LAPORAN AKHIR KAJIAN

A COST-EFFECTIVE ANALYSIS OF INTRAPARTUM CARE FOR LOW RISK MOTHERS AT TWO DIFFERENT LEVELS OF CARE IN JELI, KELANTAN.

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ABSTRACT

A study of the cost-effectiveness of intrapartum care for the low risk antenatal mother was undertaken at two different levels of care in Kelantan. Cases were selected from Jeli alternative birthing center (ABC) (community-based center) and the respective district hospital, Tanah Merah Hospital (hospital-based center) for one year starting from 1st January until 31st December 2001. Cost analysis was conducted from provider and patient perspectives. The research team used effective intrapartum care as the outcome measure. The criteria for the effective intrapartum care are based on normal clinical outcome and maternal satisfaction. A total of 117 low risk antenatal mother were recruited in the study, 58 and 59 low risk antenatal mothers from community-based and hospital-based center respectively.

Results: The marginal means of provider cost, patient cost and societal cost differed significantly ($p<0.001$) between Jeli ABC and Tanah Merah hospital for intrapartum care of low risk antenatal mother. The marginal mean provider costs were RM 390.55 and RM 521.93 per case for Jeli ABC and Tanah Merah hospital respectively. The marginal mean patient costs were RM110.32 and RM256.81 per case for ABC Jeli and Tanah Merah hospital respectively. The marginal mean societal costs were RM541.59 and RM per case for ABC intrapartum care and Tanah Merah hospital respectively. Jeli ABC was five times more effective (OR 5.17, CI: 2.010,13.304). The cost-effectiveness ratios of RM138.00 and RM323.90 per unit outcome for Jeli ABC and Tanah Merah hospital respectively were significantly different ($p<0.001$).

Conclusion: The study found that Jeli alternative birthing center level (community-based center) is less expensive than Tanah Merah hospital (hospital-based center) in providing intrapartum care for low risk mothers. The center also has a better clinical outcome and higher satisfaction than Tanah Merah hospital therefore Jeli ABC is more effective in providing intrapartum care for low risk mother than Tanah Merah hospital. Jeli ABC is also more cost-effectiveness compared to Tanah Merah hospital.

ABSTRAK

Satu kajian keberkesanan kos telah dijalankan terhadap penjagaan intrapartum untuk ibu-ibu berisiko rendah di dua peringkat jagaan di Kelantan iaitu Klinik Kesihatan Jeli berasaskan komuniti dan Hospital Daerah Tanah Merah berasaskan hospital. Kes-kes dari dua peringkat jagaan tersebut di pilih untuk tempuh satu tahun dari bulan Januari hingga Disember 2001. Analisis kos telah dilakukan dari perspektif pembekal, pesakit dan masyarakat. Penyelidik menggunakan keberkesanan jagaan intrapartum sebagai ukuran hasil. Kriteria keberkesanan jagaan intrapartum adalah berasaskan hasil klinikal dan kepuasan pesakit. Seramai 117 ibu-ibu berisiko rendah direkrutkan dalam kajian ini, 58 orang adalah dari penjagaan berasaskan komuniti dan 59 orang dari penjagaan berasaskan hospital.

Keputusan : Hasil kajian mendapati kos pembekal, pesakit dan masyarakat adalah berbeza secara bererti($p<0.001$) antara peringkat jagaan tersebut dalam jagaan intrapartum ibu-ibu berisiko rendah. Purata kos marginal pembekal bagi Pusat Bersalin Alternatif Jeli adalah RM390.55 berbanding RM521.93 bagi jagaan hospital Tanah Merah. Purata kos marginal pesakit pula adalah RM 110.32 dan RM256.81 masing-masing bagi jagaan pusat bersalin alternatif Jeli dan jagaan hospital Tanah Merah. Purata kos marginal keseluruhan untuk jagaan intrapartum ibu-ibu berisiko rendah adalah masing-masing RM541.59 dan RM728.02 di pusat bersalin alternatif dan hospital Tanah Merah. Keberkesanan jagaan intrapartum di ABC Jeli juga adalah lima kali lebih berkesan (OR 5.17, CI : 2.010, 13.304) dari Hospital Tanah Merah. Purata keberkesanan kos keseluruhan juga berbeza secara bererti($p<0.001$) untuk menaikkan satu unit skor hasil, jagaan di pusat bersalin alternatif memerlukan RM138.00 berbanding RM323.90 di pusat jagaan berasaskan hospital.

