

The Investigation of Pharmaceutical Price Discrimination Among Public Hospitals in Thailand: A Case Study of Agent Acting on the Renin-Angiotensin System (ACE) Inhibitors

การตรวจหาและวัดขนาดการกระจายราคายาที่ไม่อาจยอมรับได้ระหว่างโรงพยาบาลรัฐบาลในประเทศไทย : กรณีศึกษายาซึ่งออกฤทธิ์ต่อระบบเอนไซม์ Renin-Angiotensin (ACE) Inhibitors

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This study was aimed to identify and quantify the magnitude of pharmaceutical price discrimination among public hospitals using agent acting on the renin-angiotensin system (ACE) inhibitors as a case study. Drug and Medical Supply Information Center provided 2003 data of purchased quantities and prices of the selected drugs. The study employed inequality indices together with data transformation and comparative condition arrangement in order to ensure only unacceptable price dispersion (price discrimination).

Results showed that more than half of ACE inhibitor product entities were found price discrimination among hospitals in primary and secondary hospital markets, while price discrimination between markets was not as much serious as discrimination within the markets. In short, the main concern of price discrimination for this group of drug was the price discrimination among hospitals within the same level of care; primary and secondary hospitals.

This study showed an evidence of the existence of pharmaceutical price discrimination among public hospitals. Employing a measure which is more sensitive and has higher separating power than the current one to monitor the situation of pharmaceutical price dispersion is recommended.

Keywords : pharmaceutical price discrimination, agent acting on the renin-angiotensin system (ACE) inhibitors, public hospitals

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งานวิจัยนี้ มีวัตถุประสงค์เพื่อบ่งชี้และวัดขนาดการกระจายราคาขายที่ไม่อาจยอมรับได้ระหว่างโรงพยาบาลรัฐในสังกัดสำนักงานปลัดกระทรวงสาธารณสุขโดยเลือกเอากลุ่มยาที่ออกฤทธิ์ยับยั้งระบบเอนไซม์ renin-angiotensin (ACE) เป็นกรณีศึกษา

ทำการศึกษาโดยนำเอาดัชนีวัดความไม่เท่ากัน (inequality indices) มาปรับใช้ ประกอบกับการปรับเปลี่ยนข้อมูลและการสร้างเงื่อนไขในการเปรียบเทียบ เพื่อตัดการกระจายราคาซึ่งยอมรับได้ออกไป โดยใช้ข้อมูลการจัดซื้อยากลุ่มดังกล่าวของโรงพยาบาลในสังกัดสำนักงานปลัดกระทรวงสาธารณสุข ปีพ.ศ. 2546 จากศูนย์ข้อมูลข่าวสารด้านเวชภัณฑ์

ผลการศึกษา พบว่า ยาตามชื่อการค้ามากกว่าครึ่งหนึ่ง มีขนาดการกระจายราคาขายในระดับที่ไม่อาจยอมรับได้ภายในตลาดโรงพยาบาลชุมชนและโรงพยาบาลทั่วไป ในขณะที่ความแตกต่างของราคาขายระหว่างตลาด ยังอยู่ในระดับที่ยอมรับได้ สำหรับยากลุ่มนี้ เมื่อเทียบกันแล้ว การกระจายราคาขายภายในตลาดเดียวกัน เป็นเรื่องที่ต้องให้ความสนใจก่อน และหาวิธีการในการลดขนาดลง

การวิจัยนี้ เป็นหลักฐานหนึ่งที่ยืนยันว่า มีการกระจายราคาขายชนิดและระดับที่ไม่อาจยอมรับได้ จึงควรมีเครื่องมือที่มีความไวมากกว่าและอำนาจในการจำแนกสูงกว่ามาตรการหรือเครื่องมือที่ใช้อยู่ในปัจจุบัน เพื่อการติดตามเฝ้าระวังสถานการณ์การกระจายราคาขาย

คำสำคัญ : การกระจายราคาขายที่ไม่อาจยอมรับได้ กลุ่มยาที่ออกฤทธิ์ยับยั้งระบบเอนไซม์ renin-angiotensin
โรงพยาบาล

