

CHAPTER 2

LITERATURE REVIEW



This chapter presents the literature review on costing, utilization, technical evaluation, and cost recovery of Automated Clinical Analyzer.

2.1 Cost of Using Automated Clinical Analyzer.

There are a few studies in Indonesia in this field as well as other countries regarding to the cost study of Automated Clinical Analyzer. A review of some of the available literatures related to this study is as follows:

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. This 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. They found that utilization rate of Biochemical Analyzer was 46.41% of full capacity per year. The highest price of Biochemical Analyzer was US\$ 160,000 . Using Fixed cost and Variable cost as cost classification, they found that most of the service charges (Rp. 3,000) for laboratory tests were higher than the unit costs (Rp. 2,303). Average fixed cost per unit was 27.64% of total cost per unit and average variable cost per unit was 72.36% of total cost per unit. Cost recovery range between 35.73% to 196.21%, with average 140.42%. With the high cost investment, and low utilization rate, the patient had to pay a high cost for the examination. This 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), at Chulalongkorn hospital, Bangkok. They classified the cost into capital cost, material cost, and labor cost, using the direct and indirect cost allocation. They found that most of the service charges for laboratory test were higher than the unit costs. Average unit cost of blood chemistry test was 26.84 Baht, and the charge was 40 Baht. Average unit cost of electrolyte test was 11.36 Baht, and the charge was 33.75 Baht. Average unit cost of liver function test was 16.34 Baht, and the charge was 30 Baht. Most of the numbers of tests requested were higher than a break-even point. This revealed that their revenue could cover the cost. This study also found that the material cost was the highest cost, which was the chemical cost contribute the greatest portion (76%) of material cost.

2.2 Utilization of Medical Services.

There are many factors influencing the utilization of medical services. Some studies explain as follows. Factors influence the utilization are socioeconomic status, accessibility of the services provided, financing sources, and pricing system.

Gilson (1988) explored the factors influencing utilization from user characteristic and provider, both public and private perspective, by reviewing related studies in health care utilization. From user characteristics, higher income status was, however, clearly associated with preference for modern care. Other proxies of socioeconomic status of utilization decision included education, age, size of household and urbanization. From the provider features, she found that access to health care influence the utilization, poor physical access generates costs additional to the price of care. There is probably because of transport costs, time cost due to a loss of income resulting from the time taken to seek care. It affects not only whether a patient will seek medical care but also the extend of the care once treatment is undertaken.

From the study of assessment of utilization pattern in rural and urban government health facility, using data from random sample survey of the population and health provider, Berman et al (1987) examined the differences in health care utilization and

expenditure by socioeconomic group. It was found that at all levels of illness severity, higher income groups were more likely to seek care than lower income groups. Utilization of all types of care except traditional care increased with income. Use of private care was primarily restricted to the upper income category. Majority of cash expenditure for health care came from high income groups. From severity of illness, he found that per episode expenditure was greater for more serious illness. He also found that cost recovery interventions might force some people (low-income groups) out of the health care market. Public services play an important role in providing a low cost modern treatment alternative.

Feldstein (1993) stated that education was also believed to affect the demand for medical services. A greater amount of education in the household may enable a family to recognize the early symptom of illness, resulting in a greater willingness to seek early treatment. Higher level of education may also lead to increased efficiency in a family's purchase and use of medical services. With the growth of more comprehensive hospital insurance, financial constraints became less important, and physicians prescribed the highest quality of medical care for their patients. This was rational behavior on the part of the physician and the patient, since the marginal benefit of additional tests and other services, no matter how small, was probably greater than the out-of-pocket price the patient had to pay.

Marital status and number of person in the family also affect the demand for medical care. Single person generally uses hospital care more than the married person. The availability of people at home to care for an individual may substitute for additional day in the hospital.

The change in the reimbursement rate for laboratory services also had a strong impact on the quantity of laboratory services provided. The lower the price of laboratory tests are, the greater the number of tests will be ordered by the physician. It may be rationalized that the additional demand created by physician (known as supply induced demand) provides beneficial services. However, these additional services may be unnecessary and should not be provided when there are sufficient demands of more serious cases.

