Chulalongkorn Medical Journal

Volume 46
Issue 1 *January 2002*

Article 4

1-1-2002

Comparative study of direct test-cost betweenpurchased and rented laboratory instruments

S. Pingsuthiwong

Y. Vanavanitkun

N. Charuruks

Chula Med J Vol. 46 No. 1 January 2002

Comparative study of direct test-cost between purchased and rented laboratory instruments

Sakorn Pingsuthiwong*

Yuwaree Vanavanitkun** Navapun Charuruks**

Pingsuthiwong S, Vanavanitkun Y, Charuruks N. Comparative study of direct test-cost between purchased and rented laboratory instruments. Chula Med J 2002 Jan; 46(1): 21 - 33

Background : *The current economic constrain demands effective management of laboratory. Key to the efficiency is utilization of laboratory equipment. Since bureaucratic administration allows only two channels to obtain instruments: purchasing with fiscal budget, and through rental contract. However, information concerning advantages and disadvantages of both choices for laboratory consideration is limited.*

Objective : *To compare direct test-cost (dTC) between a purchased and a rented instrument : 594,336 tests processed by Hitachi-911 (purchased) and Cobas-Integra-700 (rented) were descriptively and retrospectively studied. Direct test-cost of each test was calculated from the major direct cost categories, including labor cost (LC), material cost (MC) and capital cost (CC).*

Results : *We found that dTC of 13 of 28 items paid for Cobas-Integra-700 were lower than the amount paid for Hitachi-911, whereas 15 of 28 items were higher. In addition, we calculated the annual payment for each instrument with the total number of tests performed. Interestingly, we found that if we use Cobas-Integra-700 for 594,336 tests, we would expend 4,430,813.14 Baht, whereas if we decide to use Hitachi-911, we would pay 4,261,319.80 Baht.*

* Department of Laboratory Medicine, King Chulalongkorn Memorial Hospital,Thai Red Cross Society

** Department of Laboratory Medicine, Faculty of Medicine, Chulalongkorn University

Conclusion : *From the data, we concluded that the rental condition was favorable in big hospitals since reagent prices, maintenance costs, instrument models, and conditions were open for bargaining. However we believed that the efficiency of management remained the most important factor benefiting laboratory investment.*

Key words : *Direct test-cost, Buy instrument, Rented instrument.*

Reprint request : Pingsuthiwong S, Department of Laboratory Medicine, King Chulalongkorn Memorial Hospital, Thai Red Cross Society.

Received for publication. November 9, 2001.

สาคร ปิงสุทธิวงศ์, ยุวรีย์ วนาวณิชย์กุล, นวพรรณ จารุรักษ์. การศึกษาเปรียบเทียบต้นทุนโดยตรงต่อรายการตรวจทางห้องปฏิบัติการโดยเครื่องมือที่ซื้อและเช่าวาง. จุฬาลงกรณ์เวชสาร 2545 ม.ค; 46(1): 21 - 33

ภูมิหลัง : *ในปัจจุบันประสิทธิภาพในการบริหารจัดการห้องปฏิบัติการทางการแพทย์มีความสำคัญมาก เครื่องมือนับเป็นส่วนหนึ่งในปัจจัยหลักที่จะช่วยเพิ่มประสิทธิภาพในการทำงาน และวิธีการให้ได้มาซึ่งเครื่องมือ ปัจจุบันมีอยู่ 2 วิธีคือ โดยการซื้อจากเงินงบประมาณ และโดยวิธีการตกลงหรือเช่าวาง อย่างไรก็ตามข้อมูลที่เกี่ยวกับข้อดีและ ข้อเสียเกี่ยวกับเครื่องมือที่ได้มาทั้ง 2 แบบนี้ยังมีอยู่จำกัด*

