

Development of Relative Value Units for Unit Cost analysis of Medical Services in Vietnam

Trung Quang Vo^{1,2}, Usa Chaikledkaew¹, Minh Van Hoang³,
Huong Thuy Nguyen⁴, Arthorn Riewpaiboon¹

¹Division of Social and Administrative Pharmacy, Department of Pharmacy, Faculty of Pharmacy, Mahidol University, Bangkok 10400, Thailand, ²Department of Pharmacy Administration, Faculty of Pharmacy, University of Medicine and Pharmacy, Ho Chi Minh City 700000, Vietnam, ³Hanoi School of Public Health, Hanoi 100000, Vietnam, ⁴Hanoi Representative Office, Medisch Comité Nederland-Vietnam (MCVN), Hanoi 100000, Vietnam

Abstract

Context: The unit costs of hospital services are essential for hospital and public health management. There are alternative methods on the costing with different results. The relative value unit (RVU) method, which is also known as the “weight procedure method”, is a method universally used in many countries due to its applicability. **Aims:** This study is aimed to develop RVU of hospital medical services for unit cost calculation in Vietnam. **Settings and Design:** Development of the RVU is designed by objective data approach where the RVUs were estimated based on results of unit cost analysis employing micro-costing from two provincial hospitals. **Materials and Methods:** From 776 services of Ha Nam Hospitals and 2064 services of Thu Duc Hospital, a reference list of 1,464 medical services was developed. **Results:** The standard unit cost used for health economic evaluation in Vietnam can possibly be developed thanks to the RVUs from this study. **Conclusions:** Due to the constant improvement of the health service’s framework, the RVUs should be developed and updated continuously. Moreover, the RVUs of health centers and the other types of hospital should be studied further to complete for health economic evaluation.

Key words: Hospital, medical service, relative value units, unit cost, Vietnam

INTRODUCTION

Economics is a science of using limited resources in producing goods or services with efficiency. In health context, the term “efficiency,” a much broader concept, is defined as “the relationship between the level of resources invested in the healthcare system and the volume of services, or what amounts to the same thing, improvements in health achieved.”^[1] In the efficiency management, information of unit cost is pivotal. In health care, to evaluate efficiency, unit costs of hospital medical services are basically compared. In addition, they are used in the cost of illness study and economic evaluation of health interventions. To estimate unit cost, we require accuracy and feasibility. In public health management, standard or reference unit cost is usually developed. Recently, standard unit costs

have been introduced into economic evaluation analyses to measure the potential differences in resource use resulting from the selection of one intervention over another,^[2] for instance, analyze cost effectiveness of new drugs to the list of national essential drugs, new vaccines for the national immunization programs, new medical procedures in the package of the health insurance benefits. Standard costs are

Address for correspondence:

Dr. Arthorn Riewpaiboon, Department of Pharmacy, Division of Social and Administrative Pharmacy, Faculty of Pharmacy, Mahidol University, Thailand, Address: 447, Sri Ayutthaya Road, Bangkok 10400, Thailand. Phone: 662-644-8677-90 ext. 5745; Fax: +662-644-8694. E-mail: arthorn.rie@mahidol.ac.th

Received: 20-07-2017

Revised: 28-02-2018

Accepted: 02-03-2018

deemed to be desirable in evaluation studies to ensure that the study results will not vary with the costing methods used.

Reference or standard unit cost of medical services has been developed in various countries including Australia,^[3] Canada,^[4] The Netherlands,^[5,6] The United Kingdom,^[7] Philippines,^[8] Thailand,^[9] and India.^[10] In general, unit cost analysis of medical services is based on standard costing methodology. It is composed of six steps, i.e. (1) Study design and planning, (2) organization analysis and cost center classification, (3) direct cost of cost centers determination, (4) indirect cost determination; (5) full cost determination, and (6) unit cost of hospital services calculation.

