	1,045 (23)	613 (23)	
Least disadvantaged	979 (22)	528 (20)	
Lives in regional area*	1,405 (31)	910 (34)	**0.007**
Married/de facto¶	3,156 (70)	1,789 (67)	**0.019**
Living alone*	1,023 (23)	600 (22)	0.915
Clinical			
Type of Stroke*			**<0.001**
Intracerebral haemorrhage	300 (7)	244 (9)	
Ischaemic	2,980 (66)	1,742 (65)	
Transient ischaemic attack	1,119 (25)	601 (22)	
Not determined/missing	140 (3)	88 (3)	
Able to walk independently on admission (stroke severity proxy)*	2,502 (55)[a]	1,351 (51)[b]	**<0.001**
History of mental health treatment			
Medicare uptake ≥ 1‡	115 (3)	391 (15)	**<0.001**
Pharmaceutical dispensing ≥ 1§	307 (7)	1,581 (59)	**<0.001**
Hospital presentation ≥ 1¶	12 (0)	43 (2)	**<0.001**
Mean CCI weighted score (*SD*)#	1.54 (1.72)	1.85 (1.79)	**<0.001**
Self-reported anxiety/depression†	1,271 (28)	1,516 (57)	**<0.001**
CD management plan during exposure period‡	1,881 (41)	1,363 (51)	**<0.001**
Structural			
Private health insurance¶	1,916 (42)	1,142 (43)	0.690
Health benefits card¶	3,063 (67)	1,905 (71)	**0.001**
Mean total primary care visits pre-stroke (*SD*) ‡	10.76 (8.57)	14.57 (10.08)	**<0.001**
Regularity	3,309 (73)	2,218 (83)	**<0.001**
Continuity	1,169 (26)	590 (22)	**<0.001**

CCI: Charlson Comorbidity Index; Q1: 25th percentile; Q3; 75th percentile. [a] Missing 195 data points; [b] Missing 115 data points.

* Derived from the Australian Stroke Clinical Registry from the acute stroke event

† Derived from the Australian Stroke Clinical Registry 90-180 day follow-up survey

‡ Derived from Australian Medicare (primary care) claims data

§ Derived from pharmaceutical dispensing data

¶ Derived from post-stroke hospital data

Derived from pre-stroke hospital data

Table 2: Types of Mental Health Treatment Received by People Living with Stroke

	Pre-stroke *N* = 7,214	Post-stroke overall *N* = 7,214	Self-reported post-stroke anxiety/depression *N* = 2,787
Received any mental health treatment	2,035 (28%)	2,531 (37%)	1,437 (54%)
Medicare	506 (7%)	720 (10%)	464 (17%)
Primary care physician	395	564	367
Psychologist	170	342	235
Psychiatrist	122	161	104
Allied Health	11	24	16
Pharmaceutical Dispensing	1,888 (26%)	2,460 (34%)	1,401 (50%)
Anxiety	661	660	361
Bipolar	<6	<6	<6
Depression	1,514	2,119	1,268
Schizophrenia	165	210	120
Received both Medicare and pharmaceutical dispensing	359 (5%)	505 (7%)	349 (13%)

Table 3: Factors Associated with Receiving Mental Health Treatment Including Demographic, Clinical, and Structural

	Stage 1: Demographic		Stage 2: + Clinical		Stage 3: + Structural	
	Odds Ratio	*95% CI*	*Odds Ratio*	*95% CI*	*Odds Ratio*	*95% CI*
Female	1.67*	1.51-1.84	1.32*	1.16-1.50	1.30*	1.13-1.48
Age at stroke	0.99*	0.98-0.99	0.98*	0.98-0.99	0.98*	0.97-0.98
Born in Australia	1.40	0.90-2.18	1.22	0.70-2.13	1.20	0.68-2.11
Rurality	1.14*	1.01-1.29	1.24*	1.06-1.44	1.25*	1.07-1.46
English as first language	0.96	0.82-1.13	0.94	0.77-1.15	0.94	0.76-1.15
Interpreter needed	0.86	0.63-1.17	0.72	0.49-1.07	0.75	0.50-1.12
Socioeconomic status						
Second most disadvantaged	0.99	0.84-1.17	1.04	0.84-1.29	1.04	0.84-1.29
Third most disadvantaged	1.03	0.88-1.21	1.22	0.99-1.50	1.20	0.98-1.48
Fourth most disadvantaged	1.04	0.88-1.23	1.20	0.97-1.50	1.21	0.97-1.51
Least disadvantaged	0.97	0.81-1.15	1.24	0.99-1.56	1.30	1.03-1.65
Marital status	0.93	0.82-1.05	1.02	0.86-1.19	0.97	0.83-1.15
Not living alone	1.08	0.94-1.25	1.20	0.99-1.44	1.21	0.99-1.45
Ability to walk on admission			0.85*	0.75-0.98	0.85*	0.74-0.97
Type of Stroke						
Ischaemic			0.73*	0.58-0.91	0.71*	0.56-0.89
Transient ischaemic attack			0.67*	0.52-0.87	0.64*	0.49-0.83
Undetermined/missing			0.73	0.45-1.16	0.69	0.43-1.12
Medicare mental health uptake pre-stroke			1.96*	1.49-2.58	1.80*	1.37-2.38
Mental health medication pre-stroke			17.70*	15.21-20.61	17.58*	15.05-20.55
Mental health hospital admissions pre-stroke			1.56	0.68-3.60	1.33	0.58-3.04
CCI weighted score			1.08*	1.04-1.12	1.05*	1.02-1.09
Self-reported anxiety/depression post-stroke			2.68*	2.36-3.04	2.55*	2.24-2.90
CD management plan during exposure period					1.17*	1.02-1.34
Private health insurance					1.15*	1.01-1.32
Health benefits card					0.93	0.78-1.10
Total primary care visits pre-stroke					1.04*	1.03-1.05
Regularity of primary care visits					0.98	0.83-1.16
Continuity of primary care visits					0.88	0.76-1.03
Bayesian Information Criterion	9463.64		6539.23		6461.525	
Variance accounted for	2%		30%		32%	

