Study on Variations in Price of Prescription Medicines in Thailand

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There are evidences describing that the prices of prescription medicines can affect users, suppliers, and, in particular, payers in the health care system. Despite the significant effects of prices, the information regarding their characteristics is scarce. The objective of this study was to examine the prices and price variations of prescription medicines in an actual setting. A cross-sectional study on the prices of prescription medicines listed in a hospital formulary was undertaken. The medicines (n=1531) listed in the formulary were recorded according to the category of the medicine (essential or non-essential medicines), manufacturer types (local or foreign), dosage forms, therapeutic classifications (classes), and prices per unit in Baht. This study used coefficients of relative variations (CRVs) to determine the extent of price variations. Results revealed that the mean prices of non-essential and foreign medicines were significantly greater than those of its counterparts by 1.7 and 21.2 times, respectively. On an average, the classes with the highest prices were blood-related, antineoplastic, and endocrinological agents, while those with the lowest prices were the psychotherapeutic, CNS, and cardiovascular agents. The majority of the medicines (37%) were in the price range of >10—100 Baht. The price variations of different classes of medicines varied from about 100% to 600%. The mean price and CRV levels (low and high) formed four groups of medicines with different risks of high prices and variations to payers. In conclusion, the prices are associated with the category and manufacturer type. The prices and their variations could be used to distinguish the classes of medicines that possess different risks of high prices and variations to payers. Identifying the classes with high prices and high variations, high prices and low variations, and low prices and high variations is necessary for careful intervention to reduce the effect of prices and their variations on payers.

Key words——Thailand; prices; price variations; prescription medicines; hospital formulary

INTRODUCTION

Prescription medicines are one of the essentials of a health care system since they are used to treat and prevent health problems and to promote or maintain the health of people. Agents using medicines can be classified as users, suppliers, and payers. Although each agent may have certain views regarding medications, the price of medicines is a common concern, albeit in different ways. In general, consumers-the users and payers-often require effective and affordable medicines, while suppliers are likely to provide effective and profitable medicines. Besides the normal profit from the average wholesale price (AWP), hospitals as health care providers can obtain further benefits through discounts ranging from 18% to 95% of the AWP.[1] In particular, determining the prices of medicines is generally the consideration of manufacturers who, as product providers, invest competency, time, and large amounts of money into research and de-

velopment of new medicines.[2] As payer for social health welfare, government is responsible to people by contributing a budget for this purpose. A continuous rise in health expenditure, particularly expenditure on medicines, is a burden for governments in many countries including Thailand. Several factors may affect this increase, such as population growth, higher per capita prescriptions, and an increase in the price of medicines.[3] Population aging is also associated with an increase in the expenditure on medicines.[4] However, one of the important factors is the price of medicines.[5]

The prices of prescription medicines possibly influence both persons and processes in a health care system. Some users acknowledge that the cost of medicines is a factor affecting their decision to access and purchase medicines.[6,7] Several reports describe that users tend to reduce medications when the prices are higher, resulting in decreased health levels.[8—13] Furthermore, the high cost of medicines could lead noncompliance in patients with regard to medication.[14] It is found that uninsured individuals

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use more generic medicines and purchase medicines with lower unit costs than insured individuals.[15] The promotion of the use of generic medicines rather than branded ones is also a result of the prices of medicines.[16,17] Currently, the selection of medicines for hospital formularies or for patient therapy is based not only on their effectiveness but also their prices.[18—22] In addition, the prices may play an important role in the medicine market. Price competition and importation of similar medicines with lower prices have occurred in the European Union and North America.[23—26]

Several countries facing an increase in prices and expenditure on medicines have to appropriately set health policies and actions in order to balance the therapeutic outcomes and the expenditure on medicines. Actions taken for effective medicine management include setting standards or guidelines for therapy,[27] conducting medicine coverage programs,[28] releasing a particular act for the poor,[29] promoting health insurance,[30] employing co-payment or cost-sharing between the user and the payer,[31—33] and using reference pricing.[34,35] For example, it is evident that using reference pricing can decrease the usage of higher priced dihydropyridine calcium channel blockers.[36] Several countries such as England, Germany, Italy, Sweden, Canada, USA, and Australia have applied reference pricing as a means to control the expenditure on medicines.[37] However, there are large differences in the implementation of this action among these countries. Thailand has implemented similar actions, except for controlling the prices of medicines.