Vietnam as well as many other countries have endeavored to decrease such hurdle by developing a standard or reference list of unit cost of health-care service. Currently, these countries have made attempt to create a list of standard unit costs of medical services. The purpose of this study is to develop reference relative value unit (RVU) of hospital medical services for using in the unit cost analysis of hospitals pursuing development of standard unit cost in the future.

SUBJECTS AND METHODS

Study design

RVUs can be developed using a ranking method or an objective data method.^[11,12] The ranking method employs a subjective technique of comparing the amount of resources used, commencing from the least amount, and then estimating the subsequent amounts in multiples of the first one. By comparing each service to the first service, this method is arranged in order of various relative consumption of resources. On the other hand, magnitude estimation can be defined with a survey-based methodology through measuring subjective perceptions and judgments by the rate of consumption in diversified services. The objective data method is to determine the RVU from database that is based on the real resource consumption: Either on consumption of a major selected resource such as fee, price, cost, time required, or material use to perform each service or on costing data came from other studies. In case of assigning to service, the unit cost is divided by a number of currency resulting RVU. In this study, an objective data method was applied.

A retrospective descriptive study was conducted, of which the data and the cost of all the health-care services were collected using the methodology adopt from Vo *et al.* study.^[13] The RVU list of medical services was calculated at two public provincial hospitals using micro-costing method which was chosen for its qualified functions in measuring costs for health-economic evaluation during the current context of Vietnam.^[13]

Some of unit cost analysis of hospital medical services

A list of health-care services in Ha Nam Hospital and Thu Duc Hospital was established with the reference to these places' database, which showed that there were, respectively, 767 and 2064 health-care services.

Scope of the study

To receive all unit costs of hospital services for RVU's development, the unit cost analysis of the health-care service was explored at two of the largest hospitals, which are Ha Nam General Hospital in Northern Vietnam and Thu Duc Hospital in Southern Vietnam, to represent for Vietnam health-care facilities. The study was conducted in the fiscal year 2014 and with Vietnam's official units of currency (VND) being selected to represent the value of the costs.

To calculate the unit costs of hospital medical services, the standard costing approach was brought into usage.^[14] The costs were presented by basing on the values back in 2014. The selected studied sites were two Vietnamese provincial hospitals (General Hospital of Ha Nam province/Ha Nam Hospital - North of Vietnam and Thu Duc General Hospital/Thu Duc hospital - South of Vietnam), in which there were approximately 700 beds for patients. Only these hospitals met the specific criteria of efficiency, which includes efficiency performance of hospital with its percentage being at least 80%. The occupancy rate of Ha Nam Hospital is believed to be overloaded with the percentage of 123% in 2012 compared to that of Thu Duc Hospital (86%) in 2014.

The model proposed for the implementation of this study in all of health-care service can be seen in Figure 1.

RVU development is composed of three steps, i.e., Step one: Development of a list of hospital medical services. A list of hospital medical services was developed from medical services of two provincial hospitals. Step two: Determining average cost of all services in the list tests available in two hospitals and average unit cost per health-care services in the list from Ha Nam and Thu Duc Hospital. Step three:

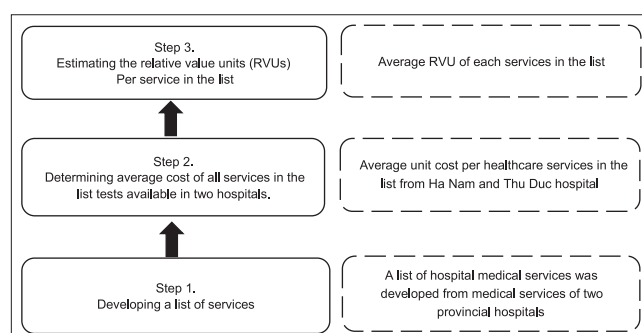


Figure 1: The process of developing the relative value unit in Vietnam

Estimating the RVUs per service in the list and average RVU of each services in the list.^[9]

Data analysis and presentation

Calculation of cost per unit of medical service in the six steps is conducted by alternative methods, i.e., the average method, the ratio of cost to charge, the RVU, and the micro-costing method.^[12] The micro-costing method is more accurate than the others. Regarding its convenience and relatively accuracy, the RVU is more widely favoured in many countries such as Thailand^[13] and India,^[15] and RVU is applied for unit cost analysis in hospitals selected as representative of the country. Then, reference costs are derived from repeated measurements of costs within a representative facility.