วัตถุประสงค์ : *เพื่อศึกษาเปรียบเทียบต้นทุนโดยตรงต่อรายการตรวจทางห้องปฏิบัติการระหว่างเครื่องมือที่ได้มา โดยเครื่อง Hitachi-911 ซึ่งได้จากการซื้อโดยเงินงบประมาณ และเครื่อง Cobas-Integra-700 ได้จากการตกลงหรือเช่าวาง ต่อรายการตรวจทางห้องปฏิบัติการจำนวน 594,336 รายการ โดยวิธีการศึกษาแบบตรวจสอบข้อมูลย้อนกลับและพรรณนาต้นทุนโดยตรงต่อรายการตรวจทางห้องปฏิบัติการ คำนวณจากค่าจ้างแรงงาน ค่าวัสดุ น้ำยา และค่าเครื่องมือ*

ผลการศึกษา : *คณะผู้วิจัยพบว่าต้นทุนโดยตรงต่อรายการตรวจทางห้องปฏิบัติการที่ใช้เครื่องมือ Cobas-Integra-700 จำนวน 13 ใน 28 รายการ มีต้นทุนต่ำกว่าค่าที่ได้จากเครื่องมือ Hitachi-911 ในขณะที่อีก 15 ใน 28 รายการ มีต้นทุนสูงกว่าตามลำดับ คณะผู้วิจัยได้คำนวณต้นทุนที่ใช้เครื่องมือชนิดใดชนิดหนึ่งสำหรับรายการตรวจทั้งหมดในเวลา 1 ปี และพบว่าหากใช้เครื่องมือ Cobas-Integra-700 สำหรับรายการตรวจ 594,336 รายการ จะมีต้นทุนทั้งสิ้น 4,430,813.14 บาท ในขณะที่หากใช้เครื่องมือ Hitachi-911 จะมีต้นทุน 4,261,319.80 บาท*

สรุป : *จากผลการศึกษา คณะผู้วิจัยสรุปว่าต้นทุนโดยตรงต่อรายการตรวจทางห้องปฏิบัติการโดยเครื่องมือที่ได้จากวิธีการตกลงหรือเช่าวาง มีค่าสูงกว่าที่ได้จากการซื้อเครื่องมือโดยงบประมาณไม่มากนักสำหรับโรงพยาบาลที่มีขนาดใหญ่ในกรณีที่มีการตกลงอย่างมีประสิทธิภาพในเรื่องของน้ำยา ค่าใช้จ่ายในการบำรุงรักษา รุ่นของเครื่องมือและข้อตกลงอื่น ๆ อย่างไรก็ตามการบริหารจัดการที่มีประสิทธิภาพ นับเป็นปัจจัยที่สำคัญที่สุดที่จะสร้างความคุ้มทุนในการลงทุนในห้องปฏิบัติการ*

In the 21st Century, economic factors determine the success or failure of laboratory operations. Minimizing operation cost remains a big challenge, it can even leads to reorganization of laboratory structure. To survive the new challenge, laboratory management and budget planning need to be carefully organized.[1] Laboratory instrument is one of the most burdensome cost component that involves directly to the test-cost. In Thailand, large laboratories can install laboratory instruments by using two important methods: budget planning, and rental agreement. The instruments bought by the budget, can be chosen by users who can control the whole situation, permitted by the budget. However, there are increasing incidences where budget is limited. To solve the problem many laboratory managers decide to contract rental instruments. As for rented instruments, the users are dependent upon the providers. This development may involve in the laboratory structure-plan. In addition, we should think and plan ahead to ensure that our restricted resources are effectively utilized. More information about both conditions should be studied to provide a reliable data-base for future planning for the laboratory managers. Analysis of direct test- cost of an equipment is an important figure that should be studied.[2] Like most laboratories, at the Central Laboratory, King Chulalongkorn Memorial Hospital, we experienced both methods. However, the comparative study of direct test-cost provided by purchased and rented instruments have not been calculated. To figure out the data for the future management plan, we decided to compare the direct test-cost between Hitachi-911 and Cobas-Integra-700. The former represented purchased instruments, and the latter, the rented. These data could be useful not only for us but also for other users, who are dealing with the same condition. In addition, the information of direct test-costs of each instrument could be used as isolated data.