Kesimpulan : Kajian mendapati pusat jagaan berasaskan komuniti, Pusat Bersalin Alternatif Jeli adalah lebih murah untuk jagaan intraprtum bagi ibu-ibu berisiko rendah berbanding dengan hospital Tanah Merah. Ia juga memberikan hasil jagaan yang lebih baik dari segi klinikal dan kepuasan pelanggan yang lebih tinggi, oleh itu keberkesanan jagaan intrapartum adalah lebih baik di ABC Jeli. Pusat bersalin alternatif Jeli juga adalah lebih kos-efektif dalam jagaan intrapartum ibu-ibu berisiko rendah berbanding dengan pusat jagaan berasaskan hospital iaitu Hospital Tanah Merah.

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AIMS AND OBJECTIVES

TITLE OF STUDY

Cost-effective analyses of intrapartum care for low risk mothers at two levels of care in Jeli, Kelantan.

GENERAL OBJECTIVE

To analyze the cost-effectiveness of intrapartum care for low risk mothers at district hospital and alternative birthing center in Jeli, Kelantan.

SPECIFIC OBJECTIVES

1. To determine and compare provider, patient and societal cost for intrapartum care of Jeli low risk mothers at Jeli alternative birthing center and Tanah Merah district hospital in Kelantan.
2. To determine the clinical outcomes of intrapartum care for Jeli low risk mothers at Jeli alternative birthing center and Tanah Merah district hospital in Kelantan.
3. To determine maternal satisfaction of intrapartum care for Jeli low risk mothers at Jeli alternative birthing center and Tanah Merah district hospital in Kelantan
4. To determine the cost-effectiveness ratio of intrapartum care of Jeli low risk mother at Jeli alternative birthing center and Tanah Merah district hospital in Kelantan.

INTRODUCTION

Both government and non-governmental health facilities provide maternity services in Malaysia. The services include antenatal, intranatal or intrapartum, postnatal and family planning. Until December 1998, maternal services were provided at 117 government hospitals, 772 health clinics, 216 private hospitals and 26 mine and estate hospitals in Malaysia (Ministry of Health Malaysia, 2000). The hospital-based services are offered at state hospitals, district hospitals, private hospitals and estate hospitals where as the community-based are at the health clinics, klinik desa and private clinics. Intrapartum services can be domiciliary deliveries by public health personnel, trained private midwives, traditional birth attendants and others, government institutions and private hospital/maternity homes. Postnatal care mainly provided by health clinic and klinik desa.

Normal delivery is the principal cause of hospitalization in Malaysia. In 1999, 21.52% (329,381 discharges) of total hospital discharges are mothers with normal delivery. Total hospital deliveries in Malaysia for 1999 are 360,836 with 85.1% of them are normal deliveries. Kelantan has a total of 29,513 hospital deliveries for the same year and 86.0% of them are normal deliveries (JKNK, 2001a). With a large numbers of admission, usage of resources and the workload of hospital health personnel increased particularly of maternity ward. With the implementation of risk color- coding (red, yellow, green and white) in maternity services, identification of high risk and low risk antenatal mothers are made and appropriate guideline of managing them are set including setting up of alternative birthing center in early nineties where reductions of cost and hospital workload are among the objectives of the ABC (Ismail *et al*, 1999). Although it has been set up for more than 10 years, it is not known until recently. Not many are familiar with this services event among medical staff that works at hospital-based facilities because ABC is a health-based activities under maternal and child health program. Evaluation of this set up has not yet be done either of its efficiency or costing of service provided that is intrapartum care. As ABC is an alternative to hospital for intrapartum care for low risk mother, this study is done to evaluate the cost and outcome of this alternative service. For evaluation purpose, the description of the set up is elaborate with some issues related to it.

Literature Review

It is a delivery center that is provided at health clinic or klinik desa meant for low risk antenatal mothers (Ismail *et al*, 1999). ABC was first introduced in Sarawak in early nineties. In Kelantan, the first ABC was built in Tanah Merah District in 1992. The objectives of ABC are to provide safe delivery center for low risk antenatal mothers, to reduce rate of born before arrival (BBA), to reduce cost of transportation, to reduce social and financial burden if the patient is admitted to hospital and to reduce workload of hospital (Ismail *et al*, 1999). The staff of ABC comprise of the medical and health officer, public health nurse, community nurses and midwives. Some of the ABCs have a family medicine specialist in charge at their Health Clinic. The family medicine specialist and medical & health officer are available during office hour and on call basis for consultation. The core staff are midwives, community nurses and public health nurses who have been trained in midwifery courses.