Application of RVU method for unit cost analysis starts with the development of standard or reference RVU for each medical service. Then, the standard or reference RVU is used in unit cost analysis of each hospital. In the process of unit cost analysis, the total RVUs used by the hospital are calculated by multiplying standard RVU of each service by the number of service produced in the study year. Total RVUs of all medical services are summed to be total hospital RVUs. After that, the cost per RVU is calculated by dividing the total cost of the hospital by the total RVUs of the hospital. Finally, the cost per RVU is multiplied by the number of standard RVU for each service to obtain a unit cost.

Data management and analysis are presented using the computer program Microsoft Excel 2013. The result is presented in the RVUs of medical service which consist of service name, unit, code, and relative value.

Ethical consideration

The research process was approved by the Research Ethics Council at Ha Nam General Hospital, Vietnam (IORG0007245), and Thu Duc Hospital, Vietnam (IORG0007136). Data are confidential and are only available for research; some sensitive information will be encrypted.

RESULTS

The results are presented regarding three steps of the RVU development as the followings:

To develop a list of hospital medical services

After all the services with similar names practiced in different departments collected and required calculations were done, the results displayed the total number of health-care services in both Ha Nam Hospital and Thu Duc Hospital which were 601 and 1,063 medical services, respectively. Then, 1464 medical services which were 200 services by coincidence

in two hospitals, and 863 distinctive services for Thu Duc Hospital were developed for a list of hospital medical services [Figure 2].

The average unit cost of medical services practiced in different departments of Ha Nam and Thu Duc Hospital was calculated using micro-costing methods and later is deligated (mentioned in some of unit cost analysis of hospital medical services part). It can be recognized that the services conducted in different departments have different unit cost and quantity. The average unit cost of one service was calculated by the average of unit costs of every department which supplied that service. Successively, a list of health-care services for Ha Nam Hospital was established with the exclusion of the services bearing the same name practiced in different departments. In this study, the value of the average unit cost was computed by practicing the based-on-weight method.^[16,17]

Determining average cost of the services in the list including 2 steps

- Making average of the same service produce by different departments.
- Making average of the same service produce by different hospital.

As can be seen from Table 1, measurement intraocular pressure and gastric lavage service occupied in two cost centers. It is measurement intraocular pressure service taking in two cost centers of A8 and A23 while gastric lavage service occupying in cost centers of A6 and A9. It is noticed that average weight cost (Y) of each service above was unequal. Value Y of measurement intraocular pressure service was 7,265,262 VND, whereas that value of gastric lavage service was only 141,335 VND.

Suction phlegm service and bladder wash service (excluding chemical service) were two services occupying in five cost centers. Suction phlegm service was carried out in A9, A10, A13, A16, and A17 cost center while bladder wash service (excluding chemical service) was occupied in cost centers of A6, A9, A18, A19, and A22. The unit cost of suction phlegm service can be ranged from 320,721 VND (A9 cost center) to 2,546,696 VND (A17 cost center), and the average weight cost was 149,015 VND. On the contrary, the average weight cost of bladder wash service (excluding chemical service) was much higher with 5,380,087 VND ranged from the lowest at 1,003,314 VND (A6) to the highest at 11,790,442 VND (A19).

