

Psychiatrists' caseload volume, length of stay and mental healthcare readmission rates: A three-year population-based study

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Abstract

This study aimed to compare psychiatrists' in-patient caseload volume with length of stay (LOS) and 30-day readmission rates in Taiwan. We hypothesized that high-volume psychiatrists would be associated with shorter LOS and lower 30-day readmission rates. The sample of 66,959 patients hospitalized for the first time for mental disorders was taken from Taiwan's 2001–2003 National Health Insurance Research Database and categorized into four patient groups according to attending psychiatrists' caseload volume. A total of 21,669 (32.4%) of the patients sampled were readmitted within a 30-day period, with the mean LOS being 24.0 (± 19.5) days. As caseload volume increased, there was a corresponding increase in the adjusted odds ratio for 30-day readmission rates. The regression analysis reveals adjusted LOS for patients treated by psychiatrists with medium caseload volumes was 1.22 days shorter than that for patients treated by low caseload volume psychiatrists. The adjusted LOS for patients seeing high caseload volume psychiatrists was 2.03 days shorter than for those seeing psychiatrists with low caseload volumes; and for the very-high-volume group, it was 7.59 days shorter. Although the findings confirm our hypothesis regarding LOS, they do not support our hypothesis regarding the relationship between psychiatrists' caseload volume and readmission rates.

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1. Introduction

Since the late 1970s, numerous studies have attempted to investigate the association between physician or hospital patient volume and outcomes of particular procedures or of particular medical conditions. An overwhelming majority of these studies have reported that treatment outcomes are better in hospitals where these procedures are performed in greater

numbers, or where the appropriate conditions prevail (Nguyen et al., 2004; Rasmussen et al., 2005; Shah et al., 2005; Harling et al., 2005).

Based upon the volume–outcome relationship, a body of research has emerged recommending feasible policies, such as regionalized or centralized programs, in an attempt to reduce preventable mortalities (Birkmeyer et al., 1999; Epstein, 2002). However, most major discoveries relating to the volume–outcome relationship have tended to come in the fields of cancer, cardiovascular or peripheral vascular operations; virtually no studies have focused on healthcare provider case volumes and health outcomes for mental health patients.

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To our knowledge, only one published study has attempted to explore the relationship between caseload volume and mental healthcare outcomes. Using 1999 data on 384 health maintenance organizations in the US, Druss et al. (2004) found that the performance of psychiatrists in the lowest quartile of in-patient and out-patient caseload volumes was poorer than that of their counterparts in other groups, in terms of plans for provider measures of outcomes for antidepressant treatment, as well as having adequate 7-day and 30-day follow-ups. However, that particular study focused only on plan level, rather than provider level, limiting clinicians and policymakers alike to provider-level strategies for optimizing patient outcomes for mental disorders.

To date, therefore, the volume–outcome relationship in mental healthcare remains under-investigated. As a result, this study sets out to compare 30-day readmission rates and length of stay (LOS) with psychiatrists' caseload volume for in-patient mental healthcare, using 3-year nationwide population-based data on Taiwan covering the period from 2001 to 2003.

The main reason for selecting psychiatrist volume, as opposed to hospital volume, in this study is that many of many of the prior studies have consistently reported not only that physician volume is a much more significant factor than hospital volume with regard to predicting patient outcomes, but also that hospital volume is only marginally related to patient outcomes (Hannan et al., 2003; Lien et al., 2007). In line with much of the existing medical and surgical literature, in this study we hypothesize that psychiatrists with high-volume practices will be associated with shorter LOS and lower 30-day readmission rates for mental health patients.

2. Research methods

2.1. Database

The patient sample was taken from the Taiwan 2001–2003 National Health Insurance Research Database (NHIRD), which covers all in-patient claims for the island's population of over 23 million people. The NHIRD database includes a registry of contracted medical facilities, a registry of board-certified psychiatrists, a monthly claims summary for all in-patient claims, and details of all in-patient orders and expenditure on prescriptions dispensed at contracted pharmacies. Given its provision of ICD-9CM codes for the primary diagnosis, and up to four secondary diagnostic codes, the NHIRD is possibly the largest and most

comprehensive population-based data source currently available anywhere.

2.2. Study sample

All patients admitted to the psychiatric departments of hospitals in Taiwan between January 2001 and December 2003 were selected from the dataset as our study sample. The dataset contained almost 8.5 million in-patient records coinciding with the period of this study, of which 224,014 involved admissions to hospital psychiatric departments for acute care for mental disorders. Our sample was limited to first-time hospitalizations between 2001 and 2003, with a principal diagnosis of mental disorder ($n=73,585$). Those patients who died during their period of hospitalization ($n=45$), those who were discharged against medical advice ($n=5195$) and those who were transferred to other hospitals ($n=1422$) were all excluded from the study sample. Ultimately, we were left with a sample of 66,959 eligible hospitalizations for mental disorders during the period of the study.

