Original Article

Factors of Medication Expenditure for Bipolar Disorder in a Thai Hospital over Ten Years

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Objective: To examine factors influencing medication expenditure for treating bipolar disorder by using the Laspeyres index.

Materials and Methods: Retrospective utilization data were retrieved from a Thai hospital's database. Changes in medication expenditure between 2008 and 2012 compared to between 2013 and 2017 were attributed to two factors, number of patient (Q) and cost per patient (P) for each 5-years. By measuring quantity as defined daily dose (DDD), changes in P comprised two sub factors, DDD per patient (q) and cost per DDD (p). Moreover, sub factor was weighted average with percentage of patient mix for q index and with percentage of product mix for p index.

Results: Expenditure on medication in bipolar patients rose from 11.19 to 19.83 million Thai Baht (THB) per year between 2008 to 2012 and 2013 to 2017 (77.2%). With Laspeyres index, the total index of 1.77 was a result of three main factors, change in DDD per patient (q index at 1.40), weighted cost per DDD (p index at 1.16), and weighted number of patient (Q index at 1.09). The only factor that made a fall in expenditure was percentage of product mix, which meant more generic medications have been prescribed within 10 years.

Conclusion: Over the last 10 years, only the impact of product mix has been a negative factor declining the total expenditure in bipolar disorder medication. Switching from brand to generic prescription may be the most suitable strategy to control medication expenditure in the authors' setting.

Keywords: Medication, Laspeyres index, Prescription data, Bipolar disorder

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Bipolar disorder is an illness that affects emotions, behaviors, and thoughts[1]. The patient will have varying moods between manic and depressive phases. During depression, these symptoms may lead to suicide of the patient. In 2016, the department of mental health, Ministry of public health, Thailand, reported the suicide rate at 6.35 per 100,000 in the Thai population[2]. Bipolar prevalence was 1% in adults, with the same ratio among genders. Around 20% of patients develop symptoms between the ages of 15 and 19. However, some may develop symptoms before adolescence. In Ramathibodi Hospital, a 1,166 beds Thai hospital, bipolar-treated medication expenditure has increased 77.2% over the past 10 years, which may be a result from changes in number of patients, patient symptoms, or types of medication.

The medication used to control the symptoms in the early stages was Lithium, which cost only 6 Thai Baht (THB) per tablet. More effective drugs with higher price have been periodically launched, including sodium valproate and other drugs in atypical antipsychotics such as aripiprazole[3]. To explain the composite of expenditure, a mathematic model called Laspeyres index[4,5] has been applied. There are studies applying this index to explain drug expenditures in many countries, such as Canada, China, Korea, and Colombia[6-9].

Laspeyres index computes as present total expenditure over total expenditure in a previous

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period, while holding the other factors the same. Index greater than 1 indicates that the considered factor has a positive impact or a rise on total expenditure, while index less than 1 means a negative impact or a fall in total expenditure.

The present study aimed to describe the trend and factor affecting medication expenditure in bipolar disorder patients between 2008 and 2012 and between 2013 and 2017 by using the Laspeyres index in Ramathibodi Hospital, a Thai tertiary university hospital.

Materials and Methods

Prescription records of oral medicines under the MIMS code "4A" to "4H" were retrieved for bipolar disorders (ICD10="F31*") patients at the outpatient clinics between January 1, 2008 and December 31, 2017. Each data record comprised encrypted patient's hospital number, date of birth, gender, health insurance schemes [i.e., Civil Servants Medical Benefit Scheme (CSMBS), National Health Security Office (NHSO), Social Security Insurance (SSI), or self-pay] of each visit or admission, prescribing date, medication code and name, generic name, strength, prescribed quantity, and unit selling price. Data were cleaned for any duplicated. Patient's age was calculated at the date of each prescription. Dispensed drug quantity was measured as number of defined daily dose (DDD):

$$\text{Number of DDD} = (\text{prescribed quantity}) \times (\text{strength in milligram}) / \text{DDD}$$

where DDD is the assumed average maintenance dose per day for a drug used for its main indication in adults[10], as defined by the World Health Organization (WHO).