The case of lumbar puncture service, emergency intubation service, aspirate pleural service, and bladder wash service can be classified into services occupying in six cost centers. Among cost centers related lumbar puncture service, A11 cost center had the lowest unit cost (752,472 VND), whereas A9

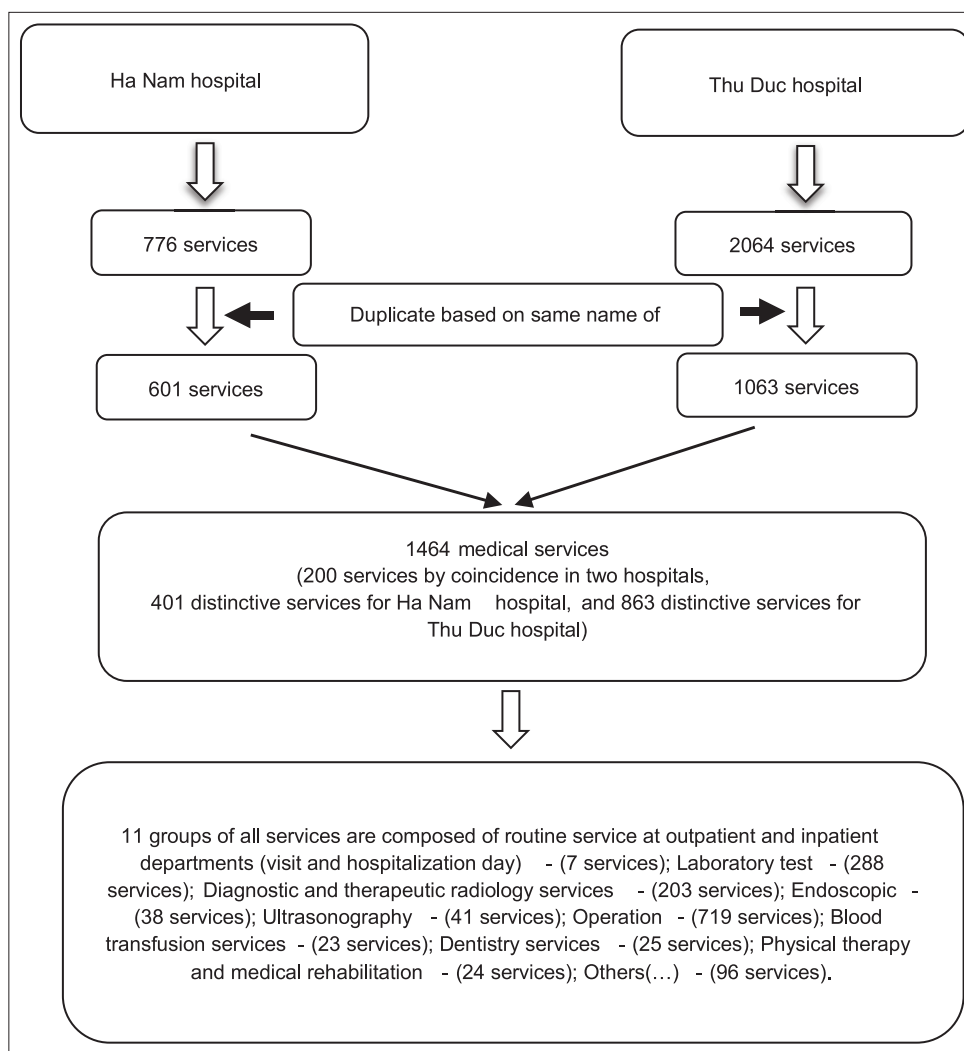


Figure 2: Process of development a list of hospital medical services

cost center had the highest unit cost (19,386,526 VND). In emergency intubation service, the highest unit cost belonged to A12 cost center with 5,373,462 VND while the lowest cost belonged to A16 cost center with 196,134 VND. In addition, aspirate plural service's unit cost ranged from 2,203,912 VND (A18 cost center) to 11,660,682 VND (A9 cost center). Moreover, bladder wash top unit cost was 6,471,381 VND in A20 cost center and bottom unit cost was 44,369 VND in A9 cost center. Of four services above, lumbar puncture is the service with the highest value of average weight cost (Y) (12,237,196 VND). Meanwhile, bladder wash service had the lowest average weight cost calculated for 546,941 VND. The value Y of emergency intubation service and aspirate pleural service was 7,788,910 VND and 820,162 VND, respectively.