Introduction

Public hospitals have been a main channel providing health care services for Thai people. Pharmaceutical products acquisition in these hospitals, with their limited government budgets, has to conform to National Drug List policy. For each generic drug, hospitals usually carry only 1-2 brand based on their purchasing criteria on product quality and price. All of these purchasing records have been requested by and submitted to Drug and Medical Supply Information Center (DMSIC), under the Ministry of Public Health (MOPH). These procurement

data are then compiled to determine a reference price for each generic drug. Hospitals regard the reference price as the maximum price in their drug purchasing. However, the price variation below this reference level is still extensively presented as evidence shown in Table 1.

The compilation of a particular brand of enalapril 20 milligram based on 2002 data of purchased prices and quantities of pharmaceutical products bought through group purchasing downloaded from <http://www.dmsic.moph.go.th> has confirmed evidence of price dispersion.

Table 1. Quantity and purchased price by group purchasing (enalapril 20 milligram package size 100 tablets of a particular manufacturer), year 2002

Province	Quantity (Package)	Purchased Price (Baht)
NE-2	394	110.00
E-1	456	57.00
NE-1	590	78.00
S-1	825	69.00
N-1	849	67.00
C-3	884	86.00
S-3	1,987	128.00
C-1	2,944	57.00
S-2	4,878	70.00
C-2	4,910	71.00

Note: S = Southern region, NE = North-east region, C = Central region, N = Northern region. Number represents each province within the region.

Data summary illustrated in Table 1 indicated that drug prices of the same product dispersed across provinces were related to neither quantities bought nor transportation cost. Although the existence of price dispersion among pharmaceutical products is generally recognized, how much and why these differences occur has not been thoroughly studied. This phenomenon calls for more in-depth exploration and explanation.

There are 2 main concepts brought into this study, price dispersion and inequality measurement. Theoretically, price dispersion could stem from two sources: cost differences or discrimination.¹ Dispersion due to cost differences is usually reflected by product competitive potential in the market whereas price

discrimination, or discriminating-induced price dispersion, is a pricing strategy aiming at profit maximization by charging different prices of the same product for different units or buyers with no relation to cost differences.² This evidence, when detected, signals intensive investigation and in most cases is urged for control.

Two inequality indices, Gini coefficient and Thiel Index, which have been applied to quantify price variation^{1,3} were selected to serve the purposes of this study. These inequality measurements are widely used in measuring social welfare, particularly, income distribution. The indices are intended to measure whether incomes per head, or price variation in this study, are equitable among the studied population. The bigger indices reflect the larger extent of inequality or variation.

Objective

This study was aimed at indentifying and quantifying the magnitude of pharmaceutical price discrimination among public hospitals.

Methods

1. Data Source. DMSIC was the prime source of data in this study. It is a MOPH bureau responsible for a national database of quantities and prices of drugs purchased by all public hospitals under the administration of MOPH. The study had received a permission to use 2003 data of purchased quantities and prices of the selected drugs.

2. Variables and Measurement

2.1 Market. Since the size of hospital as well as the complexity of health care services provided more or less classify hospitals into primary, secondary, and tertiary care. The same characteristics would at the same time imply their purchasing powers, in turn pharmaceutical prices. This study, thus, confined the market within the same level of care. Hospitals with different levels of care then belonged to different markets.

2.2 First Degree Price Discrimination. The first degree price discrimination was operationalized in this study as price discrimination of a particular product among hospitals under the same market or level of care.

2.3 Third Degree Price Discrimination. The third degree price discrimination was defined as price discrimination across the comparative markets, i.e. primary hospital, secondary hospital, and tertiary hospital markets. Since there were only 3 markets, the third degree price discrimination of a product could be estimated only when it was purchased by all 3 levels of care.