Materials and Methods

We designed a descriptive and retrospective survey to determine direct test-costs of the two pieces of equipment deployed at Department of Laboratory Medicine, King Chulalongkorn Memorial Hospital. A total of 594,336 tests that were recorded during official hours (8.00 am - 4.00 pm) from 1 January to 31 December 1999, were chosen and calculated. 594,336 tests were categorized into 28 items of clinical chemistry tests, and that the details were shown in Table 1. Data was collected from the following sources: labor cost from Department of Accounting, material and capital cost from Department of Supplies, and maintenance cost and statistics of laboratory tests from Department of Laboratory Medicine. In addition, electricity and water expenses were calculated from power and water consumptions of each instrument.

The Hitachi-911 was chosen to represent purchased instruments with its service rated 360 tests per hour, and 720 tests per hour when electrolytes were included. The power supply was 100 - 240 $\pm$ 10 % Volts and 50 or 60 Hz in frequency. Its water requirement was 30 liters per hour. The physical dimensions of the machine were 100 cm in width, 110 cm in height, and 77 cm in depth, with and 350 kg of weight.[3]

The Cobas-Integra-700 was chosen to represent rented instrument with its service rated up to 600 tests per hour and up to 855 tests per hour when electrolytes were included. The electrical supply

was 100 -125 / 200 -240 Volts and 50 or 60 Hz in frequency. Its power consumption was 1400 VA. Its water requirement was 5 - 7 liters per hour. Its physical dimensions were 144.5 cm in width, 115.5 cm in height, and 80 cm in depth and with 420 kg of weight.[4]

We calculated the direct test-cost of each test from the major direct cost categories including: labor cost (LC), material cost (MC) and capital cost (CC) with using the following formula.

direct Test-cost (dTC) = LC + MC + CC

LC was collected from the amount of salary paid to technicians who directly used the instruments at Clinical Chemistry Unit, Department of Laboratory Medicine. All technicians worked with both instruments were the same. Their average labor cost was calculated from the total amount of salaries paid for three technicians divided by the total amount of tests. MC was calculated from the costs of test reagents, control and calibrate reagents, all disposable materials used, and electricity and water bills. CC was instrument and maintenance costs. The comparison of test-cost obtained from purchased and rented laboratory instruments was also calculated and shown below.

Results

A total 594,336 tests, composed of 28 items of clinical chemistry tests, 342,421 tests (57.6 %) were retrospective and analyzed by Cobas-Integra-700 and 251,915 tests (42.4 %) by Hitachi -911 (Table 1). From our data, measuring the mount of blood glucose was the most common test (9.30 % of 28 items) requested by clinicians, whereas acid measuring phosphatase was the least commonly ordered (0.04 % of 28 items) requested. LC was calculated from 3 technicians who worked with the instruments (Table 2). From our data, the hospital paid 590,040.00 Baht for three technicians per year as salaries. Three technicians worked only with both instruments and were responsible for 594,336 tests during the data-collection period. Average labor cost per test was 0.99 Baht. Reagent cost per test was collected from the total reagent cost per year divided by the total number of tests and is shown in Table 3. It is not out of our expectation that reagent cost per test of all 28 items paid for Cobas Integra -700 (rented instrument) was higher than reagent cost per tests paid for Hitachi-911 (purchased instrument) since for the rented cost was already included in reagent cost. Control and calibrate reagents and disposable material costs were collected from the whole year record of each instrument. The expense for the control and calibrate reagents was no different between both instruments since the same reagents and amount were used (Table 4). The disposable material cost of Hitachi-911 was cheaper than Cobas-Integra-700. The causes of the difference came from the cheaper test cuvette and cleaner and detergent solution using in Hitachi-911 and water required in running the system. Since we did not paid for the instrument and its maintenance in management of the rented instrument, the CC in Cobas-Integra-700 was much lower than in Hitachi-911 (Table 5.1,5.2). In Table 6, we found that direct test-cost 13 of 28 items we paid for Cobas-Integra-700 were lower than for Hitachi-911 and 15 of 28 items were higher. In addition, we calculated for whole-year payment of each instrument using total number of tests. Interestingly, we found that if we use Cobas-Integra-700 for 594,336 tests, we would invest 4,430,059.60 Baht while if we decide to use Hitachi-911, we would pay 4,261,319.80 Baht (Table 7).