Briefly, in Thailand, there are several health insurance schemes for people when they visit or are admitted to hospitals. Employees contributing a specific percentage of their wages monthly to the Social Security Fund can receive health care from hospitals that they have contacted. This fund pays hospitals via a capitation mechanism. Government officials and their dependents (parents, spouse, and children) have a fringe benefit to obtain essential medicines (EMs) without payment; however, they have to pay for nonessential medicines (non-EMs) via a fee-for-service mechanism. The social health welfare scheme established by the government provides a free health card for certain people (such as the indigent, elderly, and handicapped) or a co-payment health card for the rest; further, it pays hospitals using the capitation

method. However, those who do not want to use these cards can pay for themselves via the fee-for-service mechanism. Private health insurance is also an alternative for individuals who need additional health packages. Moreover, individuals injured due to traffic accidents are provided with medical care that is paid for from a fund contributed by all the owners of registered vehicles. This fund works on the basis of the fee-for-service mechanism. Apart from hospitals, people can obtain medicines from drugstores or clinics. Here, they have to pay for the medicines themselves. Drugs being an important component of these health care schemes and of private consumption constitute about one third of the total health expenditure; further, this share tends to increase.[38] It is necessary to control such an increase in prices, and empirical findings of price characteristics from a real scenario are required to appropriately deal with it. Hospitals are settings that are involved in all health insurance schemes. Additionally, they are the main routes of the distribution of medicines to people, and major expenditures on medicines occur largely through hospitals.[38,39] Thus, this study aimed to examine the prices and the price variations of prescription medicines in a hospital formulary of a government hospital.

METHODS

Study Design   A cross-sectional study of a hospital formulary for the year 2004 was undertaken in Thailand in 2005. Medicines included in the hospital formulary were recorded and analyzed to determine the prices and the extent of variations in the prices of prescription medicines among various groupings.

Data Source   A hospital formulary (2004) belonging to a large hospital with more than 500 beds was randomly selected. In this formulary, there are 23 classes of drugs based on their pharmacological actions and therapeutic uses. In most cases, each medicine was referred to by its generic name and the following details were mentioned in their descriptions: indications, recommended doses, adverse reactions, precautions, contraindications, interactions, preparations, manufacturers, distributors, and prices. For certain drugs, special descriptions, such as storage conditions and monitoring parameters, were noted in addition to the other information. The medicines excluded from this study were those included in the

classes of diagnostic drugs, radiopharmaceuticals, and miscellaneous drugs as well as those with incomplete investigations. Thus, 20 classes of drugs were included in this study. A generic medicine in the formulary could differ in dosage forms, strengths, trade names, manufacturers/distributors, and prices. Here, a drug could be listed under several items. For example, cimetidine was available in the form of a 200 mg-tablet, 400-mg tablet, and as an injection. In such a case, cimetidine would be identified as three items, and each item would have its own price.

Data Recording Each item was recorded and coded as follows: generic name, trade name, drug category, manufacturer type, dosage form, therapeutic classification, and price. To categorize the medicines, those present in the National List of Essential Medicines 1999 (EML) were referred to as essential medicines (EMs) while those absent from it were described as non-essential medicines (non-EMs). Manufacturers were classified as local or foreign types. Local manufacturers meant that the owners were Thai, while foreign manufacturers included international companies. The dosage forms were categorized in six ways: (1) tablets/capsules, (2) injections, (3) oral liquids, (4) eye, ear, nose and throat preparations (EENT), (5) creams/ointments including enemas and suppositories, and (6) powders/granules. The EML 1999 was used as a framework to record classes of medicines. The researchers could not employ the updated EML 2004 that was officially promulgated and used in December 2004 because the hospital formulary used in this study was based on the EML 1999. The classes listed in the hospital formulary differ from those in the EML with regard to the class number and the name. However, this study listed the medicines under class names based on the EML and class numbers based on the frequency. The price of each item was indicated in Baht (approximately 40 Baht = 1 US Dollar) for an undivided unit of dispensing or purchase of that item. A unit of the item could be a tablet, a capsule, an ampoule, a vial, a strip, a bottle, a tube, or a sachet.

Data Analysis The authors used descriptive statistics to characterize the items and the t-test (continuous variables) or the chi-square test (categorical variables) to determine the differences between data. This study employed a standardized measure of dispersion, called the coefficient of relative variation, to compare the dispersions of different price sets. This coefficient is expressed as SD, *i.e.*, as a percentage of the mean, given by 100 $\times$ SD/Mean.[40] A higher coefficient indicates a larger dispersion. The significant level of analyses was 0.05. All analyses were performed on SPSS 12.0 for Windows.

RESULTS

Overall Average Prices and Price Variations A total of 1531 items consisting of 64.7% EMs and 29.7% local medicines showed a mean price of 481.4 Baht. The significantly different mean prices of EMs and non-EMs were 383.4 Baht and 660.8 Baht, respectively. The mean price ratio of non-EMs to EMs was 1.7. The mean price of local items was 31.6 Baht; it was significantly different from that of foreign ones, which was 671.6 Baht. The price ratio of foreign to local medicines was 21.2. The mean prices of different dosage forms varied from 33.6 Baht to 1,513.9 Baht. While the mean prices of medicine classes ranged from 7.3 Baht to 3,634 Baht, the price variations for all the items were 469.3%; further, those of EMs and non-EMs were 394.3% and 484%, respectively. The variations for local and foreign medicines were 365.4% and 397.8%, respectively. Among dosage forms, the variations were between 117.3% and 505.7%. Among the 20 classes, the variations were between 55.1% and 602.3%. Other values, mean prices, and coefficients of relative variations (CRVs) are presented in Table 1.