2.3. Hospital volume groups

Since unique psychiatrist identifiers are available against each claim within the NHIRD, we are able to calculate the total in-patient mental healthcare volume for each psychiatrist over the 3-year study period. Remaining consistent with the methodology adopted in the prior studies (Birkmeyer et al., 2002; Goodney et al., 2003), we take the total number of mental health hospitalizations by a given psychiatrist as the 'psychiatrist volume'.

All psychiatrists are sorted by their total mental healthcare volume, in ascending order, with cutoff points subsequently being selected that would most closely sort the sample patients into four approximately equal groups. This sorting method is also consistent with the methodology used in many of the prior studies (Birkmeyer et al., 2002; Goodney et al., 2003). The four quartiles are referred to in this study as 'low-volume (≤ 328 hospitalizations)', 'medium-volume (329–530 hospitalizations)', 'high-volume (531–822 hospitalizations)' and 'very-high-volume (≥ 823 hospitalizations)' groups.

2.4. Statistical analysis

The unit of analysis in this study is 'patient'; the outcome measures are the '30-day readmission rate' and 'LOS'; and 'psychiatrist volume' is measured at

the psychiatrist level. Since it is suggested, in HEDIS 2000, that 30 days provides an appropriate measure of mental healthcare quality – with regard to readmissions for mental disorders – we set out to determine, as a key dependent variable in our study, whether or not patients suffering from a schizophrenic disorder were readmitted within a 30-day period (Druss et al., 2002). The SAS statistical package (SAS System for Windows, Version 8.2) was used to undertake the analysis.

After adjusting for psychiatrist, hospital and patient characteristics, logistical regression analysis was performed in order to assess the independent association between ‘psychiatrist volume’ and ‘30-day readmission’ rates by type of mental disorders. The types of mental disorders were grouped into ‘schizophrenia’ (ICD-9-CM code 295), ‘major depressive disorder’ (ICD-9-CM code 2962 ad 2963), ‘bipolar disorder’ (ICD-9-CM code 296 — excluding 2962 and 2963), and ‘Other mental disorders’. Since prior studies have documented the inverse association between readmission and LOS (Lin et al., 2006), the variable of “LOS” was controlled for in the analysis. A multiple regression analysis was also employed to assess the adjusted relationship between ‘psychiatrist volume’ and ‘LOS’. Generalized estimated equation (GEE) analyses were additionally applied so as to account for any clustering effects amongst sample patients treated by any given psychiatrist; the term ‘clustering effects’ refers to the likelihood of the similarity of patient outcomes by a given provider, as opposed to the similarity of patient outcomes between different psychiatrists.

This study also controls for psychiatrist, hospital and patient characteristics. Psychiatrist characteristics comprised of ‘age (as a surrogate for practice experience)’ and ‘gender’. Psychiatrist age was categorized into one of the three groups: ≤ 40 , 41–50 and ≥ 51 years old. Hospital characteristics included ‘hospital ownership’, defined as ‘public’, ‘private not-for-profit’, or ‘private for-profit’; ‘geographical location’ refers to northern, central, southern or eastern Taiwan; and ‘hospital level’ can be either a medical center with ≥ 500 beds, a regional hospital with 250–499 beds, or a district hospital with 20–249 beds. Hospital level also serves as a proxy for hospital size and technological clinical service capabilities. Patient characteristics controlled for in this study include ‘age’ (≤ 19 , 20–44, 45–64 and ≥ 65) and ‘gender’.

Hospital teaching status is not included as a variable in this study since all medical centers and regional hospitals in Taiwan are teaching hospitals. A two-sided *P* value of less than, or equal to, 0.05 was considered to be significant.

3. Results

Table 1 presents descriptive analysis of the sampled patients, by patient, psychiatrist and hospital characteristics. Of the total of 66,959 first-time hospitalizations for a mental disorder in Taiwan during the 2001–2003 period, 21,669 (32.4%) were readmitted within a 30-day period, with the mean LOS being 24.0 (± 19.5) days. As for the type of mental disorder, 29,356 (43.8%) were hospitalized for schizophrenia, 8579 for a major depressive disorder, 8242 (12.3%) for bipolar disorder, and 20,776 (31.0%) in the category of ‘Other mental disorders’, including diagnoses such as obses-

Table 1
Descriptive analysis of first-time hospitalizations for mental disorders in Taiwan, 2001–2003 *

Variables	Total no.	%	Mean	S.D.
Patient characteristics				
Gender				
Male	39,372	58.8	–	–
Female	27,587	41.2	–	–
Age				
0–19	1847	2.8	16.2	3.9
20–44	41,072	61.3	32.0	7.2
45–64	16,218	24.2	52.1	5.4
>64	7822	11.7	75.5	6.8
Type of mental disorder				
Schizophrenia	29,356	43.8	–	–
Major depressive disorder	8579	12.8	–	–
Bipolar disorder	8248	12.3	–	–
Other mental disorders	20,776	31.0	–	–
Psychiatrist characteristics				
Gender				
Male	60,416	90.2	–	–
Female	6543	9.8	–	–
Age				
<41	38,422	57.4	36.2	3.4
41–50	22,853	34.1	44.3	7.8
>50	5684	8.5	54.7	4.6
Hospital characteristics				
Hospital level				
Medical center	17,226	25.7	–	–
Regional hospital	36,041	53.8	–	–
District hospital	13,692	20.5	–	–
Hospital ownership				
Public	42,532	63.5	–	–
NFP	17,385	26.0	–	–
FP	7042	10.5	–	–
Hospital location				
North	26,991	40.3	–	–
Central	13,190	19.7	–	–
South	21,888	32.7	–	–
East	4890	7.3	–	–
Teaching status				
Yes	55,535	82.9	–	–
No	11,424	17.1	–	–

Note: **n* = 66,959.