There are three services carrying out in seven cost centers included endotracheal intubation service, nebulized service, and changing bandages under 15cm service. The nebulized service occupied in seven cost centers of A9, A10, A13, A14, A15, A16, and A24. Of those cost centers, the unit cost of nebulized service in A15 was highest with 30,633,933 VND while that value in A24 was lowest with 170,861 VND. The

seven cost centers of changing bandages <15 cm service were A7, A11, A18, A20, A21, A23, and A24. Further, the unit cost in A11 was highest (1,551,582 VND) while the unit cost in A20 was lowest (31,412 VND). The endotracheal intubation service was taken in seven cost centers including A6, A8, A9, A15, A18, A20, and A22. Of this, A15's unit cost was highest (33,413,733 VND) while A8's unit cost was lowest (1,305,551 VND). The average weight cost of nebulized service and changing bandages under 15 cm service was 525,517 VND and 103,987 VND, respectively. On the other hand, the value Y of endotracheal intubation service was much higher than other services above with 10,302,938 VND per unit.

Contrary to the cases above, put sonde in gastric service can be seen in nine cost centers including A9, A10, A11, A12, A13, A14, A16, A17, and A18. The unit cost of put sonde in gastric service was differed between cost centers. That can be seen that the unit cost of put sonde in gastric service in A16 cost center was only 18,522 VND while that cost in A12 was 5,187,362 VND. Using the equation, we calculated that the average weight cost for this service in nine cost centers was 368,618 VND.

Table 1: Sample of adjusted unit cost of services (medical procedures) provided by different departments (2014)

Ha Nam Hospital			Thu Duc Hospital		
Services	Cost center - unit cost (VND) - quantity	Y=Weight cost	Services	Cost center - unit cost (VND) - quantity	Y=Weight cost
Measurement intraocular pressure	(A8-182,959-2,046) (A23-45,324-887)	141,335	Lumbar puncture	(A6-7,717,008-1) (A9-19,386,526-9) (A11-752,472-1) (A15-2,824,001-2) (A19-5,592,931-3) (A20-2,657,326-1)	12,237,196
Put sonde in gastric	(A9-208,741-34) (A10-249,093-255) (A11-1,022,430 – 22) (A12-5,187,362-12) (A13-875,907-53) (A14-2,527,197-56) (A16-18,522-269) (A17-7,616,990-3) (A18-37,370-337)	368,618	Gastric lavage	(A6-363,115-16) (A9-34,873,849-4)	7,265,262
Suction phlegm	(A9-320,721-510) (A10-254,402-269) (A13-1,740,404-10) (A16-15,732-1,205) (A17-2,546,696-12)	149,015	Endotracheal intubation	(A6-6,028,300-65) (A8-1,305,551-1) (A9-11,747,115-119) (A15-33,413,733-1) (A18-7,954,460-1) (A20-32,304,188-4) (A22-10,994,546-9)	10,302,938
Emergency intubation	(A9-454,651-36) (A10-431,526-18) (A12-5,373,462-3) (A13-1,071,853-3) (A16-196,134-2) (A17-7,807,074-1)	820,162	Aspirate pleural	(A6-7,915,690-1) (A9-11,660,682-7) (A18-2,203,912-6) (A20-12,830,895-20) (A21-2,302,822-2) (A22-2,564,740-16)	7,788,910
Nebulized	(A9-601,871-21) (A10-730,645-94) (A13-3,476,344-63) (A14-2,522,474-59) (A15-30,633,933-20) (A16-41,617-1,024) (A24-170,861-1,216)	525,517	Bladder wash	(A7-923,638-3) (A9-44,369-18) (A16-948,610-5) (A20-6,471,831-1) (A21-987,885-1) (A22-508,776-12)	546,941
Changing bandages <15 cm	(A7-1,148,895-228) (A11-1,551,582-32) (A18-57,785-2,196) (A20-31,412-3,253) (A21-101,323-1,881) (A23-135,512-20) (A24-447,505-167)	103,987	Bladder wash (excluding chemical)	(A6-1,003,314-1) (A9-11,664,473-8) (A18-3,491,241-17) (A19-11,790,442-3) (A22-2,078,150-10)	5,380,078