Price Variations across Medicine Categories and Manufacturer Types Table 2 shows the frequencies, mean prices, and price variations of all classes across medicine categories and manufacturer types. It also presents the price ratios of non-EMs to EMs and the price ratios of foreign to local medicines. The price variations of different groups were between 55.1% and 483.8%, while the price ratios of non-EMs to EMs varied from 0.5 to 39.3. In the EM category, the price ratios of foreign to local medicines ranged from 5.1 to 316.7. The broader ranges found in the non-EM category were between 2.1 and 3096.2.

Price Variations among Manufacturer Types The price ratios of foreign to local medicines are shown in Table 3. These ratios varied among classes (n > 30) from 5.7 (gastrointestinal) to 464.1 (blood-related agents). The variations in local medicines were between 17.6% and 281.7%. In this group, the four classes with the highest variations were those of drugs for gastrointestinal (281.7%), endocrinologi-

Table 1.　Overall Mean Prices and Price Variations

	F	%	Mean	SD	CRV
Total	1531	100	481.4	2259.3	469.3
Medicine categories* :					
EM	990	64.7	383.4	1511.7	394.3
Non-EM	541	35.3	660.8	3198.0	484.0
Manufacturer types* :					
Local	455	29.7	31.6	115.6	365.4
Foreign	1076	70.3	671.6	2671.6	397.8
Dosage forms :					
Tablet/capsule	726	47.3	33.6	135.1	402.6
Injection	424	27.6	1513.9	4087.2	270.0
Oral liquid	109	7.1	168.1	850.1	505.7
Cream/ointment	130	8.5	115.6	199.8	172.8
EENT	122	8	280.8	329.4	117.3
Powder/granule	20	1.3			
Classes :					
1) Anti-infective	198	12.9	421.5	1702.7	404.0
2) Cardiovascular	177	11.6	84.6	509.5	602.3
3) Gastrointestinal	124	8.1	115.9	349.0	301.1
4) CNS	112	7.3	76.9	187.9	244.4
5) Respiratory	106	6.9	177.0	300.8	169.9
6) Psychotherapeutic	86	5.6	50.3	156.8	311.8
7) Nutritional	85	5.6	139.9	241.1	172.4
8) Musculoskeletal	73	4.8	472.2	2363.1	500.4
9) Genito-urinary	64	4.2	198.7	439.0	220.9
10) Endocrinological	61	4	1096.5	3363.6	306.8
11) Dermatological	106	6.9	96.2	135.1	140.3
12) EENT	81	5.3	306.4	498.6	162.7
13) Antineoplastic	104	6.8	2236.6	4522.9	202.2
14) Electrolytes	48	3.1	102.5	145.5	142.0
15) Blood related agents	47	3.1	3634.0	8044.0	221.4
16) Immunological	24	1.6	646.1	592.4	91.7
17) Antidotes	12	0.8	418.5	719.6	171.9
18) Local anesthetics	12	0.8	207.3	208.1	100.4
19) Dental preparations	8	0.5	26.1	22.7	87.0
20) Antiseptics	3	0.2	7.3	4.0	55.1

F: number of medicines, % : percentage of the total, Mean (Baht): mean of price in Baht, SD: standard deviation, CRV: coefficients of relative variations.
* Significantly different in percentage and mean between the two groups.

cal（271.6%）, anti-infective（235.5%）, and musculoskeletal（232.1%）therapy. In the group of drugs manufactured by international companies, *i.e.*, the foreign drugs, the variations ranged from 98.9% to 539.6%. The three classes with the greatest variations were those of drugs for cardiovascular（539.6%）, musculoskeletal（422.5%）, and anti-infective（320%）therapy. A majority of the classes（16/20）of medicines produced by local manufacturers showed lesser variations than those by foreign ones.

