

COST RECOVERY OF AUTOMATED CLINICAL ANALYZER

(A Case Study In Public Hospital Laboratory and Private Clinical Laboratory)

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ABSTRAK

Biaya pelayanan laboratorium adalah informasi yang perlu diketahui oleh pembuat keputusan dalam rangka penetapan tarif yang diberlakukan sebagai bagian dari sumber pendapatan yang tujuannya adalah untuk memulihkan biaya produksi. Namun pertimbangan penetapan tarif juga harus mempertimbangkan misi dari masing-masing penyedia pelayanan antara lain pemerintah dan swasta. Sehingga perlu dilakukan studi untuk mengetahui besarnya biaya pemulihan yang layak sebagai pedoman untuk penetapan besar tarif di masing-masing fasilitas.

Tujuan dari studi ini adalah untuk mempelajari biaya pemulihan dari Automated Clinical Analyzer (ACA) di laboratorium rumah sakit pemerintah dan laboratorium klinik swasta di Jawa Timur.

Studi ini menerapkan distribusi langsung anggaran dari pusat pembiayaan institusi yang bersangkutan untuk alokasi biaya dalam perhitungan biaya total cost. Biaya total diklasifikasikan dalam biaya kapital (capital cost) dan biaya kembali (recurrent cost). Rasio biaya pemulihan dihitung dari total pendapatan dibagi biaya total. Bila ratio biaya pemulihan kurang dari satu menunjukkan bahwa provider mengalami kerugian, sebaliknya bila ratio biaya pemulihan lebih dari satu, berarti provider mendapatkan keuntungan.

Hasil studi menunjukkan, di kedua fasilitas pelayanan, biaya kapital memberi kontribusi terbesar dari total biaya, diikuti biaya material dan biaya tenaga. Di laboratorium rumah sakit pemerintah biaya capital sebesar 48,3%, biaya material 44,4% dan biaya tenaga 7,3%. Sedangkan di laboratorium klinik swasta biaya capital sebesar 53,5%, biaya material 31,7% dan biaya tenaga 14,8%. Dari biaya kapital, harga pembelian ACA menggunakan porsi biaya terbanyak. Biaya satuan rata-rata di kedua fasilitas masing-masing adalah Rp. 7.330 dan Rp. 13.983. Ratio biaya pemulihan di laboratorium rumah sakit pemerintah adalah 1,22 sedangkan di laboratorium klinik swasta adalah 1,45. Berarti kedua fasilitas mendapatkan untung. Tarif rata-rata pemeriksaan test laboratorium di rumah sakit pemerintah adalah Rp. 9.220 dan jumlah pemeriksaan test laboratorium telah melebihi titik impas (break-even point) maka disarankan untuk menurunkan biaya sebesar biaya satuan (Rp. 7.330) mengingat rumah sakit pemerintah mempunyai misi tidak mengambil keuntungan (non-profit). Untuk sektor swasta, keuntungan 20% merupakan keuntungan yang layak sehingga disarankan menurunkan tarif pemeriksaan sebesar 3% dari tarif rata-rata yang saat ini adalah Rp. 17.250. Kebijakan penetapan tarif juga perlu mempertimbangkan

pengeluaran tarif untuk mereka yang membayar langsung (out of pocket) dan mereka yang tidak mampu membayar pelayanan.

Key words: *Cost Automated Clinical Analyzer; Public Hospital Laboratory; Private Clinical Laboratory.*

INTRODUCTION

The use of new medical technology tends to increase steadily. It will improve the accuracy, specificity and sensitivity of this machine producing the precise diagnosis. For examples: Utilization of Magnetic Resonance Imaging (MRI), Computerized Tomography Scanning (CT scan), Ultrasonography (USG) and Autoanalyzer. It also can improve the management of patient's care.