$$\text{Average-weight cost} = \frac{\sum_{i=0}^n (\text{Unit cost of Cost center}_i * \text{Quantity of Cost center}_i)}{\sum_{i=0}^n (\text{Quantity of Cost center}_i)}$$

Estimating the RVUs per each test of Ha Nam Hospital and Thu Duc Hospital and all-tests cost average per test

Table 2 illustrates data about samples taken from a list of health-care services after categorizing the similar services in two opted hospitals (Ha Nam Hospital and Thu Duc Hospital). Moreover, the surveyed subjects do not solely include services practiced in both the hospitals but those

which are exclusively conducted in one particular hospital as well. This results in the average unit cost from two hospitals' values. Moreover, the surveyed subjects do not solely include services practiced in both the hospitals, but those which are exclusively conducted in one particular hospital as well. This results in the average unit cost from two hospitals' values (possibly being equivalent to the weight average unit cost' values of either Ha Nam or Thu Duc Hospital) or it could

Table 2: Sample of adjusted unit cost and standard RVU of services

Service	Unit cost		RVU	No.	Service	Average unit cost		Unit cost		Average unit cost	RVU
	Ha Nam Hospital	Thu Duc Hospital				Ha Nam Hospital	Thu Duc Hospital				
Platelet (numbering)	1375	-	0.07	16	Suction phlegm	149,015	-	149,015	-	149,015	7.45
Leukemia (numbering)	1375	-	0.07	17	Dystocia	249,070	-	249,070	-	249,070	12.45
Bilirubin (indirect)	5028	-	0.25	18	Nebulized	525,517	41,083	283,300	41,083	283,300	14.17
Albumin	5028	8536	0.34	19	Put sonde in gastric	765,096	-	765,096	-	765,096	38.25
ALT	5028	8464	0.34	20	Put sonde in gastric	368,618	1,453,606	911,112	1,453,606	911,112	45.56
AST	5028	8464	0.34	21	Changing bandages <15 cm	103,987	1,725,497	914,742	1,725,497	914,742	45.74
Amylase urine	-	7983	0.40	22	Bladder wash	1,485,263	546,941	1,016,102	546,941	1,016,102	50.81
ASLO	7191	10,600	0.44	23	Measurement intraocular pressure	141,335	2,414,413	1,277,874	2,414,413	1,277,874	63.89
A/G	-	9532	0.48	24	Emergency intubation	820,162	5,989,293	3,404,728	5,989,293	3,404,728	170.24
ADA	-	13,003	0.65	25	Gastric lavage	713,970	7,265,262	3,989,616	7,265,262	3,989,616	199.48
AFP	14,215	23,422	0.94	26	Aspirate pleural	644,860	7,788,910	4,216,885	7,788,910	4,216,885	210.84
Anti-HCV (ELISA)	7662	32,237	1.00	27	Bladder wash (excluding chemical)	-	5,380,078	5,380,078	5,380,078	5,380,078	269.00
ECG	34,534	-	1.73	28	Endotracheal intubation	462,690	10,302,938	5,382,814	10,302,938	5,382,814	269.14
EEG	82,842	-	4.14	29	Lumbar puncture	2,517,098	12,237,196	7,377,147	12,237,196	7,377,147	368.86
Adrenalin	-	94,949	4.75	30	Removing extraneous out of gastrointestinal tract by endoscopy	113,198,088	-	113,198,088	-	113,198,088	5,659.90

RVU: Relative value unit, ALT: Alanine transaminase, AST: Aspartate transaminase, HCV: Hepatitis C virus, ECG: Electrocardiogram, EEG: Electroencephalogram, ADA: American Diabetes Association, AFP: Alpha-fetoprotein

even be equal to the average value of the figures from both said columns. The operation needed to calculate the average cost of the service that is performed in two hospitals is simple average method.