Price Variations among Medicine Price Levels
This study divided medicines into 5 levels according to the price ranges as follows: level 1（>0—1 Baht）, level 2（>1—10 Baht）, level 3（>10—100 Baht）, level 4（>100—1,000 Baht）, and level 5（>1,000 Baht）. The distribution of medicines in each level is shown in Table 4. All the classes showed different distributions. On an average, the majority of the medicines

Table 2. Price Variations and Price Ratios across Medicine Categories and Manufacturer Types

	F		F	Mean	CRV	Ratio*	F	Mean	CRV	Ratio*	Ratio**
				EM				Non-EM			
Total	1531	local	346	34.0	379.5		109	24.2	225.8		
		foreign	644	571.1	323.1	16.8	432	821.4	433.6	33.9	
		sum	990	383.4	394.3		541	660.8	484.0		1.7
1) Anti-infective	198	local	69	23.6	235.3		6	16.0	60.6		
		foreign	91	170.6	145.7	7.2	32	2069.6	186.3	129.4	
		sum	160	107.1	190.6		38	1745.4	206.8		16.3
2) Cardiovascular	177	local	33	7.5	194.4		7	7.9	75.0		
		foreign	62	42.5	168.3	5.7	75	160.5	483.8	20.2	
		sum	95	30.4	199.8		82	147.4	504.1		4.9
3) Gastrointestinal	124	local	38	27.9	361.6		25	46.4	210.7		
		foreign	28	317	208.6	11.4	33	99.2	178.8	2.1	
		sum	66	150.6	303.1		58	76.5	195.7		0.5
4) CNS	112	local	29	6.9	148.6		3	14.0	74.2		
		foreign	43	94.1	180.3	13.6	37	116.7	224.9	8.3	
		sum	72	59.0	233.2		40	109.0	232.8		1.8
5) Respiratory	106	local	20	12.8	109.2		10	8.7	121.4		
		foreign	45	226.7	121.5	17.7	31	265.2	153.7	30.6	
		sum	65	160.9	154.9		41	202.6	182.7		1.3
6) Psychotherapeutic	86	local	26	2.6	131.8		5	6.6	63.3		
		foreign	34	34.4	136.7	13.3	21	145.5	203.1	22.0	
		sum	60	20.6	187.7		26	118.8	227.4		5.8
7) Nutritional	85	local	28	10.3	127.1		8	10.6	196.4		
		foreign	25	255.8	92.9	24.9	24	213.4	152.9	20.2	
		sum	53	126.1	161.5		32	162.7	181.4		1.3
8) Musculoskeletal	73	local	16	2.3	128.5		5	29.6	123.5		
		foreign	27	43.5	161.5	19.1	25	1324.5	298.2	44.7	
		sum	43	28.2	209.0		30	1108.7	327.1		39.3
9) Genito-urinary	64	local	3	10.3	53.2		7	4.9	74.5		
		foreign	29	134.0	147.6	13.0	25	350.7	183.8	72.2	
		sum	32	122.4	156.4		32	275.1	212.9		2.2
10) Endocrinological	61	local	9	10.9	247.2		2	0.5	0.0		
		foreign	38	1268.8	295.6	116.8	12	1548.1	232.1	3096.2	
		sum	47	1027.9	330.8		14	1327.0	252.6		1.3
11) Dermatological	106	local	29	15.0	103.1		18	31.7	178.1		
		foreign	20	158.6	130.2	10.6	39	154.4	79.2	4.9	
		sum	49	73.6	201.9		57	115.7	103.8		1.6
12) EENT	81	local	9	52.7	99.2		8	25.5	63.2		
		foreign	36	450.9	149.4	8.6	28	282.4	96.6	11.1	
		sum	45	371.2	167.6		36	225.3	116.7		0.6
13) Antineoplastic	104	local	1	19.0			0				
		foreign	88	1963	168.7	103.3	15	3989.2	221.8		
		sum	89	1941.2	169.9		15	3989.2	221.8		2.1
14) Electrolyte	48	local	15	32.3	37.1		5	24.8	83.1		
		foreign	21	163.2	121.8	5.1	7	126.4	41.0	5.1	
		sum	36	108.6	151.0		12	84.1	78.5		0.8

Table 2.   Continued

	F		F	Mean	CRV	Ratio*	F	Mean	CRV	Ratio*	Ratio**
				EM				Non-EM			
15) Blood related agents	47	local	1	8.0			0				
		foreign	22	2533.8	150.0	316.7	24	4793.6	221.9		
		sum	23	2423.9	154.7		24	4793.6	221.9		2.0
16) Immunological	24	local	7	857.1			0				
		foreign	14	556.2			3	573.3	85.3		
		sum	21	656.5			3	573.3	85.3		0.9
17) Antidotes	12	local	3	97.7	168.8		0				
		foreign	9	525.5	153.9	5.4	0				
		sum	12	418.5	171.9		0				
18) Local anesthetics	12	local	0				0				
		foreign	11	160.6	85.5		1	721.0			
		sum	11	160.6	85.5		1	721.0			4.5
19) Dental preparations	8	local	8	18.4	38.4		0				
		foreign	0				0				
		sum	8	18.4	38.4		0				
20) Antiseptics	3	local	3	7.3	55.1		0				
		foreign	0				0				
		sum	3	7.3	55.1		0				

F: number of medicines, Mean（Baht）: mean of price in Baht, CRV: coefficients of relative variations, Blanks: not available.
* Price ratio of foreign to local, ** Price ratio of non-EM to EM.