Gini-coefficient and Theil Index were chosen to assess the extent of both the first and the third degree of price discrimination. The former is the famous and widely used inequality measurement in various settings,⁴ but sensitive to the middle part of the data distribution. The latter, Theil Index, was additionally employed due to its sensitivity to the extreme value of the distribution⁵. Gini

coefficient ranges from 0 to 1; the closer the index to 1 the bigger the magnitude of inequality. Theil index ranges from 0 to α ; the bigger number means higher inequality. This study used the value of 0.500 of both indicators as the cut-off point to caution unfavorable price variation.⁶

Decomposition analysis had additionally been conducted to get the whole picture of price discrimination and at the same time to weight the concern between the first and the third degree price discrimination. From the relationship, "*inequality between markets (I_b) + inequality within market (I_w) = total inequality (I)*", percent contribution of each type of price discrimination to overall discrimination could be decomposed using level of care as a partition variable. The result would indicate that "x % of total discrimination was contributed by the third degree, and (100-x) % was accounted for by the first degree". Higher percent contribution within the market would raise the concern that the particular product selectively discriminated within the markets and vice versa if higher percent contribution between the markets was found.

3. Data Analysis

3.1 Data Preparation and Processing.

The inequality measurements selected for the study have embedded the social welfare concepts, thus go well with a group of corresponding variables, e.g. population income, of which higher value conveys superior social position. The variable of this study, pharmaceutical

price was not included, therefore, required some transformation into the new concept, Miscellaneous Acquisition Capability (MAC) Index, representing power of price negotiation beyond purchased volume, which better conforms to inequality measurement implication.

Beside the purchased volume, MAC Index quantifies another source of the hospital's power of negotiating the price. It reflects a hospital's efforts relative to other equivalent hospitals: the higher the MAC, the greater the effort. Buyers who can negotiate a lower price by a smaller quantity carry a higher MAC. All acquisition prices were transformed into MAC. Inequality then measures MAC variation as evidence of price variation among hospitals.

3.2 Inclusion Criteria. A hospital purchases a product by either self purchasing or group purchasing method which was a source of price differentiation. In order to control price differentiation caused by different purchasing methods, only self purchasing records were selected for the analysis.

3.3 Exclusion Criteria. An incomplete purchasing report of a particular product was eliminated. Any drug item with doubted small purchasing size than generally found in other hospitals, for instant, only one purchasing record with unreasonably small volume, was excluded from the analysis.

Within each hospital market or level of care, the product bought by less than 4 buyers was also excluded. Using less than 4 points of data to quantify the extent of price discrimi-

nation within the market by inequality index was less reliable.

3.4 Analysis Context. Because claiming for discrimination needed to ensure cost indifference, the analysis had to be done separately brand by brand in each market. In quantifying price dispersion among buyers of the identical brand, production cost indifference was the prerequisite and needed to be established. The marketing cost of the same brand was assumed indifference among buyers in the same level of care.

Results and Discussion

The situation of price discrimination of agent acting on the renin-angiotensin system (ACE) inhibitors was selected for this study on the basis of their considerable contributions to hospital budget.

1. Group Overview. The ACE inhibitor group included 8 generic names in the purchasing database with 2 different strengths for each of 6 generic drugs and one strength for the remaining 2 drugs. Hence, 14 items were included in the study. Each item was supplied by a number of manufacturers representing by different product brands. When taking into account all different brands, there were 39 available entities. Of these, enalapril 5 milligram was the generic drug with the most available entities of 10 brands. About half of these generic entities with no competitor included cilazapril, quinapril, fosinopril, perindopril, and ramipril 2.5 milligram.

Only some brands of each item meeting the inclusion and exclusion criteria could be included for analysis. The analyzable entity needed at least 4 entries of buyers under the same level of hospitals. Overall, there were only 15 entities or less than 50 percent analyzable with 4 entities of enalapril 5 and 20 milligram and the rests were evenly distributed of 1 entity as detailed in Table 2.

2. Types and The Extent of Price Discrimination. Price discrimination situation of each applicable entity was structured into two types: first and third degree price discrimination. For the entities that presented both the first and the third degree price discrimination, the decomposition contributions to the overall inequality from each type of discrimination, across markets and within the same markets, were also be included.