Table 1. A total of 594,336 tests that had been recorded from 1 January to 31 December 1999, were composed of 28 types of clinical chemistry tests.

Test name	Total amount of each test type	Amount of tests	
		Cobas-Integra-700	Hitachi-911
1. Glucose	55,279	32,153	23,126
2. BUN	45,705	26,531	19,174
3. Creatinine (Cr)	49,655	28,652	21,003
4. Uric acid	22,585	12,473	10,112
5. Sodium (Na)	28,020	16,010	12,010
6. Potassium (K)	28,020	16,010	12,010
7. Chloride (Cl)	28,020	16,010	12,010
8. Carbonate (CO_2)	28,020	16,010	12,010
9. Magnesium (Mg)	5,915	3,215	2,700
10. Calcium (Ca)	8,866	5,120	3,746
11. Phosphate (PO_4)	5,915	3,415	2,500
12. Total protein	12,558	7,228	5,330
13. Albumin	15,548	8,542	7,006
14. Globulin*	12,558	7,228	5,330
15. Total bilirubin (TB)	17,166	9,256	7,910
16. Direct bilirubin (DB)	15,951	8,871	7,080
17. Alanine aminotransferase (ALT)	34,460	20,270	14,190
18. Aspartate aminotransferase (AST)	33,832	19,840	13,992
19. Alkaline phosphatase	25,484	15,284	10,200
20. Acid phosphatase	211	121	90
21. Amylase	1,909	1,102	807
22. Cholesterol	38,436	22,341	16,095
23. Triglyceride (Tg)	37,815	21,954	15,861
24. HDL-cholesterol (HDL)	32,476	19,056	13,420
25. Lactic dehydrogenase (LDH)	3,517	2,017	1,500
26. Creatine phosphokinase (CPK)	3,413	1,925	1,488
27. CK-MB	796	481	315
Gramma-Glutamyl transferase (GGT)	2,206	1,306	900
Total Tests	**594,336**	**342,421**	**251,915**

*Test result is received from calculation

Table 2. Labor cost data were collected from Accounting Department.

Technician	Salary per year (Baht)	Salary per month (Baht)
1. Technician A	255,840	21,320
2. Technician B	219,480	18,290
3. Technician C	114,720	9,560
Total Salary	590,040	49,170
Average labor cost per test	590,040 / 594,336 = 0.9927 Baht	

Table 3. Comparative of test reagent cost per test between Cobas-Integra-700 and Hitachi-911.

Test name	Cobas-Integra-700 (Baht)	Hitachi-911 (Baht)
1. Glucose	2.0	1.3
2. Bun	6.0	5.7
3. Cr	2.3	1.1
4. UA	5.0	4.2
5. Ca	5.0	1.9
6. Phosphate	8.0	4.9
7. Total protein	2.8	1.4
8. Albumin	2.5	2.0
9. GGT	8.0	6.1
10. TB	2.9	2.9
11. DB	6.0	0.6
12. Alkaline phosphatase	6.0	1.0
13. ALT	4.0	3.5
14. AST	4.0	3.5
15. LDH	7.0	5.5
16. CK	130	13.0
17. CK-MB	42.0	23
18. Mg	13.0	7.0
19. Amylase	20	17.9
20. TG	6	4.7
21. HDL	220	19.5
22. Cholesterol	5.0	4.7
23. Na	2.00	2.33
24. K	2.00	2.33
25. Cl	2.00	2.33
26. CO_2	23	12.0
27. Acid Phosphatase	32	14.0

Table 4. Control and calibrate reagents, and disposable material cost were collected from one-year record of each instrument and one year electricity cost calculated from power requirement of each instrument.