Descriptive analysis was applied using IBM SPSS Statistics software, version 25.0 (IBM Corp., Armonk, NY, USA). The number of patient and percent by age group, gender, and type of health scheme were calculated. Test for independent factors between time periods was performed by a chi-squared test. Microsoft Access 2013 and Excel 2013 were used for index analysis. Medication expenditure was compared between the two time periods, 2008 to 2012 (period t-1) and 2013 to 2017 (period t). The expenditure was a summation of (prescribed quantity) × (unit selling price) for each 5-years period. Change in expenditure between the two time periods was presented by total (Laspeyres) index with the following equation:

$$\text{Total index} = (\text{Q index}) \times (\text{P index}) = (\text{Q index}) \times (\text{p index} \times \text{q index})$$

where Q is number of patients in five years, P is medication cost per patient in five years (THB), q is the weighted average number of DDD per patient of new and current patients in five years, and p is the weighted average medication cost per DDD of original and generic medicine.

The weighted average number of DDD per patient or q was a summation of number of DDD per patient multiplied by their patient mix, while patient mix was a ratio of number of type of patients in each period, and patient mix was a ratio of new or current to total patients. New patients determined as who have never visited the hospital in the previous five years-period and current as the ones who have visited the hospital previously.

$$\text{q index} = \sum_{n=1 \text{ to } 2} \left(\frac{\text{DDD}}{\text{patient}}\right)_n \times (\%\text{patient mix})_n$$

where n is each type of patient.

The weighted average medication cost per DDD or p was a summation of bipolar-treated medications cost per DDD multiplied by their product mix. While product mix was a ratio of type of medication in each period, and product mix was a ratio of original or generic medicine to total. Original medication was the brand-name drug, while generic was the local copied drug.

$$\text{p index} = \sum_{n=1 \text{ to } 2} \left(\frac{\text{medication cost}}{\text{DDD}}\right)_n \times (\%\text{product mix})_n$$

where n is each type of medication.

Ethical considerations

The present study has been approved with the Institutional Review Board, Faculty of Medicine, Ramathibodi Hospital, Mahidol University, Bangkok, Thailand (COA no. MURA2018/969).

Results

The severity of bipolar disorder symptom, which is reflected by the number of DDD use, could be considered from the ICD10. Patients who had more severity should be recorded in the ICD10 to more severe code. However, in the system, most of ICD10 was recorded as F31.9, bipolar disorder, unspecified at 79.6% and 66.0%, followed by F31.8, other bipolar disorders at 13.3% and 19.8% and F31.1, bipolar disorder, current episode manic without psychotic features at 3.6 and 9.6%, in period t-1 and period t, respectively. The rest was less than 2% for each code.

During the present study period, total outpatient medication expenditure for treating bipolar disorder symptom increased from 11.19 to 19.83 million THB per year (77.2%) while the number of patients

Table 1. Patients' demographic characteristics and percentage of change between 2008 to 2012 and 2013 to 2017

Characteristics	Year; n (%)		p-value	% change
	2008 to 2012	2013 to 2017		
Age				
≤20 years	107 (7.9)	104 (7.1)	0.404	–2.8
>20 years	1,251 (92.1)	1,370 (92.9)		9.3
Sex				
Male	508 (37.4)	492 (33.4)	0.025*	–3.1
Female	850 (62.6)	982 (66.6)		15.5
Health scheme				
CSMBS	267 (19.7)	312 (21.2)	0.321	16.9
NHSO	128 (9.4)	171 (11.6)	0.060	33.6
SSI	43 (3.2)	62 (4.2)	0.143	44.2
Self-pay	920 (67.7)	929 (63.0)	0.008*	1.0
Total	1,358 (100)	1,474 (100)		25.5

CSMBS=Civil Servants Medical Benefit Scheme; NHSO=National Health Security Office; SSI=Social Security Insurance

* Significant difference between 2008 to 2012 and 2013 to 2017 at the 0.05 level in a chi-squared test

increased 8.5% from 1,358 to 1,474 during period t-1 and period t. Table 1 shows patients' demographic characteristics in each time period. About 7% of the patients were children and adolescences aged 20 years or less with no significant difference between the two time periods (p=0.404). However, male patients significantly decreased from 37.4% to 33.4% between the two time periods (p=0.025). Most patients were under CSMBS and self-pay, which pay by fee-for-service, at 87.4% and 84.2% in period t-1 and period t, while the other two health schemes were paid by capitation. The ratio of CSMBS, NHSO, SSI were not significantly different at p=0.321, 0.060, and 0.143, respectively, while self-pay was significantly different (p<0.001) between the two time periods at 67.7% in period t-1 and 63.0% in period t.