Table 3.   Price Variations and Ratios between Manufacturer Types

	F	%	Local Mean（Baht）	CRV	%	Foreign Mean（Baht）	CRV	Ratio*
Total	1531	29.7	31.6	365.4	70.3	671.6	397.8	21.2
Classes :								
1) Anti-infective	198	37.9	22.7	235.5	62.1	664.6	320.0	29.3
2) Cardiovascular	177	22.6	7.5	176.8	77.4	107.2	539.6	14.3
3) Gastrointestinal	124	50.8	35.2	281.7	49.2	199.2	238.4	5.7
4) CNS	112	28.6	7.6	136.4	71.4	104.6	207.0	13.8
5) Respiratory	106	28.3	11.4	112.9	71.7	242.4	137.6	21.2
6) Psychotherapeutic	86	36.0	3.2	116.8	64.0	76.8	249.4	23.8
7) Nutritional	85	42.4	10.4	142.6	57.6	235.0	120.1	22.7
8) Musculoskeletal	73	28.8	8.8	232.1	71.2	659.4	422.5	75.1
9) Genito-urinary	64	15.6	6.5	73.0	84.4	234.3	200.6	36.0
10) Endocrinological	61	18.0	9.0	271.6	82.0	1335.8	275.4	148.8
11) Dermatological	106	44.3	21.4	174.3	55.7	155.9	98.9	7.3
12) EENT	81	21.0	39.9	102.6	79.0	377.2	143.0	9.5
13) Antineoplastic	104	1.0	19.0		99.0	2258.1	201.0	118.8
14) Electrolytes	48	41.7	30.4	47.2	58.3	154.0	112.7	5.1
15) Blood related agents	47	2.1	8.0		97.9	3712.8	218.6	464.1
16) Immunological	24	29.2	857.1	17.6	70.8	559.2	122.4	0.7
17) Antidotes	12	25.0	97.7	168.8	75.0	525.5	153.9	5.4
18) Local anesthetics	12	0.0			100.0	207.3	100.4	
19) Dental preparations	8	87.5	18.4	38.4	12.5			
20) Antiseptics	3	100.0	7.3	55.1	0.0			

F: number of medicines, %：percentages of each class, Mean（Baht）: mean of prices in Baht, CRV: coefficients of relative variations.
* Price ratios of foreign to local, Blanks: not available.

Table 4. The Price Profile of Prescription Medicines

	F	%	Level 1 >0–1 Baht Mean (Baht)	CRV	%	Level 2 >1–10 Baht Mean (Baht)	CRV	%	Level 3 >10–100 Baht Mean (Baht)	CRV	%	Level 4 >100–1000 Baht Mean (Baht)	CRV	%	Level 5 >1000 Baht Mean (Baht)	CRV
Total	1531	6.8	0.7	32.1	24.6	4.9	56.5	37.2	37.3	61.4	24.4	341.7	66.3	6.9	5529.0	123.1
Categories:																
EM	990	9.1	0.7	32.6	26.5	4.7	59.1	34.5	36.4	63.9	23.4	346.9	63.7	6.5	4458.5	93.4
Non-EM	541	2.6	0.6	26.0	21.3	5.4	50.1	42.1	38.6	57.7	26.2	333.4	71.0	7.8	7160.2	130.6
Manufacturer types:																
Local	455	19.8	0.7	32.4	40.7	4.5	63.8	35.6	28.6	63.0	3.7	451.4	66.1	0.2	1200.0	
Foreign	1076	1.3	0.8	29.9	17.8	5.4	49.3	37.9	40.7	58.2	33.2	336.5	66.0	9.8	5570.2	122.5
Classes:																
1) Anti-infective	198	4.5	0.7	26.5	27.3	5.0	57.1	36.9	37.0	61.7	25.3	355.2	63.8	6.1	5226.0	94.7
2) Cardiovascular	177	5.6	0.7	36.9	32.8	5.2	55.8	50.8	27.6	62.1	10.2	306.3	68.1	0.6	6666.0	0.0
3) Gastrointestinal	124	11.3	0.7	33.7	37.1	4.7	58.0	37.1	42.0	62.4	12.9	466.7	48.0	1.6	2373.5	42.7
4) CNS	112	11.6	0.7	31.8	31.3	4.9	50.9	42.9	35.7	59.5	13.4	355.5	61.9	0.9	1387.0	
5) Respiratory	106	7.5	0.7	34.5	29.2	4.2	66.7	34.0	34.2	42.5	24.5	454.3	47.2	4.7	1116.6	6.0
6) Psychotherapeutic	86	15.1	0.7	33.5	43.0	4.5	58.9	32.6	42.9	60.1	8.14	255.3	105.3	1.2	1160.0	
7) Nutritional	85	17.6	0.7	31.9	25.9	4.0	67.8	27.1	35.3	53.6	27.1	382.9	48.8	2.4	1086.5	6.7
8) Musculoskeletal	73	13.7	0.8	32.1	31.5	4.1	57.5	39.7	42.6	66.5	11.0	227.1	43.8	4.1	10440.0	64.5
9) Genito-urinary	64	0.0			21.9	5.5	48.6	39.1	34.3	64.5	37.5	360.4	75.2	1.6	3134.0	
10) Endocrinological	61	16.4	0.7	34.3	24.6	5.2	58.6	21.3	37.0	85.5	24.6	322.7	52.7	13.1	7685.4	81.9
11) Dermatological	106	0.0			20.8	6.8	46.2	47.2	40.6	58.1	32.1	235.9	69.8	0.0		
12) EENT	81	0.0			3.7	4.0	25.0	30.9	52.2	58.3	58.0	263.3	80.5	7.4	1854.2	29.1
13) Antineoplastic	104	0.0			3.8	7.8	11.2	24.0	45.8	45.8	35.6	317.7	72.1	36.5	5780.8	104.6
14) Electrolytes	48	0.0			6.3	5.3	75.8	66.7	36.6	41.9	27.1	287.1	61.8	0.0		
15) Blood related agents	47	2.1	0.5	14.9	5.5	33.3	17.0	34.8	81.9	21.3	439.2	54.0	44.7	7908.9	135.0
16) Immunological	24	0.0			0.0			12.5	28.0	37.1	75.0	567.8	47.2	13	1734.3	58.3
17) Antidotes	12	8.3	1.0	8.3	4.0	25.0	29.8	37.2	41.7	262.0	34.5	17	1809.0	51.7		
18) Local anesthetics	12	0.0			0.0			33.3	65.5	10.6	66.7	278.3	81.0	0		
19) Dental preparations	8	0.0			0.0			100.0	26.1	87.0	0			0		
20) Antiseptics	3	0.0			66.7	5.0	33.3	12.0		0			0			