From provider features, Cherrnichovsky and Meesok (1985) in their study of utilization of health services in Indonesia, using national household sample survey data, found that, limited services availability, relatively high cash price, and low household income reduced utilization. They conclude that the provision of zero-price public services to the poor is an essential public policy for the country. More expensive private care had to be used by higher income groups.

2.3 Studies of Technical Evaluation of Autoanalyzer

There are many studies of technical evaluation of autoanalyzer in some countries. These studies were conducted according to the evaluation of laboratory equipment guidelines and protocols such as Evaluation Control of Clinical Laboratory System (ECCLS), French Society for Clinical Biology (SFBC). The evaluation emphasize on quality control, such as accuracy, precision, linearity, reliability, practicability, carry-over, both samples and reagents, effective speed, effect of the sample storage, contamination among samples and reagents, analytical performance and drift effects.

Here is some empirical results on technical evaluation of autoanalyzer in some countries.

Table 2.1 Summary of Empirical Result on Technical Evaluation of Autoanalyzer in Some Countries.

Author	City / Country	Year of publication	Type of Analyzer	Result
Las Heras G, Milla F, Ribera JM, Oriol A, Feliu E	Barcelona / Spain	1993	The System 9000-AX	Accuracy better than manual method ($r > 0.80$) Sensitivity, specificity and efficiency $> 80\%$ No significant contamination (low carry-over percentage) The samples were stable for 24 hours at 4°C
Ben Naoui, Periou C, Harault C, Le Moel G	Paris, France	1993	Technicon Dax 48 system	Accuracy, precision and analytical range show excellent analytical performance, 85% of coefficient of variation $< 2\%$. No significant contamination Automated procedures (start up, shut down, maintenance, and an effective throughput) 1.5 higher than routine analyzer
Blijenberg BG, Braconnier F, Vallez JM, Burlina A, Plebani M, Celadin M, Haeckel R, Et al	Rotterdam, The Netherlands	1989	ABBOTT Spectrum	The precision was good, with majority of the coefficient of variation were between 1 and 4%, The recovery for method assigned control sera values was within 10%, No drift observed, No reagent-related carry over,
Bayer PM, Knedel M, Montalbetti N, Brenna S, Prencipe L, Vassault A, Bailly M, Phung HT, Bablok W, Poppe W	Vienna	1987	Boehringer Mannheim / Hitachi 704	The mean coefficient of variation for three control sera at different concentration were found 1.6% for the within-run imprecision and 2.8% for the between-day imprecision, No drift was observed, High linear measuring range, No samples-related carry-over, No reagent-dependent carry-over, The recovery of assigned values of control sera showed average values 99 and 104% No malfunction or breakdown of the instrument during the entire evaluation period. High linear measuring range can avoiding rerun analysis.

Table 2.1 (Continued)

Author	City / Country	Year of publication	Type of Analyzer	Result
Gonzales BJM, Ruiz J, Garcia BJL, Navajo JA, Borque L, Maside C	Spain	1994	Boehringer Mannheim Hitachi 911	Within run and between run coefficients of variation were <3%. The methods compared with other commercial method showed coefficient correlation were higher than 0.94 for all the methods. There were differences of slope and intercept for rheumatoid factor , apolipoprotein A-I and apolipoprotein B
Bonini p, Ceriotti F, Keller F, Brauer P, Stolz H, Pascual C, Garcia BL, Vonderschmitt DJ, Pei p.	Milan, Italy	1992	Boehringer Mannheim / Hitachi 747	The median coefficient of variation for three control sera were found below 1% (acceptance limit 2%) for the within-run and 2% (acceptance criterion 3%) for the between-day imprecision, No drift was observed, linear over a wide range, No samples-related carry-over, reagent-dependent carry-over outside the acceptance limit, The recovery of assigned values of control sera showed average values 95 and 105% Out of 40 method comparison studies for enzymes and substrates, 31 yielded regression equations with less than 5% proportional errors and less than 5% constant errors.
Knedel M, Haeckel R, Seidel D, Thiery J, Vonderschmitt DJ, Haenseler E	Italy	1986	Hitachi 737	The precision can be termed very good, The day-to-day coefficients of variation were below 2%, The recovery of assigned values of control sera showed average values 95 and 105%, No drift effects were observed as well as carry-over effects. Since large measuring range, repeated analysis only in exceptional cases.
Flood J, Liedtke R, Mattenheimer H, Rothouse L, Trundle D.	Boston.	1990	Boehringer Mannheim / Hitachi 717	Excellent precision with Coefficient variance < 2% for within run precision, < 3% for between day precision, minimal sample and reagent carry-over, The recovery of assigned values was acceptable.