Following implementation of Safe Motherhood Initiative, risk color-coding was introduced. According to World Health Organization (WHO) guidelines, the antenatal mother will be screen at first antenatal visit and given risk color-coding. The color code given can be change during follow up visit accordingly. The color code are white, green, yellow and red, the color code will be given by following the standard form of risk color-coding. Antenatal mother who had been coded as white and green can be manage by public health nurses where as yellow and red coded must be seen by medical officer or admitted to hospital because they are categorize as high risk antenatal mothers.

The Ministry of Health Malaysia has allocated budget ranging from RM130 thousand to RM176 thousand to built an ABC in each clinic around the country (JKA, 1999), however to date not many study done to evaluate this new service, to study the efficiency of the service provided, commitment of staff to the new service and response of the public.

In Malaysia, over the period 1991-1994, there were 1,066-reported maternal deaths, 808 of them direct, 121 indirect and the rest fortuitous. The principal causes of maternal death were postpartum hemorrhage, hypertensive disorder in pregnancy, obstetric pulmonary embolism, and associated medical condition, accounting for 24%, 16% 13% and 7% death respectively. In a maternal mortality review during 1991-1995, remoteness or inaccessibility was a factor in 7.2% of cases where in 4.0% of cases there

was no transport at all, in other 2.0% transport was not immediately available and the remaining 1.2% were not stated the causal factor. Deaths from postpartum hemorrhage were associated with substandard care, and in most cases there was delay in providing suitable care. Almost half of these deaths were mothers who delivered at home, often in areas where access was difficult. The establishment of facilities for staying in hospital before delivery and of **alternative birthing centers** in rural areas has therefore been recommended (Suleiman *et al*, 1999).

In 2001, the registered births in Peninsular Malaysia were 380,221, with 99.2% conducted by trained personnel. Government hospitals contributed 74.6%, government clinics 1.3%, private hospital/maternity homes 21.3%, estate hospital 0.02%, home deliveries by government midwives 1.3%, 0.015% by trained kampong midwives and 0.005% by private midwives. Only 0.6% of deliveries occur at ABC. There were 2914 (0.76%) deliveries attended by untrained personnel which are categorized as unsafe deliveries,and may jeopardize their life and their babies (IDS, 2001). In Kelantan, 507 (1.87%) of 28,948 total deliveries in 2001 were unsafe deliveries (JKNK, 2001b). Many programs were planned to improve the maternal health services, with one of the strategies was to make maternal healthcare more effective by improving access, and the ingredient necessary for making motherhood safer includes **safe delivery** (Making Motherhood Safer, 2000). ABC setting is then relevant for the accessibility and providing safe alternative place of delivery for the mothers, especially in the rural areas.

ABC will reduce the avoidable unsafe deliveries because the center will be an alternative to low risk antenatal mothers to deliver their babies and to those who refuse to go to hospital. But this can be a reality if both antenatal mothers and staff of ABC fully utilize the facilities and understand the purpose of the centers.

Not many studies have been done in Malaysia on costing of maternal health services. Cost for vaginal delivery was between RM 1629 to RM 1929 (Amrizal, 2000). Reinharz *et.al* (1999), in comparing cost of midwifery services versus medical services found that average per client direct cost of hospitalization for antenatal mother were $395 and $1652 (Canadian dollar) for midwifery services and standard medical services respectively.

No cost-effectiveness study on intrapartum care at alternative birthing center done in Malaysia, but some study have been done abroad evaluating alternative set up quite similar to our ABC, comparing with standard maternity care.

Conceptual Framework

Intrapartum care of low risk antenatal mother involve the provider of the service, patient and their family. There are 3 levels of care that provide the intrapartun care for the low risk antenatal mother, namely general hospital, district hospital and the health clinic. Different levels of care have differences in their services facilities and resources. Patients also differ their social and clinical characteristics, which influence their judgment in choosing the services provided. Staff also plays a major role in the quality of care and cost because they also have different scope of work at different level of care, different characteristics influenced by the work environment including knowledge, attitude and practice. Factors that will affect the cost of intrapartum care for the low risk antenatal mother hence can be divided into level of care, patient factors and staff factors. The antenatal mother will be discharged from the respective health facilities with an outcome and cost. The outcomes can be clinical outcomes and patient satisfaction whereas cost involve are from provider, patient and societal perspective. The ratio of outcome to cost will yield the cost-effectiveness ratio. The cost-effectiveness ratio obtained will give an economic evaluation to the two level of intrapartum care, which are alternative birthing center and district hospital. (Figure 2.2) With alternatives available in providing intrapartum care for low risk mother, the efficiency of the new alternative should be justify preventing the substandard care for the patient. This study will add on information pertaining to this service and help in other future efficiency studies.