Change in medication expenditure from 55.96 million in period t-1 and 99.16 million THB in period t resulted in a total index of 1.77 (Table 2). The total index comprised of two main factors, quantity or number of bipolar patients (Q index) and medication cost per patient (P index), which equaled 1.09×1.63. For more details, P index was a result of two sub-factors, weighted number of DDD per patient (q index) multiplied by weighted medication cost per DDD (p index), which was 1.40×1.16.

Weighted number of DDD per patient was a weighted average of DDD per patient by percentage

Table 2. Medication expenditure for bipolar disorder and its factors by health scheme between 2008 to 2012 and 2013 to 2017

	All			CSMBS			NHSO			SSI			Self-pay		
	2008 to 2012	2013 to 2017	Index	2008 to 2012	2013 to 2017	Index	2008 to 2012	2013 to 2017	Index	2008 to 2012	2013 to 2017	Index	2008 to 2012	2013 to 2017	Index
Medication expenditure (million THB)	55.96	99.16	1.77	26.11	51.73	1.98	1.71	3.02	1.76	1.43	2,.45	1.92	26.71	41.67	1.56
1. Number of patients (Q)	1,358	1,474	1.09	267	312	1.17	128	171	1.34	43	62	1.44	920	929	1.01
2. Cost/patient (P)	41,211	67,276	1.63	97,776	165,809	1.70	13,385	17,639	1.32	33,263	44,285	1.33	29,038	44,855	1.54
2.1 Weighted DDD/patient (q)	546.66	766.46	1.40	881.71	1,373.43	1.56	377.01	547.94	1.45	922.61	776.14	0.84	455.46	602.19	1.32
DDD/patient			1.29			1.28			1.29			0.70			1.30
% patient mix			1.07			1.18			1.07			1.14			1.01
2.2 Weighted Cost/DDD (p)	75.39	87.77	1.16	110.89	120.73	1.09	35.50	32.19	0.91	36.05	57.06	1.58	63.76	74.49	1.17
Cost/DDD			1.24			1.16			0.94			1.73			1.29
% product mix			0.91			0.91			0.94			0.88			0.86

CSMBS=Civil Servants Medical Benefit Scheme; DDD=defined daily dose; NHSO=National Health Security Office; SSI=Social Security Insurance; THB=Thai Baht

Table 3. Number of medication use, measured by DDD per patient and its mix among current and new bipolar patients and medication cost, measured by cost per DDD and its mix among original and generic drugs, between 2008 to 2012 and 2013 to 2017

	2008 to 2012		2013 to 2017	
	Current patients	New patients	Current patients	New patients
DDD/patient	787.1	347.7	1,108.6	372.3
% patient mix	45.3	54.7	53.5	46.5
	Original	Generic	Original	Generic
Cost/DDD	126.6	6.7	137.1	35.7
% product mix	57.3	42.7	51.4	48.6

DDD=defined daily dose

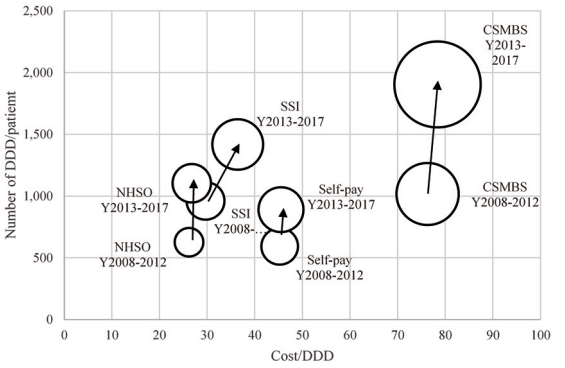

Figure 1. Factor influence by p (cost/DDD) and q (number of DDD/patient), by health scheme by time period.

CSMBS=Civil Servants Medical Benefit Scheme; DDD=defined daily dose; NHSO=National Health Security Office; SSI=Social Security Insurance

of patient mix (Table 3). While holding other factors constant to period t-1 where only two sub-level quantity factors were considered, the impact of change in DDD per patient in new and current patients in period t would make the q index to be 1.29 and when the patient mix changed to period t, the q index would be at 1.07. The result showed that a higher number of DDD in current patients (1,108.64) had more effect than the percentage of patient mix (45.3% in period t -1 and 53.5% in period t).