The whole picture of price discrimination in this pharmacological group was summarized in Table 3. Majority of the ACEIs group were detected first degree price discrimination in at least one of their analyzable markets. More than half of analyzable brands behaved first degree price discrimination among primary and secondary hospitals, while there were about 40 percent of brands detected in the tertiary hospital market. There was no serious extent of third degree price discrimination detected from 2 applicable entities.

It was not feasible for every drug to have applicable entities consistent with the exclusion criteria in every market, since some entities might not be available in some markets or mainly marketed only in their profitable markets. Some items of drug were restricted

Table 2. Analysis size of ACE inhibitor products

Items	Generic Name	Available Entities	Applicable Entities
1	Enalapril 5 mg	10	4
2	Enalapril 20 mg	8	4
3	Captopril 25 mg	5	1
4	Ramipril 5 mg	2	1
5	Ramipril 2.5 mg	1	1
6	Fosinopril 10 mg	1	1
7	Quinapril 5 mg	1	1
8	Quinapril 20 mg	1	1
9	Perindopril 4 mg	1	1
10	Perindopril 2 mg	1	0
11	Lisinopril 5 mg	3	0
12	Lisinopril 10 mg	2	0
13	Captopril 12.5 mg	2	0
14	Cilazapril 2.5 mg	1	0
Total		39	15

Note: mg = milligram

for the higher level of care such as some new advanced drugs which were not available for primary hospitals. If no applicable entity was found in only one market out of three, the third degree price discrimination was consequently undetermined. There were thus a number of sign “n/a” in every table which reflected the nature of pharmaceutical market behavior according to the regulations and/or business reasons. Most entities of drug were not usually applicable for analysis in every level of care. This meant that the hospital carried the same generic drug from different brands.

As shown in Table 3, most of applicable entities other than enalapril 5 and 20 milligram were unable to analyze in the primary hospital market. The third degree price discrimination was consequently undetermined since it measured the price differentiation among markets thus

required data entries from all levels of hospital.

Among those with one entity except ramipril 5 milligram and captopril 25 milligram were single source drug or available only one brand in the market. Even though ramipril 5 milligram and captopril 25 milligram have competitors in the market, the brands analyzed in this study still revealed moderate degree of first degree price discrimination (Table 4). Gini and Theil Indices showed conflicting results for rami-pril 5 milligram due to the borderline value of both indices but the concern on price variation should not be ignored. Fosinopril 10 milligram and perindopril 4 milligram were the only 2 single source drugs that did not illustrate price discrimination in their analyzable markets, whereas the rest showed significant first degree price discrimination in the secondary hospital market.

Table 3. Summary of ACE inhibitors price discrimination

Items	First Degree PD			Third Degree PD
	Primary	Secondary	Tertiary	
Enalapril 5 mg	2/4	0/1	0/1	0/1
Enalapril 20 mg	2/3	1/2	1/1	0/1
Perindopril 4 mg ^a	n/a	0/1	0/1	n/a
Quinapril 5 mg ^a	n/a	1/1	n/a	n/a
Quinapril 20 mg ^a	n/a	1/1	0/1	n/a
Ramipril 2.5 mg ^a	n/a	1/1	0/1	n/a
Ramipril 5 mg	n/a	n/a	1/1	n/a
Captopril 25 mg	n/a	n/a	1/1	n/a
Fosinopril 10 mg ^a	n/a	n/a	0/1	n/a
Total (detected/applicable) ^b	4/7	4/7	3/8	0/2
Percentage of items with PD	57.14	57.14	37.50	0.00

Note: PD = price discrimination, mg = milligram. n/a= data were not enough for calculation based on exclusion criteria. a = single source drug with only one brand available in the market, b = out of the applicable entities, there were a number of detected the crucial magnitude of first degree price discrimination among primary hospitals, e.g. out of 4 applicable entities of enalapril 5 milligram there were 2 detected for first degree price discrimination.