F: number of medicines, %: percentage in row of each class, Mean (Baht): mean of price in Baht, CRV: coefficient of relative variations, Blank: not available.

(37.2%) were included in level 3. Most of the classes demonstrated greater percentages of items in level 3. Among the classes in level 1, the classes of nutritional, endocrinological, and psychotherapeutic drugs were the most frequent. In level 2, the most common classes of drugs were psychotherapeutic, gastrointestinal, and cardiovascular agents. In level 4, the most common classes were EENT, antineoplastic, and dermatological drugs, whereas in level 5, blood related agents, antineoplastic, and endocrinological classes of drugs were the most frequent.

DISCUSSIONS

The main findings of this study are that the prices are associated with the category and manufacturer type. On an average, EMs and local medicines are cheaper. Further, this study has provided price profiles of prescription medicines along with information regarding their distribution based on the price. The prices of drugs and their variations can be used to distinguish the medicines. The classes of medicines with high prices and high variations, high prices and low variations, and low prices and high variations can potentially increase the payers' expenditure on medicines.

Promotion of the Use of Essential and Local Medicines A policy on medicines in the country is to use EMs in government hospitals. The higher percentage of EMs (64.7%) that was observed in this hospital formulary indicates that this hospital has followed the above policy up to a certain level. The usage of drugs included in the EM category could result in increased usage of cheap and affordable medicines. With regard to economic issues, this policy is beneficial to individuals. An increase in the number of EMs included in the hospital formulary may help people avoid paying the high prices of non-EMs. Despite the lower percentage of non-EMs, their mean price is higher than that of EMs. Non-EMs in most classes-particularly, the musculoskeletal and anti-infective medicines (Table 2)-have demonstrated higher prices. Cost-effectiveness analysis is essential prior to decisions regarding the use of very high-priced medicines. Apart from the category of the medicines, the manufacturer type may strongly affect the prices. On an average, foreign medicines have been shown to have not only the higher prices but also the greater number (70.3%). Foreign medicines of

almost all classes, particularly those of blood-related, endocrinological, and antineoplastic classes, are available at very high prices (Table 3). Certain local medicines may not be available in hospitals; therefore, it becomes necessary to use foreign ones. However, if both types of medicines are available, the prescription of local ones should be strongly encouraged.

The Price Profile of Prescription Medicines
The price profile of prescription medicines is probably being reported for the first time in the country. It can provide information regarding the distribution of percentages, mean prices, and price variations of medicines (Table 4). In the lower priced levels 1 and 2, the number of local medicines (60.5%) is about three times greater than the foreign ones (19.1%). In contrast, for the higher price levels 4 and 5, the number of foreign medicines (43%) is approximately ten times greater than the local ones (3.9%). An increased presence of foreign medicines in the hospital formulary may lead to increased opportunities of these being prescribed, resulting in higher expenditure on medicines by people. Thus, one possible way to

avoid the higher priced medicines is to limit their numbers carefully. Classes of medicines exhibit different distributions; therefore, the intervention required to manage their prices should also be different. Additionally, the trends observed for CRVs are likely to increase from the price levels 1 to 4. This observation has suggested that higher priced medicines demonstrate a tendency toward higher price variations. Thus, the management of prices of medicines should involve the consideration of its variations.