Reagents	Cobas-Integra-700 (Baht)	Hitachi-911 (Baht)
1. Precinorm U	7,640.00	7,640.00
2. Precipath U	7,640.00	7,640.00
3. Calibrator for automated System	5,000.00	5,000.00
4. Test cuvette	100,600.00	42,372
5. Control cuvette	4,356.00	*
6. Cleaner and detergent solution	43,656.00	49,862.00
7. Electricity cost (working day)	7,674.50	6,701.50
8. Water cost (working day)	178.30	891.50
Total Cost per year	176,744.80 / 335,193	120,107.00/246,585
Average cost per test	0.5272	0.4871

* Control : Cuvette is included in Test cuvette.

Table 5.1. One-year Instrument cost and maintenance of each instruments.

Electricity cost	Cobas-Integra-700 (Baht)	Hitachi-911 (Baht)
1. Instrumentation cost	-	2,555,551.00
2. Instrumentation cost per year	-	255,555.10
3. Instrument maintenance cost	-	5,356.00
4. Maintenance for water filtration	8,280.00	8,280.00
5. Halogen lamp	-	25,252.00
Total cost per year	8,280.00 / 335,193	294,443.10 / 246,585
Average cost per test	0.0247	1.1941

Table 5.2. Comparative result of direct test-cost between Cobas-Integra-700 and Hitachi-911.

Test name	Cobas-Integra-700 (Baht)				Hitachi-911 (Baht)			
	LC	MC	CC	dTC	LC	MC	CC	dTC
1. Glucose	0.99	2.53	0.02	3.54	0.99	1.79	1.19	3.97
2. Bun	0.99	6.53	0.02	7.54	0.99	6.19	1.19	8.37
3. Cr	0.99	2.83	0.02	3.84	0.99	1.59	1.19	3.77
4. UA	0.99	5.53	0.02	6.54	0.99	4.69	1.19	6.87
5. Ca	0.99	5.53	0.02	6.54	0.99	2.39	1.19	4.57
6. Phosphate	0.99	8.53	0.02	9.54	0.99	5.39	1.19	7.57
7. Total protein	0.99	3.33	0.02	4.34	0.99	1.89	1.19	4.07
8. Albumin	0.99	3.03	0.02	4.04	0.99	2.49	1.19	4.67

Table 5.2. Continuous.

Test name	Cobas-Integra-700 (Baht)				Hitachi-911 (Baht)			
	LC	MC	CC	dTC	LC	MC	CC	dTC
9. Globulin	0.99	0.53	0.02	1.54	0.99	0.49	1.19	2.67
10. GGT	0.99	8.53	0.02	9.54	0.99	6.59	1.19	8.77
11. TB	0.99	3.43	0.02	4.44	0.99	3.39	1.19	5.57
12. DB	0.99	6.53	0.02	7.54	0.99	1.09	1.19	3.27
13. Alkaline phosphatase	0.99	6.53	0.02	7.54	0.99	4.49	1.19	6.67
14. ALT	0.99	4.53	0.02	5.54	0.99	3.99	1.19	6.17
15. AST	0.99	4.53	0.02	5.54	0.99	3.99	1.19	6.17
16. LDH	0.99	7.53	0.02	8.54	0.99	5.99	1.19	8.17
17. CK	0.99	13.53	0.02	14.54	0.99	13.49	1.19	15.67
18. CK-MB	0.99	42.53	0.02	43.54	0.99	13.49	1.19	25.67
19. Mg	0.99	13.53	0.02	14.54	0.99	7.49	1.19	9.67
20. Amylase	0.99	20.53	0.02	21.54	0.99	18.39	1.19	20.57
21. TG	0.99	6.53	0.02	7.54	0.99	5.19	1.19	7.37
22. HDL	0.99	22.53	0.02	23.54	0.99	19.99	1.19	22.17
23. Cholesterol	0.99	5.53	0.02	6.54	0.99	5.19	1.19	7.37
24. Na	0.99	2.53	0.02	3.54	0.99	2.82	1.19	5.00
25. K	0.99	2.53	0.02	3.54	0.99	2.82	1.19	5.00
26. Cl	0.99	2.53	0.02	3.54	0.99	2.82	1.19	5.00
27. CO_2	0.99	23.53	0.02	24.54	0.99	12.49	1.19	14.67
28. Acid Phosphatase	0.99	32.53	0.02	33.54	0.99	14.49	1.19	16.67