Table 2.1 (Continued)

Author	City / Country	Year of publication	Type of Analyzer	Result
Blinjenberg BG, Boerma GJ, Leijnse B.	The Netherlands	1989	Technicon Chem 1 system	The precision of the system can be rated as good with between-day coefficient of variation <3% No drift was observed, No carry-over was observed, either sample or reagent related, Practicability of the system was categorized as good. General linearity was found to agree with manufacturer's claims.
Lentjes EG, Harff GA, Backer ET.	Leiden, The Netherlands	1987	Hitachi 704	Linearity of response at 340nm up to 2.8 A. No sample carry-over was detected, Reagent carry-over was detected when bilirubin assay was preceded by a total protein assay and when lactate dehydrogenase was measured after alanine aminotransferase.
Van Straalen JP, Leyte A, Weber JA, GorgelsJP, Sanders GT.	The Netherlands	1995	Hitachi 911	The requirements in term of analytical performance, reliability, versatility and speed for an analyzer to be used in a routine urine setting.
Jacobs E, Vadasdy E, Sarkozi L, Colman N.	New York	1993	i-STAT Portable Clinical Analyzer	No significant differences in either the imprecision or accuracy of the system placed in a cardiothoracic ICU and operated by nurses. Intrarun imprecision (CV) ranged 0.34% - 3.97%, total imprecision over a 2-month period range 0.42% - 4.83%.

2.4 Cost Recovery

User charge is one of the sources of finance from revenue source of health services program. 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. If the investment cost is very high, the total cost must be considered.

Carrin and Evlo (1995) derived the evaluation of cost recovery into 3 ways, i.e. economic efficiency, administrative efficiency and equity.

1) Economic efficiency

One way of applying this criteria is to study the cost effectiveness analysis, which is able to show the extend to which a given system of financing is economically efficient. The aim is obviously to economize on the use of resources in attaining the set objective. The achieved savings can then be used for other interventions.

2) Administrative efficiency

Following the rules of cost effectiveness, the cost of administration must, therefore, be minimized, while the objective of producing adequate laboratory services must be still be achieved. There are several factors that improve the efficient administration.

First, the manager of the system must be allowed for a certain measure of flexibility and freedom. Imposing too many restrictions may hamper the efficiency of the system.

Second, it should have the stability of sources of financing. The charges system will be effective if there are continuously ability to pay of the services provided. If not, it will be difficult to keep the chosen system of cost recovery going.

Third, the use of too many management tools can add unreasonably to administrative cost. The number and types of management tools must be decided in the light of whether they contribute to an adequate system of health care provision. It should be noted that even the simplest system of cost recovery covering only a limited population still require a certain amount of administration. Resources for administration (personnel, equipment, etc) must be used judiciously.

3) Equity

A system of cost recovery is said to be equitable when patients with similar needs for medical care are effectively able to obtain the same treatment. It is obvious that the charges that patients must pay influencing the extent to which they seek care. It is essential to have a good knowledge of these effects if the objective of equity is to be pursued.