It was also proved that the diversification in the types of services relied on with the specific characteristics of each particular region (central, province, or district). As a consequence, this feature resulted in the disparity in the number of patients in each hospital service. For instance, ECG test is the service that is performed most regularly in Ha Nam Hospital with the frequency of around 11,000 times, yet such service is not practiced in Thu Duc Hospital.

Estimating RVUs is dividing average cost by cost per RVU with cost value equal to 1 RVU is 20,000 VND. Sample Standard RVUs of medical obtained from the analysis of this study are presented in Table 2.

DISCUSSION

To test the accuracy of the unit cost analysis with the use of RVU, the result should be compared with that from micro-costing method which reflects the resource of consumption more accurately than the other methods. In this study, the researchers analyzed the unit cost of health services in the fiscal year of 2014 using micro-costing method. Nevertheless, some service subjects were taken from Trung *et al.* study.^[11,13] As a consequence, there are discrepancies found during the progress of matching and comparison the results of two researches with each other.

Overall, the total number of services in Ha Nam Hospital is 1,270,166 compared to 710,662 services in Thu Duc Hospital [Table 2]. Nevertheless, the entire unit cost in Ha Nam is considerably lower than that in Thu Duc Hospital (61.5 billion VND compared to 234 billion VND). Furthermore, it appears that roughly all services in Thu Duc Hospital have higher prices than in Ha Nam. For instance, anti-HCV (ELISA) is just 7,662 VND in Ha Nam Hospital but costs 32,237 VND in Thu Duc Hospital which is approximately 4 times greater. By dividing the total unit cost for 20,000 VND, RVU value can be achieved. As a result, the total RVU of Ha Nam Hospital ranges from 0.07 to 1,085.17, while the highest total RVU of Thu Duc Hospital is 5,659.90. This causes the highest overall RVU after accumulating two statistics from two hospitals to fluctuate between 0.07 and 5,659.90. Overall, the Ha Nam Hospital's RVU is considered to be quite low due to the difference in expenses that hospitals have to cover in disparate types of services being highly various, including spending on machinery, human resource, medical devices, and chemicals.

The RVU of a service is a constant value that can be used to compute the precise cost of a particular service in different

years. For instance, to calculate the cost of a service in a specific year, we need to recover it by multiplying the value of RVU by 20,000 VND and later on by that year's consumer price index.

Applications of RVUs

The standard unit cost used for health economic evaluation in Vietnam can possibly be developed thanks to the RVUs from this study which is considered to be simple and does not require much data to be practiced. Hospitals can apply the cost information to establish rates and comply with both internal and external reporting requirements, then determine whether departments are operating within budget, construct budget for a department, or even allocate budgets among departments.

Limitations of the study

This study developed the RVUs of health services for the health settings under the public health-care sector. The RVUs of health services from this study were developed based on the assumption that the resource equally consumed in the same service in every type of hospital. Even though RVUs have been developed, it has yet been tested in other hospitals in Vietnam context.

Suggestions for future research

Due to the constant alteration in the framework of health services, it is vital that further studies should be ceaselessly conducted. This cost would make economic evaluations more convenient, fast, and reliable for decision-maker.^[9] Furthermore, to cover the expense of the Health economic evaluation, the RVU should be advanced and continuously kept up-to-date. Furthermore, as there are a vast variety of hospitals with diversified features affected by specific regions, disparate frameworks, and policies, it is likely that the difference in resource consumption ratio for each service will experience changes. Thus, further research is required to evaluate the suitability of using this RVU for costing in the other hospital type. For instance, the RVU normally applied for the provincial hospitals should be put under investigation to test its availability when practiced in other hospitals of central, district, or community level. Furthermore, further research should develop the additional RVU for health centers based on unit cost data from good performance health center.