Due to high capital investment, new medical technology will increase the health expenditure. The experience in developed countries reveal that new medical technology contributes up to 20%-25% of the expenditure of a medical care institution (Feldstein, 1993). Like other countries, Indonesia also needs to assess the new medical technology that has been introduced in medical care, since national health expenditure in Indonesia which is less than 3% of Gross Domestic Product (GDP) should not be consumed too much for high medical technology equipment so that public health program (e.g. promotion and preventive) could be expanded (MOH, 1997).

Automated Clinical Analyzer (ACA) is a costly laboratory equipment that has more test capability, more investment cost

(29.06% of total cost) and high operational and maintenance cost (70.94% of total cost) (PPEKI, 1991), resulting cost for every test become expensive. To be effective, such equipment must be operated, calibrated and maintained by trained staff. It also involves the use of digital system in which the price of the system i.e. the hardware and the software are expensive and the cost of maintenance of the system (i.e. replacement component or spare part) is also high. In addition, the use of a new medical technology needs a high-qualified clinician as well as the support infrastructure necessary for continuing use of the device, and this will add the expenses of medical care.

There are advantages from this machine, such as the machine developed continuously to improve the outcome of patient care; only need one operator or technician to operate so the labor cost become lower; mass production which means more capacity in one run; and rapid assessment which means result can achieve more faster. The accuracy, precision and sensitivity of this machine were show excellent performance than the manual method (Las Heras *et al*, 1993, Ben Naoul *et al* 1993, Flood *et al*, 1990). From an exploration study of

Autoanalyzer at 3 clinical laboratories in Surabaya, using cross sectional data by Sumodinoto et al (1997), revealed that the price of Autoanalyzer range between Rp. 60 Million (US\$ 24,000) to Rp. 215 Million (US\$ 86,000), with credit payment less than 5 years, at the year of purchasing between 1993 to 1997. The utilization rate was average at 20% of full capacity per year. The study did not estimate the total cost and cost revenue.

PPEKI (Association of Indonesia Health Economists) studied about Utilization of Modern Medical Equipment in Jakarta in 1991. The objectives of this study was mainly to investigate and inventarization of modern medical equipment which included aspect of utilization and cost recovery in many hospitals. Using Fixed cost and Variable cost as cost classification, the study revealed that unit cost was Rp. 2,303, while the average charge was Rp. 3,000. Cost recovery of ACA studied was range between 35.73% to 196.21%. The average was 140.42%. With the high cost investment, and low utilization rate (46.41%), the patient had to pay a high cost for the examination. The study did not show the differences of the cost and revenue in public and private sector.

A study on unit costs of laboratory tests was conducted by Chothiwan, et al (1996), The cost was classified into capital cost, material cost, and labor cost. They found that average charge for laboratory test was 33 Baht, while average unit costs was 26 Baht. They also found that the

material cost was contribute the greatest portion (44% of total cost), which is 76% spent the expenses for the reagents.

The cost of laboratory services is the information that must be known if the facility is considering to apply user charge as part of the financing sources. The aim is to recover the cost of services provided of the full costs. However it is not fair to charge the same price in public hospital and private hospital. Thus, it seems to be relevant to find the information of cost as well as revenue to provide a guide to setting the price in both facilities.

The objective was to study the cost recovery of Automated Clinical Analyzer in a public hospital laboratory and a private clinical laboratory in East Java province.

Expected Benefit

It is hoped that this study can be used as an input and information to policy makers to make appropriate decision on pricing policy for setting appropriate services charges and purchasing of medical technology assessment, especially the cost effectiveness analysis of new medical devices.

Definition

Capital costs: Those costs concentrated at the beginning of a project and associated with the establishment of productive capacity and physical infrastructure.

Recurrent costs: Those costs associated with the operation or maintenance of facilities or assets.

Revenue: The output of production had been sold in terms of money.

Cost recovery ratio: Ratio of cost that can recover from total revenue over total cost.

METHODOLOGY

Study Design

This study is cross sectional descriptive study by collected the data from laboratory unit in a public hospital laboratory and a private clinical laboratory during October 1998 to September 1999. This study proposed to estimate the total cost, total revenue and the cost recovery of laboratory tests of Automated Clinical Analyzer using capital cost and recurrent cost as cost classification. The study applied direct distribution for cost allocation.