Table 2
Psychiatrist and patient characteristics, by mental healthcare volume groups, 2001–2003

Variable	Mental healthcare volume group															
	Low (1–328)				Medium (329–530)				High (531–822)				Very high (≥ 823)			
	No.	%	Mean	S.D.	No.	%	Mean	S.D.	No.	%	Mean	S.D.	No.	%	Mean	S.D.
<i>Psychiatrist characteristics</i> ^a																
No. of psychiatrists	404	61.0	–	–	117	17.6	–	–	86	13.0	–	–	56	8.4	–	–
Psychiatrist volume	–	–	116	102	–	–	418	59	–	–	646	78	–	–	1290	485
Psychiatrist age	–	–	39.6	9.3	–	–	39.5	6.7	–	–	41.3	5.5	–	–	40.9	5.4
<i>Psychiatrist gender</i>																
Male	328	81.0	–	–	106	90.6	–	–	81	94.2	–	–	51	91.1	–	–
Female	77	19.0	–	–	11	9.4	–	–	5	5.8	–	–	5	8.9	–	–

^a Total no. of psychiatrists=664.

sive–compulsive disorder, neurotic depression, unspecified psychosis, and so on. The mean age of the sampled patients was 41.5 years, while the mean age of the attending psychiatrists was 40.6 years.

The psychiatrist characteristics are summarized in Table 2, by psychiatrist caseload volume group. As the Table shows, between 2001 and 2003, patients suffering from mental disorders were admitted into hospitals by a total of 664 psychiatrists, with a mean volume of 331 (± 383) hospitalizations per psychiatrist for the three year period. Of these, 404 (61.0%) psychiatrists were in the low-volume group, with ≤ 328 hospitalizations; a further 117 (17.6%) psychiatrists were in the medium-volume group, with 329–530 hospitalizations; 86 (13.0%) were in the high-volume group, with 531–822 hospitalizations; and 56 (8.4%) were in the very-high-volume group, with ≥ 823 hospitalizations.

Table 3 provides in detail the estimated crude odds ratio of the likelihood of re-hospitalization within 30 days, by psychiatrist caseload volume groups and by type of mental disorder. The 30-day readmission rate generally increased with increasing caseload volume ($P < 0.001$); patients treated by low-, medium-, high- and very-high-volume psychiatrists had 27.5%, 24.9%, 30.8%, 46.4% 30-day readmission rates, respectively. Table 3 also shows that the 30-day readmission rate consistently increased with increasing caseload volume without regard to different types of mental disorders.

Details of the unadjusted relationship between LOS and psychiatrist volume groups according to the type of mental disorder are presented in Table 4. The mean LOS was 25.9 days for patients in the low-volume caseload group; 25.2 days for those in both the medium-volume and high-volume groups; and 19 days for patients in the very-high-volume psychiatrist caseload group. In addition, the one-way ANOVA tests consistently demon-

strated a significant relationship between psychiatrist caseload groups and the LOS for patients hospitalized for mental disorders, regardless of type of mental disorder (all $P < 0.001$).

Table 5 describes the adjusted odds ratio of readmission within a 30-day period, by psychiatrist caseload volume group for different types of mental disorder. As the Table shows, with increasing psychiatrist caseload volume, there is, for the most part, a corresponding increase in the adjusted odds ratio of readmission within 30 days in total and separately for all types of mental disorders. For example, after adjusting for hospital, patient and psychiatrist characteristics, the odds of readmissions for those patients in the low-volume caseload group were 0.90 times those of the high-volume caseload group (a reciprocal of 1.11) and 0.50 times those of the very-high-volume psychiatrist caseload group (a reciprocal of 2.00) among all sampled patients without regard to type of illness. However, contrary to our expectations, our findings indicate decreasing odds of 30-day readmission for patients in the medium-volume psychiatrist caseload group. With the exception of the widening of the confidence intervals, when these results are adjusted for clustering effects by GEE, all of the significant relationships remain.