Medicine Grouping by Prices and Price Variations
Medicines are often classified according to their pharmacological or therapeutic actions. However, this study has applied the observed means and CRVs to develop a framework in order to distinguish the medicines by their price. Ascending and separating the values of the means and the CRVs in Table 2 by the median could divide it into low or high levels to form a two by two table. The significantly different averages of the low and high levels of mean prices and CRVs are shown in Tables 5 and 6, respectively. Corresponding to the cell type, each medicine class was placed in a particular cell and in a certain position in

Table 5. General Medicine Frame Based on Categories: Mean Level by CRV Level

Mean*	CRV*			
	Low (143.1%)		High (251.3%)	
Low (92.4 Baht)	EM	6) Psychotherapeutic 7) Nutritional 9) Genito-urinary 14) Electrolytes	EM	1) Anti-infective 2) Cardiovascular 3) Gastrointestinal 4) CNS 8) Musculoskeletal 11) Dermatological
	Non-EM	11) Dermatological 14) Electrolytes	Non-EM	2) Cardiovascular 3) Gastrointestinal 4) CNS 6) Psychotherapeutic
High (1311.5 Baht)	EM	5) Respiratory 12) EENT 13) Antineoplastic 15) Blood related agents 16) Immunological	EM	10) Endocrinological
	Non-EM	5) Respiratory 7) Nutritional 12) EENT 16) Immunological	Non-EM	1) Anti-infective 8) Musculoskeletal 9) Genito-urinary 10) Endocrinological 13) Antineoplastic 15) Blood related agents

* Significantly different between low and high levels of mean and CRV.

Table 6.   Essential Medicine Frame Based on Manufacturer Type: Mean Level by CRV Level

Mean*		CRV*		
		Low (107.2%)		High (197.5%)
Low (26.3 Baht)	Local	5) Repiratory	Local	1) Anti-infective
		6) Psychotherapeutic		2) Cardiovascular
		7) Nutritional		3) Gastrointestinal
		8) Musculoskeletal		4) CNS
		9) Genito-urinary		10) Endocrinological
		11) Dermatological		8) Musculoskeletal
		14) Electrolytes		11) Dermatological
	Foreign	6) Psychotherapeutic	Foreign	2) Cardiovascular
				8) Musculoskeletal
High (613.5 Baht)	Local	12) EENT	Local	
		16) Immunological		
	Foreign	5) Respiratory	Foreign	1) Anti-infective
		7) Nutritional		3) Gastrointestinal
		11) Dermatological		4) CNS
		14) Electrolytes		9) Genito-urinary
		16) Immunological		10) Endocrinological
				12) EENT
				13) Antineoplastic
				15) Blood related agents

* Significantly different between low and high levels of mean and CRV.

the cell to obtain a general framework based on the category of the medicine (Table 5) as well as a framework for essential medicines based on the manufacturer type (Table 6). These frameworks are novel and useful because they can provide information regarding drug classes that should be considered to appropriately control the expenditure on medicines.

In general, when medicines meet standard levels of quality, payers are more likely to pay for the cheaper medicines than the expensive ones. With regard to price variations, it is likely that payers prefer lower variations to higher ones because it seems fair and acceptable to pay a similar price for a comparable medicine. Based on these ideas and the framework for medicines, the prices of medicines in cell 1 seem affordable and acceptable for payers because they possess both the positive characteristics-low prices and low variations. In contrast, the prices of the medicines in cell 4 are rather expensive and hardly acceptable or fair since these medicines exhibit both the negative properties-high prices and high variations. The prices of the medicines in this cell are probably the most difficult to pay for among the four cells. Although the prices of the medicines in cell 2 are cheap, its dispersions are large. In this case, there is a

chance that payers may pay a higher price for a cheaper medicine. If the payers knew the price ranges of the medicines in cell 2, they could choose the medicine according to the price. In fact, there is rarely any provision for supplying information regarding consumer prices to the public. However, the government as a payer can access such information and can selectively pay for lower priced medicines. The prices of the medicines in cell 3 are high, but its variations are low. In contrast to the medicines in cell 2, payers cannot avoid paying high prices and perhaps are unnecessary to select a high price from the high ones. As a result, payers face the risks of prices and price variations of prescription medicines from the least to the greatest in the following order: cell 2, cell 3, and cell 4.