Table 6. Comparative result of direct test-cost between Cobas-Integra-700 and Hitachi-911.

Test name	Cobas-Integra-700 (Baht)			Hitachi-911 (Baht)		
	dTC	Total test	Total dTC	dTC	Total test	Total dT
1. Glucose	3.54	32,153	113,821.62	3.97	23,126	91,810.22
2. Bun	7.50	26,531	198,982.50	8.37	19,174	160,486.38
3. Cr	3.84	28,652	110,023.68	3.77	21,003	79,181.31
4. UA	6.54	12,473	81,573.42	6.87	10,112	69,496.44
5. Ca	6.54	5,120	33,484.80	4.57	3,746	17,119.22
6. Phosphate	9.54	3,415	21,309.60	7.57	2,500	18,925.00
7. Total protein	4.34	7,228	32,579.12	4.07	5,330	21,693.10
8. Albumin	4.04	8,542	34,509.68	4.67	7,006	32,718.02
9. Globulin	1.54	7,228	11,131.12	2.67	5,330	14,231.10
10. GGT	9.54	1,306	12,459.24	8.77	900	7,893.00

Table 6. Continuous.

Test name	Cobas-Integra-700 (Baht)			Hitachi-911 (Baht)		
	dTC	Total test	Total dTC	dTC	Total test	Total dTC
11. TB	4.44	9,256	41,096.64	5.57	7,910	44,058.70
12. DB	7.54	8,871	66,887.34	3.27	7,080	23,151.60
13. Alkaline phosphatase	7.54	15,284	115,241.36	6.67	10,200	68,034.00
14. ALT	5.54	20,270	112,295.80	6.17	14,190	87,552.30
15. AST	5.54	19,840	109,913.60	6.17	13,992	86,330.64
16. LDH	8.54	2,017	17,225.18	8.17	1,500	12,255.00
17. CK	14.54	1,925	27,989.50	15.67	1,488	23,316.96
18. CK-MB	43.54	481	20,942.74	25.67	315	8,086.05
19. Mg	14.54	3,215	46,746.10	9.67	2,700	26,109.00
20. Amylase	21.54	1,102	23,737.08	20.57	807	16,599.99
21. Tg	7.54	21,954	165,533.16	7.37	15,86	1116,895.57
22. HDL	23.54	19,056	448,578.24	22.17	13,420	297,521.40
23. Cholesterol	6.54	22,341	146,110.14	7.37	16,095	118,620.15
24. Na	3.54	16,010	56,675.40	5.00	12,010	60,050.00
25. K	3.54	16,010	56,675.40	5.00	12,010	60,050.00
26. Cl	3.54	16,010	56,675.40	5.00	12,010	60,050.00
27. CO_2	24.54	16,010	392,885.40	14.67	12,010	176,186.70
28. Acid Phosphatase	33.54	121	4,058.34	16.67	90	1,500.30
Total dTC of total tests			**2,569,201.10**			**1,799,895.10**

Table 7. Comparative result of direct test-cost of 594,336 tests between Cobas-Integra-700 and Hitachi-911.