Target Population and Sampling Technique of Facilities.

Target population were public hospital laboratories and private clinical laboratories that have ACA in their laboratory unit. From 40 public hospitals and 92 private clinical laboratories, one sample of each institution was selected purposively. The selected public hospital was type B public hospital, while selected private clinical laboratory was Type

Utama private clinical laboratory. The availability of data provided become the consideration of selected facilities as well.

Data Collection

This study collected the secondary data of production cost and revenue from laboratory unit in public hospital and private clinical laboratory, which has Automated Clinical Analyzer to investigate the laboratory tests. The variables to be measured were number of laboratory tests, charge of each test, capital cost, material cost, maintenance cost and labor cost. The instrument used was structured questionair.

Cost Classification

This study classified the cost by input into two groups (WHO, 1989):

1) Capital cost

These include the costs of construction of building, installation of equipment, purchase of vehicle, investment in human capital (i.e. initial training)

2) Recurrent cost

Typically, they include the costs of:

- **Material cost:** administration, stationery, reagents, electricity, water, telephone and fuel (if any).
- **Labor cost:** Salary, fringe benefit and incentives
- **Maintenance:** building, equipment and spare part
- This study applied the direct distribution for cost allocation.

Calculation of Capital Cost

Since we consider the economic cost, we have to justify the opportunity cost of the capital being used up. Then, we have to compute the capital cost by including the rate of inflation in the purchase price. All of the costs were calculated at 1999 price and then the annual costs of all capital cost items were calculated. To calculate the annual costs of all capital cost inputs, the following information are needed (Carryn and Evlo, 1995):

- Purchase price of the assets at the year bought
- Lifetime of assets
- Interest rate during period of study
- Annualization factors

The interest rate in Indonesia during 1991 to 1999 was vary from 12.53% to 23.32%, with average 17.47%. The real interest rate in 1999 was 15.77%, which was nearly the average. Thus this study used the interest rate 15.77%. The data was obtained from the Central Bank of Indonesia.

Then, we should spread the amount of the current value over the n years of the lifetime of the assets, namely annual cost. If we consider to the amount saved if the value is invested in the bank at interest rate per year, then the annual cost of the capital cost can be calculated by using the following formula (Shepard *et al*, 1998):

$$\text{Annualized cost} = \frac{\text{The purchase price} \cdot (1 + \text{interest rate})^{\text{current year} - \text{purchase year}}}{\text{Annualization factor}}$$

Calculation of Recurrent Costs.

Component of recurrent cost consist of material cost and labor cost. The recurrent cost was calculate based on yearly cost. Since material cost comprises many items so the material cost were calculated as price of each item multiplied by the total number of each material item used. Labor cost calculation comprises salary, fringe benefit and incentives. The total salary received by the labor was assumed that they did not work at other unit. The labor cost was calculated by adding all items of salary.

Revenue Calculation

The revenue of laboratory test with ACA was calculated from the output of ACA utilization in laboratory unit of public hospital laboratory and private clinical laboratory. The revenue was derived by multiplying total number of each test with the charges of each test. The laboratory tests was tests of blood chemistry such as liver function tests and renal function tests. Assumed that all the tests was fully paid, without exemption of the charges.

Cost Recovery Calculation

The cost recovery ratio was defined as ratio of the cost that can recover from total revenue over total cost. If cost

recovery less than one, means the provider is loss, on the other hand if the cost recovery more than one means the provider get profit. Cost recovery could be computed by dividing total revenue over total cost.

Sensitivity Analysis

Sensitivity analysis was done to know whether the changes of variable used in the cost and revenue calculation would affect the result of calculation. Since the two facilities have different mission, then we do the sensitivity analysis separately.

1) In public hospital

The variable selected were number of tests and charge. Based on achieving break-even point can be regarded as worthwhile revenue and tests requested in public facility. In addition, sensitivity analysis was also done by applied opportunity cost of labor cost in public hospital.