The results of the multiple regression analysis are presented in Table 6, which shows that, after adjusting for patient, psychiatrist and hospital characteristics, the LOS was 1.22 days shorter for patients treated by the medium caseload volume psychiatrist group as compared to patients attended by psychiatrists in the low-volume group. It was 2.03 days shorter for those treated by the high caseload volume psychiatrists and 7.59 days shorter for those treated by the very-high-caseload volume psychiatrist group (all $P < 0.001$), without regard to type of mental illness. Similarly, the relationship

Table 3
Crude odds ratios for 30-day readmissions to hospital, by psychiatrist volume and type of mental disorder, 2001–2003

Psychiatrist volume	30-day readmission				OR	95% CI	P value
	Yes		No				
	Total no.	%	Total no.	%			
<i>Total</i>							
Low	4619	27.5	12,194	72.5	1.00	–	–
Medium	4164	24.9	12,588	75.1	0.87	0.83–0.92	<0.001
High	5118	30.8	11,516	69.2	1.17	1.12–1.23	<0.001
Very high	7768	46.4	8992	53.7	2.28	2.18–2.39	<0.001
<i>Schizophrenia</i>							
Low	2901	36.9	4959	63.1	1.00	–	–
Medium	2552	32.7	5263	67.3	0.83	0.78–0.89	<0.001
High	2905	40.6	4251	59.4	1.17	1.09–1.25	<0.001
Very high	4093	62.7	2432	37.3	2.88	2.69–3.08	<0.001
<i>Major depressive disorder</i>							
Low	359	16.3	1839	83.7	1.00	–	–
Medium	334	14.9	1914	85.1	0.89	0.76–1.05	0.175
High	458	17.7	2111	82.3	1.11	0.96–1.29	0.172
Very high	597	38.2	967	61.8	3.16	2.72–3.68	<0.001
<i>Bipolar disorder</i>							
Low	444	22.9	1495	77.1	1.00	–	–
Medium	366	20.3	1437	79.7	0.86	0.73–1.00	0.054
High	527	23.7	1693	76.3	1.05	0.91–1.21	0.523
Very high	1106	48.4	1180	61.6	3.16	2.76–3.61	<0.001
<i>Other mental disorders</i>							
Low	915	19.0	3901	81.0	1.00	–	–
Medium	912	18.7	3974	81.3	0.98	0.88–1.08	0.675
High	1228	26.2	3461	73.8	1.51	1.37–1.67	<0.001
Very high	1972	30.9	4413	69.1	1.91	1.74–2.08	<0.001

between shorter LOS and increasing psychiatrist case-load volume was also observed across all types of mental disorders.

4. Discussion

Although, over the past two decades, a substantial number of surgical and medical healthcare studies have been carried out in an attempt to explain the relationship between LOS and provider volume, these studies have tended to yield inconsistent findings. Some have reported that an increase in provider volume under particular procedures, or under certain conditions, can lead to a reduction in LOS (Lavernia and Guzman, 1995; Jain et al., 2005), whilst others have reported no significant change (Taub et al., 2004; Lyman et al., 2005). One of the main reasons for such inconsistency could be that most of these studies have been heavily reliant upon regional or statewide samples, or sub-

populations of patients, and as such, have failed to deliver unequivocal conclusions. In addition, these studies have all tended to focus on surgical procedures or medical conditions, which is clearly of little help to psychiatrists or mental healthcare policymakers, in terms of facilitating a good understanding of the relationship between LOS and physician volume in the field of mental healthcare.

The findings of our study are based on a study sample of 66,959 patients hospitalized in Taiwan for a mental disorder, between 2001 and 2003, using a nationwide population-based dataset. Our results show that, after adjusting for hospital, patient and psychiatrist characteristics, there is, for the most part, an association between psychiatrists with higher mental healthcare volume, and both shorter LOS, and higher 30-day readmission rates. As regards the relationship with LOS, the findings confirm our hypothesis; however, as regards the relationship between psychiatrist volume and readmission rates, our hypothesis is rejected. After adjusting for other factors,

Table 4
Unadjusted relationships between psychiatrist volume and length of stay, by one-way ANOVA test

Psychiatrist volume	Length of stay			
	Total no.	Mean	S.D.	Median
<i>Total^a</i>				
Low	16,813	25.9	18.8	22.0
Medium	16,752	25.2	18.7	21.0
High	16,634	25.2	18.0	22.0
Very high	16,760	19.0	17.9	14.0
<i>Schizophrenia^a</i>				
Low	7860	32.3	24.2	29.0
Medium	7815	30.4	19.5	28.0
High	7156	29.2	19.2	27.0
Very high	6525	23.7	20.9	21.0
<i>Major depressive disorder^a</i>				
Low	2198	21.0	16.3	17.0
Medium	2248	20.5	16.3	17.0
High	2569	22.6	16.0	20.0
Very high	1564	16.3	11.6	14.0
<i>Bipolar disorder^a</i>				
Low	1939	26.1	20.3	22.0
Medium	1803	24.7	16.9	22.0
High	2220	25.3	16.5	23.0
Very high	2286	23.4	22.2	19.0
<i>Other mental disorders^a</i>				
Low	4816	20.5	18.7	15.0
Medium	4886	19.0	16.7	14.0
High	4689	20.3	16.4	16.0
Very high	6385	13.4	12.2	10.0

^a P value < 0.001

Table 5
Adjusted odds ratios for 30-day readmissions to hospital, by psychiatrist volume, 2001–2003