It is not easy to incorporate the concept of equity into cost recovery system. Equity is often said to conflict with efficiency. For example, a system of itemized charges more equitable by exempting the poorer part of the population from payment for care, but it will be additional administrative costs because it will need to identify those who are poor and to monitor their poverty status. The charges that patients must pay influence the extent to which they seek care.

It is realized that the government capability to provide adequate funding is very much limited. Therefore, community participation to provide additional funding for health services should be encouraged. Effort to reach equity in the provision of health service and promotion of their accessibility, particularly by low income communities, add more complexity to the problem. The adjustment of tariffs at government health services may cause decreased accessibility to these services by low income communities. This has created problems for the delivery of health services in public health facilities and has limited the ability of government to open new facilities, and provides more service. The Ministry of health has encouraged the involvement of the private sector in delivering health services. This will relieve the government from making large investment in costly facilities. All private sector are required to provide subsidized services to the poor to eliminated equity problems.

Carrin and Evlo (1995) in their study of the cost recovery system found that flat rate and prepayment system of charges can meet the objective of equity (i.e. the patients with the same need should have the same access to care) than a system of itemized charges. In the case of guinea, a flat rate system would be the most appropriate, especially for the health centers and hospital. They stated that socioeconomic condition, the standard of living and access to care might vary so widely between the different regions of the country that the introduction of a nationwide fee system must be contemplated with great caution. A system of charges differentiated by region will then need to be considered. Many development countries have provided health care services without charge. But decreasing government resources and increasing demand for health services over the past decade have created a need for new revenue sources to operate public health systems.

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. Various targeting mechanisms are used for doing this. These can be either direct or characteristic targeting (Newbrander, 1997). Direct targeting means providing free or reduced-price benefits to people who cannot pay because of low income. It often uses means testing to determine how many people can afford to pay. Characteristic targeting involves providing free or reduced-price benefits to people with certain attributes regardless of income level, such as infants or the elderly, or people with certain illnesses such as tuberculosis. These ways of targeting can be used alone or combined to work out a solution, which fits the local situation.

Newbrander, in the 1997 study conducted in five countries to determine the effective of exemption measures in ensuring access to health care by the poor showed that the poor often pay for health services even when they were supposed to be free. Public hospital services are free, but there are no supplies of drugs, so the poor have to buy these from the private sector. Creative exemption measures have been found in both public and private health institutions.

It may be wise to charge low fees for outpatient services, or to provide them without charge but it is more difficult to grant exemptions for costly inpatient services, especially when they need more examination. The basic priority is the appropriate financing of health systems to meet national health objectives. Charge is only one option for resolving the broader issue of paying for health care. Measures to recover cost, such as user charges, have been introduced in many countries. A variety of cost recovery systems have been tried in order to replace or supplement government funds, but the impact of the charges of health services is often ignored (Newbrander, 1997).

The provision of health care should be used based on need rather than ability to pay. This principle can be used for policy maker and manager to find solutions to ensuring both quality and accessibility of health care. Private sector resources can be developed and used more systematically.

Paci and Wagstaff (1993), in their study of equity and efficiency in Italian health care, found that there was inequality in morbidity and mortality across socioeconomic group. The amount of medical care that person in the same degree of need receive, depending in part on their income or socioeconomic status. They also found that in terms of equality of access, among those using health care facility, the worse-off in Italy spending longer travelling to book an appointment, longer waiting to book after arriving on the premises, and longer waiting to see a doctor once they arrived at the surgery. This pattern remains even after controlling for region and employment status. Equality of access is best interpreted to mean that everyone should face the same costs of health care.

From the study to explore the stated goal of reasonable access to health care, using the conditional model for services utilization in the statistical analysis, Birch et al (1993), found that those in greatest need (i.e. poor self-assessed health) represented 5% of the sample but utilized 32% of the reported family physician contact. Further finding is the level of education appears to be positively associated with the quantity of use, particularly among those with lower level of need. Issues of equity and efficiency of health care delivery can be addressed in various ways which are policy-informing by considering variation in utilization among subgroups defined, according to the policy variable of interest (i.e. need).