2) In clinical laboratory

The variable selected was percentage of profit gain of total cost. Profit is a must for the sustainability of private sector. This study used the average profit of the firm, i.e. 20% to calculate the appropriate charge.

the capital cost, followed by material cost and labor cost. The percentage of cost shared by capital cost, material cost and labor cost were 48.3%, 44.4% and 7.3% respectively (see Table 1). Of the capital cost, 53% contributed by the cost of ACA (see Table 2).

In private clinical laboratory, the pattern of components was the same. The differences was the percentage of each component. The cost of ACA was determined as the largest portion (92.9%) of capital cost, even higher than portion of material cost and labor cost (see Table 2). This is because they have three machine and they use all machine to provide the laboratory services. Meanwhile, the building cost shared the lowest portion because the private clinical laboratory use the rent building so it has not to pay a larger amount of initial cost.

Material cost revealed the operational cost during one year. The reagent cost was the biggest portion of total material cost in both facilities. The material cost in private clinical laboratory contributed 31.7% of total cost. It seems they spent the material cost more efficient compare than material cost spent by public hospital laboratory. The salary in private clinical laboratory was high because they used the market price to pay their personnel, while at public hospital referred to the government regulation.

FINDINGS

Components of Total Cost

In public hospital laboratory, it was found that the highest portion of cost was

Table 1. Cost Sharing of Total Cost in Public Hospital and Private Clinical Laboratory, 1999

Cost Item	Public hospital (Rp.)	Percentage	Clinical laboratory (Rp.)	Percentage
Capital cost	346,782,575	48.3%	450,134,518	53.5%
Material cost	319,409,085	44.4%	266,808,642	31.7%
Labor cost	52,310,400	7.3%	124,200,000	14.8%
Total cost	718,502,060	100%	841,143,161	100%

Table 2. Cost Sharing of Capital Cost in Public Hospital and Private Clinical Laboratory, 1999

Cost Items	Public hospital		Clinical laboratory	
	Annual price (Rp)	Percentage	Annual price (Rp)	Percentage
Building	87,260,719	25.5%	8,416,714	1.9%
ACA*	186,171,953	53.7%	418,165,012	92.9%
Office inventory	73,349,904	21.1%	23,552,792	5.2%
Total	346,782,575	100%	450,134,518	100%

* = Automated Clinical Analyzer

The findings of this study was different with the similar study by **Chotiwan *et al*** (1996). They found that material cost was the biggest component (44% of total cost) followed by labor cost (31.43%) and capital cost (24.40%). This may be because they used direct and indirect allocation of the cost. Usually indirect allocation cost was added to material cost. Meanwhile this study only used the direct allocation. In addition, they obtained high material cost, because of their study determining all the cost of laboratory tests, which means a lot of reagent costs included, while in this study, only certain laboratory tests cost were calculated.

Average Cost / Unit Cost.

Average cost is the cost per unit of output. It also named unit cost. Irrespective of how cost are classified, we can derived three kind of average cost, that is Average Fixed Cost (AFC), Average Variable Cost (AVC) and Average Total Cost (ATC). The average cost was calculated by dividing the costs, i.e. fixed cost, variable cost and total cost, with total number of test. Basically, ATC tells us the per unit cost of production. By comparing the average total cost to the price of the product, we can determine whether production is profitable or not (**Pindyck and Rubinfeld, 1998**).

In public hospital laboratory, it was found that the average fixed cost (AFC), average variable cost (AVC) and average total cost (ATC) of laboratory test were Rp. 4,071, Rp. 3,259 and Rp. 7,330 respectively. Those average costs were lower than average charge (Rp. 9,220) (see Table 3). The average charge is the actual charge on average.

In private clinical laboratory, it was found that average charge (Rp. 17,250) much higher than average total cost. The AFC, AVC and ATC were Rp. 9,547, Rp. 4,435 and Rp. 13,982 respectively. As a private firm which tries to maximize profit, it was not surprised.