CONCLUSION

The RVUs of health services in this study consist of 1,464 items. The outcome of this research would be useful for the future research using unit cost and make the policymaker more convenient and reliable.

ACKNOWLEDGMENT

We would like to address our most sincere gratitude to the Faculty of Pharmacy, Mahidol University for research facilities as well as the Director Board and the hospital staffs of General Hospital of Ha Nam Province, and those of Thu Duc General Hospital for permitting our study to be conveyed at their sites.

REFERENCES

1. Rheault S. Financement des Services de Santé: Défis Pour les Années 90. Quebec: Les Publications du Québec; 1990.
2. Madhav Rajan SMD, Charles T. Cost Accounting with Myaccountinglab 2015. Available from: <http://www.pearson.com.au/products/H-J-Horngren-Charles-T-et-al/Cost-Accounting-Global-Edition/9781292018225?R=9781292018225>. [Last accessed on 2017 Sep 07].
3. Pharmaceutical Evaluation Section Commonwealth, and Department of Health and Ageing Australia. Manual of Resources Items and Their Associated Costs. Canberra: Pharmaceutical Evaluation Section Commonwealth, and Department of Health and Ageing Australia; 2009.
4. Pagano E, Brunetti M, Tediosi F, Garattini L. Costs of diabetes. A methodological analysis of the literature. *Pharmacoeconomics* 1999;15:583-95.
5. Oostenbrink JB, Koopmanschap MA, Rutten FF. Standardisation of costs: The dutch manual for costing in economic evaluations. *Pharmacoeconomics* 2002;20:443-54.
6. Tan SS, Bouwmans CA, Rutten FF, Hakkaart-van Roijen L. Update of the dutch manual for costing in economic evaluations. *Int J Technol Assess Health Care* 2012;28:152-8.
7. Department of Health. NHS Reference Costs: Financial Year 2011 to 2012. England: Department of Health; 2012.
8. Tsilaajav T. Costing study for selected hospitals in the Philippines. Manila, Philippines: Health Sector Policy Support Programme in the Philippines; 2009.
9. Riewpaiboon A. Standard cost lists for health economic evaluation in thailand. *J Med Assoc Thai* 2014;97 Suppl 5:S127-34.
10. Chatterjee S, Levin C, Laxminarayan R. Unit cost of medical services at different hospitals in india. *PLoS One* 2013;8:e69728.
11. Hankins RW, Baker JJ. Management Accounting for Health Care Organizations: Tools and Techniques for Decision Support. Sudbury: Jones and Bartlett Publishers; 2004.
12. George HW, Christie LK. A Guide to Cost Analysis: Developing Cost Based Fees for Maternal and Child and Adolescent Health Services. Health Policy Analysts, Inc.; 2016. p. 1-35.
13. Vo TQ, *et al.* Hospital Service Cost Analysis in Developing Countries: A Method Comparision in Vietnam. Processing.
14. Riewpaiboon A, Malaroje S, Kongsawatt S. Effect of costing methods on unit cost of hospital medical services. *Trop Med Int Health* 2007;12:554-63.
15. Jassim AL. Cost measuring of medical services in a hospital using relative value units (RVUs) -based process costing system. *Res J Soc Sci Manage* 2011;1:153-65.
16. Suver JD, Cooper JC. Principles and methods of managerial cost-accounting systems. *Am J Hosp Pharm* 1988;45:146-52.
17. Cooper JC, Suver JD. Product line cost estimation: A standard cost approach. *Healthc Financ Manage* 1988;42:60, 62, 64 passim.

Source of Support: Nil. **Conflict of Interest:** None declared.