Weighted medication cost per DDD was a weighted average of medication cost by their product mix, measured as percentage of DDD of each type, i.e., original or generic (Table 3). While holding other factors constant to period t-1 where only two sub-level price factors were considered, change in all medication costs in period t impacted the p index by 1.24 and when product mix or percentage of original to total changed to period t (57.3% to 51.4%), the p index would be negative at 0.91. This meant that the change in medication cost had more effect than the percentage of product mix.

With the same concept, the present study calculated the indexes by health scheme to find the factors affecting medications expenditure between two time periods. By health scheme, total medication expenditure indexes were 1.98, 1.76, 2.45, and 1.56 for outpatients under CSMBS, NHSO, SSI, and self-pay, respectively. The major factor influencing expenditure in every scheme was weighted DDD per patient at 1.56, 1.45, 0.84, and 1.32 for CSMBS, NHSO, SSI, and self-pay, respectively.

Figure 1 shows the change of medications utilization between period t-1 and period t. The size of the circle was medication cost per patient in five years (THB). All health scheme's size of circles increased between period t-1 and period t. In that, SSI had a direction of North-East, which meant both number of DDD per patient and medication cost per DDD increased. The direction was going North in all schemes, which meant number of DDD per patient increased in this 10 years and was a major factor of higher cost per patient.

The type of medication used by MIMS is showed in Table 4, with the number of DDD per patient over five years, comparing period t-1 with period t. The use of medications in all groups increased in all health scheme patients. The most use was antidepressants, followed by anticonvulsants and antipsychotics.

Discussion

The present study extends the findings from previous studies by applying a mathematic model to find the factors affecting the medications expenditure in bipolar disorder patients, using hospital outpatient prescribing electronic data. Most of the previous studies explored the cost pattern in bipolar patients from the prescribing data, i.e., claim datasets or

Table 4. Type of medication used for bipolar patients (DDD per patient) by MIMS group between 2008 to 2012 and 2013 to 2017

	CSMBS		NHSO		SSI		Self-pay	
	2008 to 2012	2013 to 2017	2008 to 2012	2013 to 2017	2008 to 2012	2013 to 2017	2008 to 2012	2013 to 2017
4A: Anxiolytics	54.67	106.93	57.73	94.09	23.53	69.62	42.25	54.35
4B: Hypnotics & dedatives	17.48	32.18	3.24	9.41	0.98	45.04	9.79	15.88
4C: Antidepressants	425.31	687.38	165.60	334.85	310.21	504.26	266.16	382.27
4D: Antipsychotics	177.02	417.21	95.09	175.42	168.50	274.56	82.53	192.77
4E: Anticonvulsants	271.48	442.17	244.21	400.38	398.74	456.67	162.22	207.11
4F: Other CNS drugs & agents for ADHD	0.98	1.47	3.52	20.96	2.76	4.08	3.49	6.00
4G: Neurodegenerative disease drugs	26.73	84.70	-	-	-	1.21	4.48	5.34
4H: Antiparkinsonian drugs	43.28	131.64	57.05	68.36	56.06	62.19	21.36	26.02

ADHD=attention deficit hyperactivity disorder; CNS=central nervous system; CSMBS=Civil Servants Medical Benefit Scheme; DDD=defined daily dose; NHSO=National Health Security Office; SSI=Social Security Insurance

hospital administrative database, but did not explain the factor associated with medication expenditure. In the United States, although claim datasets were retrieved for many studies, there was no evidence exploring the factors affecting bipolar medication expenditure. In 2011, Kim et al compared mental health treatment cost of bipolar disorder using retrospective claims dataset between January 1, 2003 and December 31, 2006. Analyzing on only the cost, they found that among atypical antipsychotic, aripiprazole cost was significantly lower compared with ziprasidone and quetiapine, but not to olanzapine or risperidone[11].

In 2014, Degli Esposti et al reported on the pattern of medications use, comparing two diseases but not by type of medicines from the Italian Burden of Illness in Schizophrenia and bipolar disorder or IBIS, which was a multicenter, observational cohort study based on data obtained from the administrative database of 16 local health units in Italy[12]. The study found that 70% of the patients with bipolar disorders received antipsychotic monotherapy. It also did not explain the factors of the difference in its expenditure.

Recently, a systematic review of cost of illness studies for bipolar disorders was conducted in 2015 by retrieving selected studies since 1995. However, the study discussed only methodological issues on the economic evaluation and no report on factor effecting cost of medication[13].