Theoretically, AFC does not influenced by the number of output, so the AFC will be higher with low output and become lower with high output. The AVC is the function of output, the change in output will affect the change in variable cost, so the AVC will not vary in the same services produce. A study by PPEKI (1991) also indicated that the average

charge was higher than average cost.

The effect of introducing new medical technology will shift both the fixed and variable components of ATC upward. So the ATC for all level of medical services will increase. However, new laboratory equipment has allowed many tasks to be automated. This leads to falling average cost over broad ranges of output levels because of the low variable costs associated with the use of this equipment. The concept of economic of scope was playing the role in this case. It means that producing many kind of tests in the same production unit will cost less than producing in separate production unit.

An increase in any of the input prices will increase costs. As production level increase, total variable expenditures will also increase. Improvements in quality usually cost more. The study by Wouter (1993) found that the number of visits and wages increase the total cost, but quality appears to reduce the cost.

Table 3. Average Cost and Average Charge In Public Hospital and Private Clinical Laboratory in East Java, 1999

Facility	Total cost (Rp)	Total number of tests	Average cost (Rp)			Average charge (Rp)
			AFC*	AVC**	ATC***	
Public hospital	718,502,060	98,012	4,071 (55%)	3,259 (45%)	7,330 (100%)	9,220
Clinical laboratory	814,143,161	60,157	7,483 (68%)	6,500 (32%)	13,983 (100%)	17,250

* = average fixed cost

** = average variable cost

*** = average total cost

Revenue

User charge or price is one of the sources of finance from revenue source. It was assumed that the revenue was fully collected and no exemption of the charges. It was found the total revenue of ACA in public hospital laboratory and private clinical laboratory were Rp. 883,012,800 and Rp. 1,219,805,000 respectively. It was exceed the total cost, i.e. Rp. 718,502,060 in public hospital and Rp. 841,143,161 in clinical laboratory, which means that they have profit for year 1999 from the services provided. The total revenue were obtained from certain tests such as blood glucose, total cholesterol, triglyceride, HDL, blood urea nitrogen, uric acid, total bilirubin, SGOT/SGPT, total protein albumin and alkali phosphatase.

Cost Recovery

While program considering to introduce the charge, the aim might to be recovering the costs of the services provided. It may recover either the cost of total cost or operational cost. The high investment cost of capital cost should not be ignored when the sustainability of the program was taken into consideration. The results of calculation of cost recovery ratio in public hospital laboratory and private clinical laboratory were 1.22 and 1.45 respectively. It means that they earn profit and cover the total cost in this year. With utilization rate of full capacity per year in public hospital laboratory was 17.5% and private clinical laboratory was

10.7%, they can recover the cost. The profit achieved in public hospital and clinical laboratory, were 22% and 45% respectively. This is due to some of the material and labor cost received subsidy (in public hospital laboratory) and the charge of the services above the average unit cost (in both facilities). However, it does not mean that they have profit for the long run.

This study only calculated the economic cost and financial cost for one year, meanwhile the calculation of loss and profit should be calculated start at the point when the services was provided. The finding from study by PPEKI (1991) revealed that cost recovery ratio ranged between 0.35 to 2.36 with an average of 1.40.

If the policy maker attempt to recover the cost, they have to consider the effect of charge on the demand for services. If demand falls, this may lead to an increase in average cost. Even they recover only a small portion of total cost, the charges might affect to the demand for the services.

If we concern with the long-run sustainability of the program, the total cost of paying for all of its input, even those temporarily provided by donors or paid for at less than market rates, must be estimated. Economic cost should be considered to supplement financial cost analysis as additional information for decision making.

The result of cost recovery ratio above can attracting more investor to

invest more machine because of the utilization of this machine revealed efficiency in term of cost recovery. However, the inefficiency in term of utilization rate and inequity in access and source of finance of patients, must to become consideration before implementing the program.

Concern about the equity, what will be the effect of the cost recovery systems on the health care accessibility of the poor people? And what mechanisms can ensure that the poor and other vulnerable group will receive care? In many countries, these concerns have led to measures, which exempt the poor from charges in order to ensure that they have access to health care (Carrin and Evlo, 1995 and Newbrader, 1997).