On an average, EMs are cheaper than non-EMs. However, this information is sometimes insufficient to demonstrate other differences or similarities between the two categories. The general framework for medicines (Table 5) provides more information. In contrast to non-EMS, most EM classes have low prices and low variations. On the other hand, some EM classes exhibit high prices, high variations, or both. This observation indicates that some EMs can

contribute a price burden. This fact suggests that the category of medicines may not be the only factor of importance in distinguishing the medicines on the basis of their prices. It is probable that specific classes possess their own trends with regard to high prices and variations. The result that the number of foreign medicines was about 21 times greater than the local ones may be not sufficient to understand the differences observed. Table 6 provides the classes of medicines that affect payers differently. Almost all the classes of foreign medicines (15/16) pose the risks of high prices and high price variations. Only one class-the class of psychotherapeutic agents-does not pose these risks. To avoid such risks, it is necessary to use local medicines whenever possible.

Impact of Medicine Prices: Financial Considerations ''Who pays for health systems?'' is an important topic mentioned by the World Health Organization.[41] WHO has assessed the financial contributions of its members toward health expenditure and ranked them in order of fairness. In the report, Thailand was not ranked high, indicating insufficient management of health financing. Since the number of agents, organizations, processes, and schemes related to health financing are too many to discuss, this study has focused only on the expenditure on medicines. In the health scheme for government officials, the government as the payer will pay the amount appearing on the receipt issued by government hospitals. Due to the large variations in the prices of essential prescription medicines, the payer may pay different amounts of money for the same generic medicines, particularly in the case of those with price variations. For example, the prices per 25 mg tablet of diclofenac, an essential medicine, are 0.5 Baht and 7 Baht for two different manufacturers. Consequently, the expenditure on the latter will be 14 times higher than that on the former. Additionally, if the latter is prescribed often, an increase in the expenditure on medicines is inevitable. It is likely that hospitals may prescribe and dispense the higher priced medicines for patients, particularly those who are beneficiaries of the government, in order to obtain high revenues and profits, while patients show little concern regarding the prices, whether cheap or expensive, because the government will pay for them. This example demonstrates the possibility of the way unfair financial contributions and insufficient management can occur. In such a situation, the government acts as a passive pay-

er because of unconditional payment of bills. As an alternative, the government should shift from the role of a passive payer to that of an active payer in order to appropriately allocate the limited financial resources by some interventions such as setting conditions or price limits on the payment of hospital bills. For example, whether the expensive medicines have a therapeutic advantage over the cheaper alternatives should be verified.

Dimension to Consider Price Variations Among all the classes of medicines, the overall price variations in a single dimension (Table 1) are likely to be higher than those observed across multiple dimensions (Tables 2 and 3). For example, the overall price variation in the anti-infective class of drugs is about 404% (Table 1). However, when determining the variations according to the categories of medicines and the types of manufacturers, the values are observed to be lower, i.e., 190.6% and 206.8% (Table 2), and 235.5% and 320% (Table 3). In particular, the smaller variations are about 26.5%—94.7% in case of the price range (Table 4). This finding suggests that the extent of the variation is probably related to the number and type of dimensions. Using multiple dimensions will probably result in smaller variations. It is thus necessary to identify the dimensions that are used to consider the price variations.

Limitations This study could examine the price variations of medicines only for different categories, manufacturer types, dosage forms, and classes. An investigation of individual generic medicines may lead to a greater understanding of price characteristics; however, this could not be carried out since some medicines had only one or two price variations.

Suggestions The government as both a regulatory agent and payer should recognize the influence of the prices and price variations of prescription medicines because it can affect the spending ability of people, health funds, and the budget of the country. High prices and variations of medicines can result not only in unfair inequitable payments but also be a source of financial burden. The findings of this study have given an overall idea of medicines and their prices in order to understand the actual context for better management. The suggestions from this study are as follows. The availability of the opportunities to prescribe medicines is an important factor. Thus, careful consideration is necessary for the selection of medicines for inclusion in the hospital formulary.

Whenever possible, EMs and local medicines should be included in the formulary. Further, the use of such medicines should be strongly encouraged. Sufficient evidence in the form of a comparison is necessary when similar therapeutic drugs with different prices are included. Drug procurement is another step that could reduce prices and price variations of medicines. Hospitals should conduct bidding or other competitive methods for buying drugs, particularly those with very high prices and price variations. Additionally, the government should encourage all health schemes to use EMs.

CONCLUSIONS

This study has provided empirical findings for prices and price variations of prescription medicines listed in the hospital formulary of a government hospital. The prices are associated with medicine categories and manufacturer types. Essential and local medicines are cheaper. The medicines with different risks of high prices and high variations to the payers could be distinguished using the prices and price variations. The high prices and high variations make it challenging for the payers, particularly the government-to decide efficient payments for similar therapeutic medicines with very different prices. Interventions are necessary to reduce the prices and their variations.

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