Variable	Total OR, 95% CI	Type of mental disorder			
		Schizophrenia OR, 95% CI	Major depressive disorder OR, 95% CI	Bipolar disorder OR, 95% CI	Other mental disorders OR, 95% CI
Psychiatrist volume					
≤ 328	1.00	1.00	1.00	1.00	1.00
329–530	0.91 (0.86–0.96) ^c	0.90 (0.84–0.96) ^b	1.12 (0.94–1.33)	0.73 (0.62–0.87) ^c	1.10 (0.98–1.18)
531–822	1.11 (1.05–1.17) ^c	1.12 (1.05–1.21) ^c	1.05 (0.89–1.23)	1.01 (0.75–1.03)	1.38 (1.24–1.53) ^c
≥ 823	2.00 (1.89–2.10) ^c	2.60 (2.41–2.80) ^c	2.13 (1.78–2.54) ^c	2.73 (2.33–3.20) ^c	1.81 (1.63–2.01) ^c
Psychiatrist age					
< 41	1.08 (1.04–1.13) ^c	1.15 (1.09–1.22) ^c	1.01 (0.89–1.15)	1.09 (0.97–1.23)	1.14 (1.06–1.23) ^c
41–50	1.00	1.00	1.00	1.00	1.00
> 50	1.09 (1.01–1.17) ^b	1.35 (1.23–1.49) ^c	0.65 (0.50–0.85) ^b	1.34 (1.09–1.63) ^c	0.77 (0.65–0.90) ^c
Psychiatrist gender					
Male	0.95 (0.92–1.03)	0.93 (0.91–1.04)	1.00 (0.98–1.04)	0.97 (0.90–1.05)	1.02 (0.96–1.02)
Female	1.00	1.00	1.00	1.00	1.00
Hospital level					
Medical center	0.24 (0.23–0.26) ^c	0.23 (0.21–0.25) ^c	0.42 (0.34–0.51) ^c	0.23 (0.19–0.28) ^c	0.23 (0.20–0.26) ^c
Regional hospital	0.80 (0.76–0.84) ^c	0.77 (0.72–0.83) ^c	1.17 (0.96–1.41)	1.00 (0.85–1.18)	0.75 (0.68–0.84) ^c
District hospital	1.00	1.00	1.00	1.00	1.00
Hospital ownership					
Public	1.86 (1.73–2.00) ^c	2.23 (1.04–2.45) ^c	1.42 (1.06–1.90) ^a	1.39 (1.10–1.77) ^b	1.53 (1.32–1.77) ^c
Private for-profit	1.24 (1.15–1.34) ^c	1.52 (1.38–1.68) ^c	0.69 (0.50–0.95) ^a	1.20 (0.94–1.54)	0.99 (0.84–1.16)
Private not-for-profit	1.00	1.00	1.00	1.00	1.00
Hospital location					
Northern	1.00	1.00	1.00	1.00	1.00
Central	0.53 (0.50–0.56) ^c	0.67 (0.63–0.72) ^c	0.27 (0.22–0.33) ^c	0.52 (0.45–0.61) ^c	0.40 (0.35–0.45) ^c
Southern	0.57 (0.55–0.59) ^c	0.78 (0.73–0.83) ^c	0.61 (0.53–0.70) ^c	0.60 (0.53–0.69) ^c	0.39 (0.36–0.42) ^c
Eastern	0.55 (0.51–0.59) ^c	0.88 (0.80–0.98) ^a	0.30 (0.21–0.43) ^c	0.21 (0.17–0.27) ^c	0.34 (0.29–0.40) ^c
Patient gender					
Male	1.09 (1.05–1.13) ^c	1.07 (1.01–1.12) ^a	1.29 (1.14–1.45) ^c	1.14 (1.03–1.37) ^a	1.09 (1.01–1.18) ^a
Female	1.00	1.00	1.00	1.00	1.00
Patient age					
0–19	1.36 (1.21–1.52) ^c	0.80 (0.66–0.96) ^c	1.12 (0.72–1.75)	0.94 (0.69–1.27)	2.02 (1.71–2.37) ^c
20–44	1.00	1.00	1.00	1.00	1.00
45–64	1.10 (1.05–1.15) ^c	1.22 (1.16–1.30) ^c	0.81 (0.70–0.93) ^b	1.00 (0.89–1.12)	0.88 (0.81–0.97) ^b
> 64	1.04 (0.98–1.11)	0.94 (0.83–1.08)	0.89 (0.75–1.04)	0.71 (0.57–0.88) ^b	0.93 (0.85–1.02)
Length of stay	1.00 (1.00–1.00) ^c	1.00 (1.00–1.00) ^c	1.00 (0.99–1.01)	1.01 (1.00–1.01) ^c	1.02 (1.02–1.02) ^c

Note: ^a $P < 0.05$; ^b $P < 0.01$; ^c $P < 0.001$; OR = odds ratio; CI = confidence interval.

we find a steady decline in LOS with rising psychiatrist mental healthcare volume, with the LOS for patients treated by psychiatrists in the very-high-volume group being only 34% (7.59/22.32) of the LOS of those patients in the low-volume psychiatrist group.