Sensitivity Analysis

1) In public hospital

It was found that appropriate number of tests at BEP was 66,950 tests which is 32% below the actual the number of tests (98,012 tests). For public sector, it was no significant implication of break-even point because either they have profit or loss, the services still have to be provided to the society. Since the aim is not for profit, the charge should be reduced to increase the demand only if necessary. In this case, it is

possible to increase the number of tests requested.

The result indicate that the appropriate charge at BEP was Rp. 7,331) which is 20% lower than average actual charge (Rp. 9,220). The facility should reduce the price at that point. This appropriate charge can also apply to provide the exemption charge for those who pay out of pocket or who cannot pay the services.

Concern with the long-run sustainability of services provided the total cost of all input must be estimated. In this study, the labor cost in public hospital receives subsidy from the government so the labor cost is financial cost, while concern with economic cost or opportunity cost then labor cost must be the same as the cost in the private sector or market price (Table 4). By applied opportunity cost of personnel, if they worked in private sector, the result of estimating opportunity cost showed that cost recovery ratio was 1.04. It means that the cost are still recover when opportunity costs of personnel is taken into account. It revealed that possible to increase the salary of labor with consider that cost still recover.

Table 4. The Cost Adjusted for Market Value in Public Hospital laboratory, 1999

Cost Item	Market Value	Percentage of Total Cost
Capital cost (Rp.)	346,782,575	41
Material cost (Rp.)	319,409,085	38
Labor cost (Rp.)	178,800,000	21
Total cost (Rp.)	844,991,660	100
Total revenue (Rp.)	883,012,800	–
Cost recovery ratio	1.04	–

- 2) In private clinical laboratory
If the profit reduced up to 20%, the charge was Rp. 16,779. It was 3% lower than actual average charge (Rp. 17,250). The manager should readjust the charge by reducing 3% of actual charge. The decision to reducing the charge will create more demand for the tests with assumption the physician request the appropriate laboratory tests that should be done, based on the diagnosis.

was lower than average charge both in public hospital and clinical laboratory. Limitation of data available prohibited to provide precise estimating the average cost, when considering the unit cost for each test.

In terms of cost recovery, it was indicated that both public hospital and clinical laboratory had profit in 1999. However, it did not mean they had profit for the long-run. Moreover, it is necessary to calculate the cost recovery for every year, starting from the first year of ACA utilization.

CONCLUSION

According to the economic and financial situation result, the capital cost was determined as the biggest component of total costs both in public hospital and clinical laboratory, followed by material cost and labor cost. The investment of ACA was the highest portion of total costs. It is important to consider the cost and effectiveness of this machine before decide to invest or adopt it.

Calculation of average cost for the short-run revealed that average total cost

Recommendation

With regard to equity, it is necessary to regulate the pricing policy by adjusting the prices of services provided, and promoting the competition in health services for benefit of consumers, according to the user characteristics in public hospital and clinical laboratory, since the cost can recover with the low utilization rate. For instance, the information of charge and the services should be provided to the community. Other mechanism to ensure efficient use

of laboratory services may be appropriate for referral system, which is, involves public and private sector for cooperative services as well as to ensure the alliance between public hospital laboratory and primary health centre in district area.

Moreover, in the public hospital laboratory, at break-even point the appropriate charge was 20% lower than actual charge. This should be considered by the policy makers to adjust the price to the exemption charge for the ones who has to pay out of pocket and the ones who cannot afford for the services.

Nevertheless, government has to emphasize on the private sector to adjust the charge on the basis of the average profit, i.e. 20%, since health sector is the area, which cannot ignore the social function. The reduction of charge suggested is based on the calculation of cost recovery ratio 1.20.

However, more careful analysis of the effect of any production charges, which aim to improve technical and /or economic efficiency on quality of laboratory services, should be undertaken before implication. Furthermore, when concerning with economic cost, public sector should take into account all the resources employed, not just the ones they pay for.

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