CI: Confidence Interval; Medicare: Medicare Benefits Schedule; CD: chronic disease; CCI: Charlson Comorbidity Index; * = statistical significance

Table 4: Factors Associated with Accessing Mental Health Services or Medication Including Demographic, Clinical, and Structural

	Accessed Mental Health Services (Medicare)		Accessed Mental Health Medication	
	Odds Ratio	*95% CI*	*Odds Ratio*	*95% CI*
Female	1.33*	1.11-1.59	1.23*	1.08-1.41
Age at stroke	0.95*	0.94-0.96	0.99*	0.98-0.99
Born in Australia	0.94	0.43-2.02	1.34	0.74-2.44
Rurality	0.94	0.76-1.17	1.28*	1.09-1.51
English as first language	0.79	0.59-1.06	1.00	0.81-1.24
Interpreter needed	0.49*	0.25-0.95	0.87	0.58-1.30
Socioeconomic status				
Second most disadvantaged	1.22	0.90-1.65	1.01	0.81-1.27
Third most disadvantaged	1.26	0.94-1.69	1.18	0.95-1.46
Fourth most disadvantaged	1.22	0.89-1.67	1.21	0.96-1.52
Least disadvantaged	1.36	0.97-1.90	1.34	1.05-1.71
Marital status	1.14	0.91-1.43	0.97	0.82-1.15
Not living alone	1.02	0.79-1.33	1.16	0.96-1.41
Ability to walk on admission	1.06	0.88-1.29	0.85*	0.74-0.98
Type of Stroke				
Ischaemic	0.72	0.53-0.98	0.67*	0.53-0.85
Transient ischaemic attack	0.70	0.49-1.00	0.64*	0.49-0.84
Undetermined/missing	0.63	0.33-1.18	0.74	0.46-1.20
Medicare mental health uptake pre-stroke	4.11*	3.24-5.23	1.28	0.98-1.67
Mental health medication pre-stroke	1.80*	1.47-2.18	19.28*	16.55-22.48
Mental health hospital admissions pre-stroke	1.13	0.57-2.26	1.17	0.54-2.51
CCI weighted score	0.99	0.94-1.05	1.06*	1.02-1.10
Self-reported anxiety/depression post-stroke	2.19*	1.82-2.62	2.45*	2.15-2.79
CD management plan during exposure period	1.39*	1.15-1.69	1.14	0.99-1.31
Private health insurance	0.89	0.74-1.08	1.16*	1.01-1.33
Health benefits card	0.73*	0.59-0.92	0.96	0.81-1.15
Total primary care visits pre-stroke	1.05*	1.04-1.06	1.03*	1.02-1.04
Regularity of primary care visits	0.94	0.74-1.19	1.00	0.84-1.19
Continuity of primary care visits	0.78*	0.62-0-.99	0.90	0.77-1.05
Bayesian Information Criterion	3815.60		6215.42	
Variance accounted for	21%		33%	

CI: Confidence Interval; Medicare: Medicare Benefits Schedule; CD: chronic disease; CCI: Charlson Comorbidity Index; * = statistical significance

Table 5: Hazard Ratios for Survival and Hospital Utilisation Based on Mental Health Treatment Receipt, Overall and Stratified by Self-reported Anxiety/Depression

	Survival	All hospital utilisation	Unplanned admissions	Planned admissions
	Hazard Ratio (95% CI)			
Overall	1.06 (0.82, 1.38)	1.04 (1.00, 1.09)	1.04 (0.98, 1.11)	0.99 (0.92, 1.06)
Stratified				
Reported anxiety/depression	0.86 (0.58, 1.27)	1.06 (1.01, 1.11)*	1.08 (0.99, 1.18)	0.95 (0.83, 1.09)
Did not report anxiety/depression	1.23 (0.88, 1.73)	1.03 (0.97, 1.10)	1.01 (0.93, 1.09)	1.01 (0.88, 1.16)

Models adjusted for Inverse Probability of Treatment Weights and year; * = statistical significance