Although the prior literature in this field has proposed two possible hypotheses for the volume–outcome relationship – the ‘practice makes perfect’ and ‘selective-referral’ hypotheses (Luft et al., 1979; Luft et al., 1987) – the actual mechanisms contributing to the negative relationship between LOS and psychiatrist mental healthcare volume found in this study remain unclear.

Under the ‘practice makes perfect’ hypothesis, the level of clinical performance achieved by high-volume providers is likely to be relatively higher than that of

low-volume providers, due to their greater levels of skill and experience. Therefore, we may expect high-volume psychiatrists to be able to reduce LOS, as a whole, by providing more efficient and proficient interventions, ranging from psychopharmacology to psychotherapy. Further investigations will be necessary in order to identify the specific clinical approaches and techniques which are adopted by high-volume psychiatrists, and which lead to the shortening of the LOS for those patients hospitalized for mental disorders; the results of such studies could clearly help low-volume psychiatrists to improve the overall efficiency of their patient healthcare delivery.

The second hypothesis, ‘selective-referral’, suggests that physicians, or indeed patients themselves, will refer to providers who are renowned for shorter LOS; and

Table 6
Multiple regression analysis for adjusted relationship between length of stay and psychiatrist volume, 2001–2003

Variable	Total β (S.E.)	Type of mental disorder			
		Schizophrenia β (S.E.)	Major depressive disorder β (S.E.)	Bipolar disorder β (S.E.)	Other mental disorders β (S.E.)
Psychiatrist volume					
≤328	–	–	–	–	–
329–530 (no=0)	–1.22 (0.20) ^c	–2.40 (0.34) ^c	–0.35 (0.47)	–0.85 (0.60)	–1.10 (0.32) ^c
531–822 (no=0)	–2.03 (0.21) ^c	–3.69 (0.35) ^c	–0.38 (0.46)	–2.03 (0.58) ^c	–1.62 (0.33) ^c
≥823 (no=0)	–7.59 (0.22) ^c	–9.70 (0.37) ^c	–6.90 (0.55) ^c	–6.86 (0.63) ^c	–7.04 (0.33) ^c
Psychiatrist age					
<41 (no=0)	–2.25 (0.16) ^c	–3.43 (0.27) ^c	–1.03 (0.37) ^b	–1.38 (0.45) ^b	–1.43 (0.24) ^c
41–50	–	–	–	–	–
>50 (no=0)	–0.22 (0.28)	–0.30 (0.27)	–0.49 (0.65)	1.02 (0.75)	–0.96 (0.43) ^a
Psychiatrist gender					
Male (no=0)	–1.12 (0.25) ^c	–1.30 (0.22) ^c	–1.02 (0.33)	–1.05 (0.38)	–1.11 (0.37)
Female	–	–	–	–	–
Hospital level					
Medical center (no=0)	–0.38 (0.25)	2.77 (0.43) ^c	2.75 (0.61) ^c	–1.58 (0.70) ^a	–4.35 (0.40) ^c
Regional hospital (no=0)	–2.30 (0.22) ^c	0.06 (0.35)	0.63 (0.58)	–3.40 (0.65) ^c	–4.87 (0.35) ^c
District hospital	–	–	–	–	–
Hospital ownership					
Public (no=0)	1.39 (0.29) ^c	–0.34 (0.46)	5.10 (0.80) ^c	4.53 (0.93) ^c	1.29 (0.46) ^b
Private for-profit (no=0)	–2.01 (0.31) ^c	–2.99 (0.49) ^c	–0.11 (0.84)	–0.04 (0.96)	–2.04 (0.50) ^c
Private not-for-profit	–	–	–	–	–
Hospital location					
Northern	–	–	–	–	–
Central (no=0)	4.02 (0.21) ^c	5.90 (0.34) ^c	1.98 (0.49) ^c	3.71 (0.57) ^c	0.69 (0.34) ^a
Southern (no=0)	–0.19 (0.17)	0.88 (0.31) ^b	–0.55 (0.39)	–0.15 (0.52)	–2.15 (0.26) ^c
Eastern (no=0)	4.62 (0.30) ^c	0.29 (0.51)	8.22 (0.83) ^c	11.78 (0.82) ^c	5.50 (0.45) ^c
Patient gender					
Male (no=0)	0.78 (0.15) ^c	–0.76 (0.25) ^b	2.76 (0.34) ^c	1.08 (0.40) ^b	1.71 (0.24) ^c
Female	–	–	–	–	–
Patient age					
0–19 (no=0)	0.45 (0.44)	–3.75 (0.88) ^c	–0.48 (1.25)	–2.95 (1.16) ^a	5.08 (0.55) ^c
20–44	–	–	–	–	–
45–64 (no=0)	0.27 (0.17)	0.06 (0.29)	1.81 (0.39) ^b	–1.00 (0.46) ^a	1.71 (0.29) ^c
>64 (no=0)	1.72 (0.24) ^c	–1.39 (0.67) ^a	3.74 (0.47) ^c	–2.03 (0.79) ^a	3.15 (0.28) ^c
Constant	22.32 (0.42) ^c	34.09 (0.53) ^c	14.94 (0.90) ^c	25.49 (0.98) ^c	5.08 (0.55) ^c