Table 4. Price discrimination of ACEIs with one brand

Product	Index	1 st Degree PD			Third Degree PD	%Contribution of 3 rd Degree PD
		Primary	Secondary	Tertiary		
Fosinopril 10 mg	G	n/a	n/a	0.376	n/a	n/a
	T	n/a	n/a	0.310	n/a	n/a
Perindopril 4 mg	G	n/a	0.471	0.425	n/a	n/a
	T	n/a	0.402	0.333	n/a	n/a
Ramipril 5 mg	G	n/a	n/a	0.468	n/a	n/a
	T	n/a	n/a	^a 0.546	n/a	n/a
Captopril 25 mg	G	n/a	n/a	^a 0.600	n/a	n/a
	T	n/a	n/a	^a 0.698	n/a	n/a
Quinapril 20 mg	G	n/a	^a 0.620	0.167	n/a	n/a
	T	n/a	^a 0.792	0.182	n/a	n/a
Quinapril 5 mg	G	n/a	^a 0.748	n/a	n/a	n/a
	T	n/a	^a 1.364	n/a	n/a	n/a
Ramipril 2.5 mg	G	n/a	^a 0.750	0.464	n/a	n/a
	T	n/a	^a 1.386	0.446	n/a	n/a

Note: mg = milligram, G = Gini Index, T = Theil Index, PD = price discrimination, n/a = not applicable. a = critical price discrimination, %contribution = percentage of third degree price discrimination contributed to overall inequality.

Enalapril 20 milligram (Table 5) and 5 milligram (Table 6) were cases that were rich of data entries. At least one entity of both items contained enough entries for data analysis

in all market levels. The third degree price discrimination was then quantified for the entities containing data of every market as illustrated in Table 5 and 6.

Table 5. Extent of price discrimination (enalapril 20 milligram)

ACEI-Enalapril Maleate 20 Milligram						
Product	Index	First Degree PD			Third Degree PD	%Contribution of 3 rd Degree PD
		Primary	Secondary	Tertiary		
Brand A	G	^a 0.753	0.478	^a 0.523	0.333	37.69
	T	^a 1.344	0.433	^a 0.548	0.405	41.57
Brand B	G	0.426	n/a	n/a	n/a	n/a
	T	0.394	n/a	n/a	n/a	n/a
Brand C	G	n/a	0.459	n/a	n/a	n/a
	T	n/a	^a 0.518	n/a	n/a	n/a
Brand D	G	^a 0.598	n/a	n/a	n/a	n/a
	T	^a 0.895	n/a	n/a	n/a	n/a

Note: PD = price discrimination, a = critical price discrimination, brand A, B...ranked by the number of purchasers from many to less, %contribution = percentage of third degree price discrimination contributed to overall inequality, G = Gini Index, T= Theil Index, n/a = not applicable.

Table 6. Extent of price discrimination (enalapril 5 milligram)

ACEI-Enalapril Maleate 5 Milligram						
Product	Index	First Degree PD			Third Degree PD	%Contribution of 3 rd Degree PD
		Primary	Secondary	Tertiary		
Brand A	G	^a 0.620	0.355	0.402	0.353	38.62
	T	^a 0.771	0.260	0.367	0.407	38.18
Brand B	G	0.280	n/a	n/a	n/a	n/a
	T	0.263	n/a	n/a	n/a	n/a
Brand C	G	0.375	n/a	n/a	n/a	n/a
	T	0.470	n/a	n/a	n/a	n/a
Brand D	G	^a 0.570	n/a	n/a	n/a	n/a
	T	^a 0.754	n/a	n/a	n/a	n/a

Note: PD = price discrimination. a = critical price discrimination. Brand A, B...ranked by the number of purchasers from many to less, %contribution = percentage of third degree price discrimination contributed to overall inequality, G = Gini index, T = Theil index, n/a = not applicable.

There were 4 analyzable brands of enalapril 20 milligram (Table 5). Among primary hospitals, the market leader or the popular brand behaved first degree price discrimination with Gini Index of 0.753 and Theil Index of 1.344 which were as high as brand D (0.598 and 0.895, respectively), while brand B's inequality magnitude (0.426, 0.394) was not strong enough to consider to be attentive. In the secondary hospital market, G and T of two analyzable brands, the popular brand A (0.478, 0.433) and brand C (0.459, 0.518), were fairly unattractive to be concerned. In the tertiary market, the popular brand A was the only one entity that could be analyzed. The magnitude of G and T of brand A (0.523, 0.548) also signalled the existence of first degree price discrimination.