In the present study, the gap of knowledge was filled by applying a mathematic model to explain which factors caused medications expenditure increased or decreased between the two periods of time. The present study found that in the last 10 years, the only one factor that impact the total expenditure in negative was the percentage of product mix from the strategy of shifting the original to more generic prescribing, but the magnitude was much lower than the other positive factors, which were the number of patient, the cost per patient, and the cost per DDD. To reduce the expenditure, only promoting to use generic substitute alone may not be enough. However, the study also recognized a limitation. The main cause, which was disease severity, was not included for analysis. For more severe patients, DDD per patient should be higher than less for severe ones. The result may not be applied to other hospital having a different proportion of patients under each health scheme.

Conclusion

Medications expenditure of bipolar disorder in a Thai hospital increased 77.2% over the past 10 years. With a mathematic model, the most impact was from the number of DDD per patient with an index of 1.40. The second and third factors were weighted cost per DDD (1.16) and weighted number of patient (1.09). The most impact was from DDD per patient (q index), where current patient trended to be prescribed for more DDD. The severity of diseases was not included in the present study because the ICD10 in the system was mainly recorded as F31.8, other bipolar disorders, and F31.9, bipolar disorder, unspecified. In addition, with p index, although product mix trended to be more generic, the cost of the new drugs was more expensive, even for the generic local-made. The findings can help the management team understand the factors of total medications expenditure in bipolar patients and provide appropriate policy to control its utilization.

What is already known on this topic?

Bipolar disorder is an illness requiring continuous use of medication to control its symptom. In the last decade, the pattern of medication use has changed, and total expenditure increased.

What this study adds?

By applying the Lasperyes index to hospital data, the analyst can monitor and report the factors that affect the increase or decrease of total expenditure. As a result, the administrative team will be able to design the suitable strategies to control its expenditure. This study has no funding and has no conflict of interest.

Conflicts of interest

The authors declare no conflict of interest.

References

1. Anderson IM, Haddad PM, Scott J. Bipolar disorder. Bmj 2012;345:e8508.
2. Department of Mental Health, Ministry of Public Health. Suicide report [Internet]. 2018 [cited 2018 Jun 7]. Available from: https://www.dmh.go.th/report/suicide/stat_prov.asp.
3. Yatham LN. Atypical antipsychotics for bipolar disorder. Psychiatr Clin North Am 2005;28:325-47.
4. Triplett JE. Economic theory and BEA's alternative quantity and price indexes. Surv Curr Bus 1992;72: 49-52.
5. Diewert WE. The early history of price index research. In: Diewert WE, Nakamura AO, editors. Essays in index number theory. Amsterdam, North-Holland: Elsevier Science, 1993. p. 33-66.
6. Morgan SG. Quantifying components of drug expenditure inflation: The british columbia seniors' drug benefit plan. Health Serv Res 2002;37:1243-66.
7. Song Y, Bian Y, Petzold M, Li L, Yin A. Effects of the national essential medicine system in reducing drug prices: An empirical study in four chinese provinces. J Pharm Policy Pract 2014;7:12.
8. Jo JS, Kim YM, Paek KW, Bea MH, Chun K, Lee S. Factors contributing to increases in prescription drug expenditures borne by national health insurance in south korea. Yonsei Med J 2016;57:1016-21.
9. Prada SI, Soto VE, Andia TS, Vaca CP, Morales AA, Marquez SR, et al. Higher pharmaceutical public expenditure after direct price control: Improved access or induced demand? The colombian case. Cost Eff Resour Alloc 2018;16:8.
10. WHO Collaborating Centre for Drug Statistics Methodology. Definition and general considerations. The basic definition of the defined daily dose [Internet]. Oslo, Norway; 2018 [cited 2018 Aug 10]. Available from: http://www.whocc.no/ddd/definition_and_general_considera/.
11. Kim E, You M, Pikalov A, Van-Tran Q, Jing Y. One-year risk of psychiatric hospitalization and associated treatment costs in bipolar disorder treated with atypical antipsychotics: A retrospective claims database analysis. BMC Psychiatry 2011;11:6.
12. Degli Esposti L, Sangiorgi D, Mencacci C, Spina E, Pasina C, Alacqua M, et al. Pharmaco-utilisation and related costs of drugs used to treat schizophrenia and bipolar disorder in italy: The ibis study. BMC Psychiatry 2014;14:282.
13. Jin H, McCrone P. Cost-of-illness studies for bipolar disorder: Systematic review of international studies. Pharmacoeconomics 2015;33:341-53.