Note: β = parameter estimates; S.E. = standard error ^a $P < 0.05$; ^b $P < 0.01$; ^c $P < 0.001$.

who can thus admit more patients. However, this particular hypothesis may be less plausible when it comes to attempting to explain the relationship between LOS and psychiatrist volume under the current healthcare environment in Taiwan. Chinese culture urges sick patients to stay in hospital as long as possible, in order to receive the best professional care available for the patient's own good. In addition, the Taiwan National Health Insurance scheme provides low co-payment for hospitalization, which, in turn, encourages patients to stay in hospital longer than necessary. There is, therefore, a greater likelihood of patients in Taiwan gravitating towards psychiatrists with longer LOS, or better patient outcomes.

Another possible explanation for the observed relationship between LOS and psychiatrist mental health-

care volume is the difference in patient characteristics between low-volume and high-volume providers, particularly with regard to the 'severity of illness'; indeed, the study by Lyons et al. also concluded that the severity of a patient's symptoms was an important predictor of readmission (Lyons et al., 1997).

Although this study has controlled for the age and gender of patients, the administrative database adopted for this study is extremely limited, in terms of its ability to account for differences in the severity of patients' mental disorders. Under this scenario, low-volume psychiatrists have a greater tendency to receive more severely-ill patients than high-volume psychiatrists, which ultimately results in a longer LOS. We therefore suggest the initiation of further survey research, in order to provide a better understanding of the

distribution of patients hospitalized for mental disorders between low-volume and high-volume groups, specifically in terms of their 'severity of illness'.

This study finds that, in general, patients treated by high-volume psychiatrists have higher odds of being readmitted within a 30-day period. More specifically, the odds of patients treated by very-high-volume psychiatrists being readmitted with 30 days are twice those of patients treated by low-volume psychiatrists. This finding comes in light of the conclusions of an earlier study by [Marcin and Romano \(2004\)](#), which used data from 39 non-federal Californian hospitals, and which found that non-elderly adult trauma patients were more likely to be readmitted after being initially admitted to hospitals with a higher annual volume of trauma cases.

Greater technical proficiency borne of specialization and clinical experience is presumed to underlie the association between practice volume and outcome in other fields of medicine. In psychiatric practice, however, greater practice volume may be linked to larger case loads that may paradoxically degrade rather improve clinical care as psychiatrists have less time to assess and consider each individual case. However, we must urge caution before any attempt is made to derive policy decisions from the findings of this study; although the readmission rate is regarded as an appropriate indicator of in-patient healthcare outcomes for various medical conditions, it may not be quite so valid when applied to the field of mental healthcare. Indeed, as [Lyons et al. \(1997\)](#) reported, a readmission may not necessarily be an indicator of the poor outcome of a psychiatric hospital stay, and indeed, it may only represent a specific function of hospital admission policy, or a low hospitalization threshold. Furthermore, although this study has found that higher mental healthcare volume is associated with both a shorter LOS and a higher readmission rate, we cannot conclude that the reduction in LOS which is apparent amongst high-volume psychiatrists, was achieved at the expense of increased readmission rates. We suggest that a longitudinal follow-up study should be undertaken in order to investigate the relationship between LOS and readmission rates for both high-volume and low-volume providers.

A particular strength of this study is the use of a population-based dataset which allows us to trace all readmissions, even the readmission of patients to different psychiatrists. Nevertheless, we should make note of two limitations inherent within this study. First of all, the prior studies have reported that certain patient-specific factors, such as difficulties in self-care, severity of symptoms and residential instability, are important predictors of readmission, and indeed, readmission rates may also reflect

the quality of home healthcare services, as well as local community services and support. Unfortunately, none of this information is available from the NHIRD.

Secondly, although the three-year cross-sectional data does provide a detailed picture of the relationship between physician volume and LOS and readmissions, in this study, we have been unable to precisely determine the actual causal relationships. The definitive determination of the causal relationships existing between psychiatrist volume and LOS and readmission will only be possible under a longitudinal study design. Despite these limitations, this study has found that after adjusting for patient, psychiatrist and hospital characteristics, an inverse volume–outcome relationship does exist for psychiatrists in Taiwan, in terms of the LOS for mental healthcare, but not with regard to 30-day readmission rates. This finding can help policymakers in Taiwan, as well as in other countries, to increase the awareness of the issues surrounding the volume–outcome relationship in mental healthcare.

Since this is one of the first population-based studies to explore the volume–outcome relationship in the field of mental healthcare, the results should be regarded as exploratory rather than definitive, and we suggest that further mental healthcare volume–outcome studies should be initiated in other regions or countries to confirm the generalizability of our findings. Other countries may find our study results helpful when investigating this topic, since they should help to facilitate cross-country comparisons.