Test name	Cobas-Integra-700 (Baht)			Hitachi-911 (Baht)		
	dTC	Total test	Total dTC	dTC	Total test	Total dTC
1. Glucose	3.54	55,279	195,687.66	3.97	55,279	219,457.63
2. Bun	7.50	45,705	322,220.25	8.37	45,705	382,550.85
3. Cr	3.84	49,655	190,675.20	3.77	49,655	187,199.35
4. UA	6.54	22,585	147,7.5.90	6.87	22,585	155,158.95
5. Ca	6.54	8,866	57,983.64	4.57	8,866	40,517.62
6. Phosphate	9.54	5,915	56,429.10	7.57	5,915	44,776.55
7. Total protein	4.34	12,558	54,501.72	4.07	12,558	51,111.06
8. Albumin	4.04	15,548	62,813.92	4.67	15,548	72,609.16
9. Globulin	1.54	12,558	19,339.32	2.67	12,558	33,529.86
10. GGT	9.54	2,206	21,045.24	8.77	2,206	19,346.62

Table 7. Continuous.

Test name	Cobas-Integra-700 (Baht)			Hitachi-911 (Baht)		
	dTC	Total test	Total dTC	dTC	Total test	Total dTC
11. TB	4.44	17,166	76,217.04	5.57	17,166	95,614.62
12. DB	7.54	15,951	120,270.54	3.27	15,951	52,159.77
13. Alkaline phosphatase	7.54	25,484	192,149.86	6.67	25,484	169,978.28
14. ALT	5.54	34,460	190,908.40	6.17	34,460	212,618.20
15. AST	5.54	33,832	187,429.28	6.17	33,832	208,743.44
16. LDH	8.54	3,517	30,035.18	8.17	3,517	28,733.89
17. CK	14.54	3,413	49,625.02	15.67	3,413	53,481.71
18. CK-MB	43.54	796	34,657.84	25.67	796	20,433.324
19. Mg	14.54	5,915	86,004.10	9.67	5,915	57,198.05
20. Amylase	21.54	1,909	41,119.86	20.57	1,909	39,268.13
21. Tg	7.54	37,815	285,125.10	7.37	37,815	278,696.55
22. HDL	23.54	32,476	764,485.04	22.17	32,476	719,992.92
23. Cholesterol	6.54	38,436	251,371.44	7.37	38,436	283,273.32
24. Na	3.54	28,020	99,190.80	5.00	28,020	140,100.00
25. K	3.54	28,020	99,190.80	5.00	28,020	140,100.00
26. Cl	3.54	28,020	99,190.80	5.00	28,020	140,100.00
27. CO_2	24.54	28,020	687,610.80	14.67	28,020	411,053.40
28. Acid Phosphatase	33.54	211	7,076.94	16.67	211	3,517.347
Total dTC of total tests			**4,430,059.60**			**4,261,319.80**

Discussion

We studied for direct test-cost which we designed to calculate from direct labor cost, test material cost, and direct instrument and maintenance cost. Since our study aimed to compare direct test-cost between Cobas-Integra-700 and Hitachi-911 so we did not calculate for unit cost which was an indirect cost from non-revenue departments and other materials used in the process of tests such as tubes, pipettes, process labor cost, etc. are included.[5-8] From our study, we found that we could save 168,739.80 Baht in one year if we use Hitachi-911, instead of Cobas-Integra-700 (Table 7). The result would be useful for making decision in laboratory management in the future. Although we found that in rental situation, we paid a higher than budget, there are other factors needed to be included. One was that the instrument itself should belong to the same model. However, we could not use the same model since the rental condition was depended on the vendor. Although the model of the instrument could be another factor that affected the study, but the model was depended on the contract happened from the purchasing or rental condition. In addition, during globalization period, there is a question: Could we pay less for better world class technology like when we buy a computer, we can pay

the same amount of money to buy a better one the next day ? We also compare our results to the previous study of unit costs of laboratory tests.[9] We found that our dTC was lower than unit costs with the median of dTC of 39.92 % (20.48 % - 68.47 %) of the unit costs of previous studies. These results could be used as a basic data for laboratory management and planning not only for our hospital. We also analyzed the advantages and disadvantages of each condition and demonstrated it in Table 8.