The popular brand of enalapril 20 milligram had enough entries for analysis within every market and across markets (Table 5). The third degree price discrimination analysis

indicated the magnitude of G (0.333) and T (0.405) which was less concern than its first degree price discrimination. Decomposition analysis detected approximately 40 percent of first degree and 60 percent of third degree price discrimination. The result of the percent contribution reflected that the popular brand did not price much different among markets, it could instead discriminate its price with a large extent among buyers in the same market.

From Table 5 and 6, the situation of enalapril 5 and 20 milligram looked similarly as displayed above. All brands were analyzable in the primary hospital market. The first degree price discrimination was significantly detected for two entities, the popular brand A (0.620, 0.771) and brand E (0.570, 0.754). The popular brand A was the only entities of which the third degree price discrimination could be determined and small magnitude of G (0.353) and T (0.407) were found. The results implied

marginal extents of the third degree price differentiation which was thus not prioritized to be concerned, as its contribution was only 40 percent comparing to 60 percent of the first degree contribution.

Although these data pointed toward some degree of price discrimination, they could tell the story of one single drug only. There is no implication on how the competition is between different manufacturers of the same generic drug. It means that price dispersion among a particular generic drug in a market grounds not only on first degree price discrimination of each brands but also on some degrees of price dispersion across brands. Table 7 demonstrated price dispersion both within and between brands of the same generic. Since enalapril 5 and 20 milligram were only 2 generic drugs that contained different brands enough to be analyzed for primary hospital market, they were further examined.

Enalapril 5 milligram price dispersion was contributed more to first degree price

discrimination within the same brand (approximately 60 percent) than price dispersion across brands (approximately 40 percent). A low Gini coefficient between brands (0.393) reflected that most hospitals selected cheaper brands for enalapril 5 milligram. In other words, the brands with larger market share tended to offer cheaper prices than those with smaller market share. It also implied high intensity of price competition in the market. The competitors priced their products not quite different to each other. They instead differentiated prices among their buyers. The main concern for enalapril 5 milligram was thus the first degree price discrimination within the same brand.

On the contrary, enalapril 20 milligram illustrated high price inequality both within and between brands with the value of G and T higher than critical value, 0.500. Percent contribution, here, alone was not enough to signal action to be taken. The magnitude of both within and between brands needed to be at the same time monitored. The differences of product's quality and competition among brands of the same generic name of drug have to be ensured and monitored.

Table 7. Decomposition of enalapril 5 and 20 milligram partitioned by brand

Brand Partition	Enalapril 5 mg		Enalapril 20 mg	
	Index	%Variation	Index	%Variation
G-Within	0.538	57.79	0.696	53.18
G-Between	0.393	42.21	0.613	46.82
T-Within	0.662	63.39	1.177	59.02
T-Between	0.382	36.61	0.817	40.98

Note: mg = milligram, G-within and T-within referred to the dispersion within the same brand, G-between and T-between referred to the dispersion across brands.

Conclusion

This study showed an evidence of the existence of pharmaceutical price discrimination among public hospitals. More than a half of ACE inhibitors product entities (57.40 percent) were found the first degree price discrimination among hospitals in primary

and secondary hospital markets, while price discrimination between markets (the third degree price discrimination) was not as much serious as discrimination within the markets. In short, the main concern of price discrimination for this group of drug is the first degree price discrimination: price discrimination among hospitals within the same level, i.e. primary, secondary hospitals.

The extent of price discrimination reflected by inequality indices using MAC ensured only problematic type that was not included price differentiation from neither cost difference nor volume discounting. Not only that, inequality indices concerning social welfare implication, when higher than critical value was detected, also reflect that most purchases were dealt at too high price. A whole society

was worse off from this particular product.

This study recommended the Ministry of Public Health to employ a measure which is sensitive and has high separating power to monitor the situation of pharmaceutical price dispersion. Building up information loop between data centre and hospitals to provide feedback directly that could decisively suggest price for a hospital based on its purchasing volume instead to provide only single reference price for all buyers.

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