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References

- Birkmeyer, J.D., Lucas, F.L., Wennberg, D.E., 1999. Potential benefits of regionalizing major surgery in Medicare patients. *Effective Clinical Practice* 2, 277–283.
- Birkmeyer, J.D., Siewers, A.E., Finlayson, E.V., Stukel, T.A., Lucas, F.L., Batista, I., Welch, H.G., Wennberg, D.E., 2002. Hospital volume and surgical mortality in the United States. *New England Journal of Medicine* 346, 1128–1137.
- Druss, B.G., Miller, C.L., Pincus, H.A., Shih, S., 2004. The volume–quality relationship of mental health care: does practice make perfect? *American Journal of Psychiatry* 161, 2282–2286.

- Druss, B.G., Miller, C.L., Rosenheck, R.A., Shih, S.C., Bost, J.E., 2002. Mental health care quality under managed care in the United States: a view from the Health Employer Data and Information Set (HEDIS). *American Journal of Psychiatry* 159, 860–862.
- Epstein, A.M., 2002. Volume and outcome—it is time to move ahead. *New England Journal of Medicine* 346, 1161–1164.
- Goodney, P.P., Stukel, T.A., Lucas, F.L., Finlayson, E.V., Birkmeyer, J.D., 2003. Hospital volume, length of stay, and readmission rates in high-risk surgery. *Annals of Surgery* 238, 161–167.
- Hannan, E.L., Wu, C., Ryan, T.J., Bennett, E., Culliford, A.T., Gold, J.P., Hartman, A., Isom, O.W., Jones, R.H., McNeil, B., Rose, E.A., Subramanian, V.A., 2003. Do hospitals and surgeons with higher coronary artery bypass graft surgery volumes still have lower risk-adjusted mortality rates? *Circulation* 108, 795–801.
- Harling, H., Bülow, S., Møller, L.N., Jørgensen, T., Danish Colorectal Cancer Group, 2005. Hospital volume and outcome of rectal cancer surgery in Denmark 1994–99. *Colorectal Disease* 7, 90–95.
- Lien, Y.C., Huang, M.T., Lin, H.C., 2007. Association between surgeon and hospital volume and in-hospital fatalities after lung cancer resections: the experience of an Asian country. *Annals of Thoracic Surgery* 83, 1837–1843.
- Jain, N.B., Pietrobon, R., Guller, U., Ahluwalia, A.S., Higgins, L.D., 2005. Influence of provider volume on length of stay, operating room time, and discharge status for rotator cuff repair. *Journal of Shoulder and Elbow Surgery* 14, 407–413.
- Lavernia, C.J., Guzman, J.F., 1995. Relationship of surgical volume to short-term mortality, morbidity, and hospital charges in arthroplasty. *Journal of Arthroplasty* 10, 133–140.
- Lin, H.C., Tian, W.H., Chen, C.S., Liu, T.C., Tsai, S.Y., Lee, H.C., 2006. The association between readmission rates and length of stay for schizophrenia: a 3-year population-based study. *Schizophrenia Research* 83, 211–214.
- Luft, H.S., Bunker, J.P., Enthoven, A.C., 1979. Should operations be regionalized? The empirical relation between surgical volume and mortality. *New England Journal of Medicine* 301, 1364–1369.
- Luft, H.S., Hunt, S.S., Maerki, S.C., 1987. The volume–outcome relationship: practice-makes-perfect or selective-referral patterns? *Health Services Research* 22, 157–182.
- Lyman, S., Jones, E.C., Bach, P.B., Peterson, M.G., Marx, R.G., 2005. The association between hospital volume and total shoulder arthroplasty outcomes. *Clinical Orthopaedics and Related Research* 432, 132–137.
- Lyons, J.S., O’Mahoney, M.T., Miller, S.I., Neme, J., Kabat, J., Miller, F., 1997. Predicting readmission to the psychiatric hospital in a managed care environment: implications for quality indicators. *American Journal of Psychiatry* 154, 337–340.
- Marcin, J.P., Romano, P.S., 2004. Impact of between-hospital volume and within-hospital volume on mortality and readmission rates for trauma patients in California. *Critical Care Medicine* 32, 1477–1483.
- Nguyen, N.T., Paya, M., Stevens, C.M., Mavandadi, S., Zainabadi, K., Wilson, S.E., 2004. The relationship between hospital volume and outcome in bariatric surgery at academic medical centers. *Annals of Surgery* 240, 586–593.
- Rasmussen, S., Zwisler, A.D., Abildstrom, S.Z., Madsen, J.K., Madsen, M., 2005. Hospital variation in mortality after first acute myocardial infarction in Denmark from 1995 to 2002: lower short-term and 1-year mortality in high-volume and specialized hospitals. *Medical Care* 43, 970–978.
- Shah, S.N., Wainess, R.M., Karunakar, M.A., 2005. Hemiarthroplasty for femoral neck fracture in the elderly surgeon and hospital volume-related outcomes. *Journal of Arthroplasty* 20, 503–508.
- Taub, D.A., Miller, D.C., Cowan, J.A., Dimick, J.B., Montie, J.E., Wei, J.T., 2004. Impact of surgical volume on mortality and length of stay after nephrectomy. *Urology* 63, 862–867.