From our study, we concluded that the rental condition was acceptable in big hospitals since the reagent price, maintenance cost, instrument model, and condition could be bargained for effectively. However, we believed that the efficiency of management was the most important factor to gain benefit from laboratory investment. Many factors that involved to the efficiency such as: appropriate area, budget, instruments and information system, quality system, effective technicians, and good management needed

Table 8. The advantages and disadvantages of each condition were analyzed.

Conditions	Advantage	Disadvantage
Purchase condition	1. Laboratory manager can make decision to choose technology independently. 2. Laboratory manager can change reagent and instrument without the permission of the vendor. 3. Laboratory is the owner of the instrument. 4. The more number of tests are done, the less cost it is due to lower variable cost. 5. The efficiency management will make more benefit.	1. Initial investment is high. 2. Need to prepare budget for maintenance. 3. Low number of tests causes high constant cost. 4. Could not change the instrument without instrument budget. 5. Retiring process of the broken instrument is not easy and take time. 6. The old instrument may cause trip over many times.
Rental condition	1. No initial investment. 2. Can easily catch up advanced technology. 3. Maintenance cost is taken care of by the vendor. 4. The less number of tests more benefit to the vendor. 5. No investment risk.	1. The vendor is the instrument owner. 2. There is limitation in choosing the technology and model. 3. The reagent cost is higher than purchase condition. 4. The more test number, the effect more to the vendor. 5. The less test number will not attract the vendor to invest.

to be planned out carefully.[10] An example was that a better instrument might be run by fewer technicians so the labor cost could be reduced. In addition, a better instrument could provide more laboratory test items, better test principles, faster analysis time and easier to operate or more user-friendly. In addition, we believed that during these next few years the combination of purchased and rented instruments would still the best way of management before stepping into the next laboratory management and laboratory automation technological advancements in the new coming decade.

Acknowledgement

We would like to express our gratitude to the staff of Department of Laboratory Medicine, King Chulalongkorn Memorial Hospital, the Thai Red Cross Society, who participated in the study.

References

1. Nigon DL. Business plan development. In: Nigon DL, ed. Clinical Laboratory Management, Leadership Principles for the 21st Century. New York: McGraw-Hill , 2000: 107 - 28
2. Nigon DL. A cost center or a revenue producer ? Practical finance and economics. In: Nigon DL, ed. Clinical Laboratory Management, Leadership Principles for the 21st Century. New York: McGraw-Hill, 2000: 153 - 76
3. BM/Hitachi 911. Operator's Manual. Mannheim: Boehringer Mannheim GmbH, 1993.
4. Cobas Integra: The power of total consolidation for the clinical laboratory. Basel Roche Diagnostics. Division of F. Hoffmann-La Roche, 1998.
5. Kamolratanakul P. Clinical economics I. Chula Med J 1987 Oct; 31 (10): 769 - 74
6. Kamolratanakul P. Clinical economics II. Chula Med J 1987 Nov; 31 (11): 851 - 61
7. Kamolratanakul P. Clinical decision analysis. Chula Med J 1989 Aug; 33 (8): 575 - 83
8. Dhanamun B, Wanawake J, Kongsawat S, Kamolratanakul P. Hospital costs analysis. Chula Med J 1991 Jul; 35 (7): 417 - 22
9. Chotiwan P, Hempisut P, Kamolratanakul P, Dhanamun B, Tungcharoensathien V, Hiransuthikul N. Unit costs of laboratory tests at the outpatient department of Chulalongkorn Hospital. Chula Med J 1996 Oct; 40 (10): 801 - 13
10. Charuruks N. Future trend in laboratory management in Thailand. Chula Med J (Submitted)