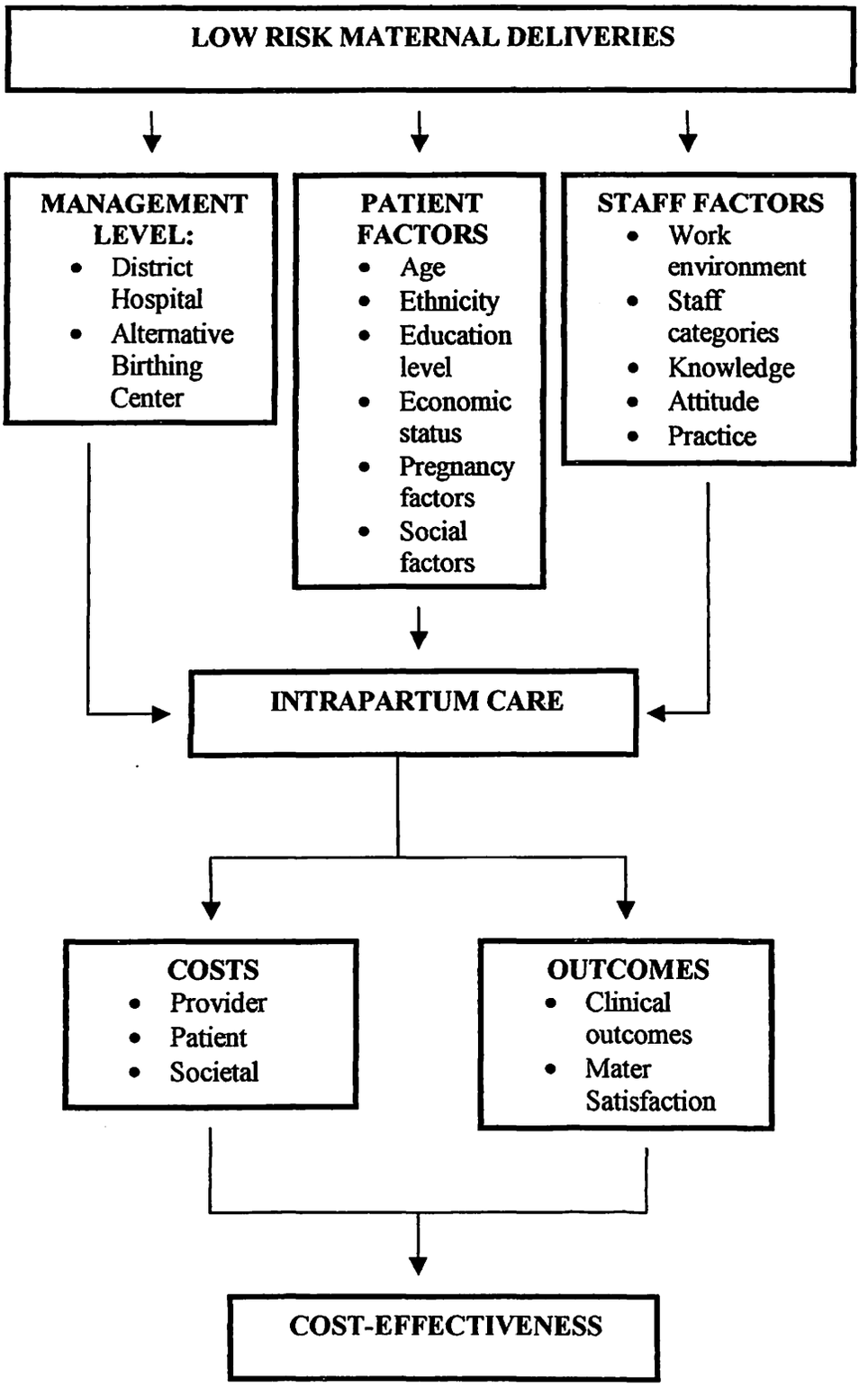

Figure 2.2 Conceptual Framework

METHODOLOGY

METHODS

Study Area

Jeli is situated in the hilly south territory of Kelantan, which covers 80% of its land, but only 20% of the Kelantan population resides there. Apart from Jeli there are 2 other districts in south teritory of Kelantan. Jeli District covers 1320,900ha area (Unit Perancang Ekonomi, Kelantan, 2000) with 42,181 populations, 2.8% of total Kelantan population (Jabatan Perangkaan Malaysia, 1998). The majority of the population involve in agricultural activities. Health facilities available at Jeli are; one district health office, three health clinics, twelve klinik desa, three private clinics, two ABCs at health clinic and 1 ABC at klinik desa.

Mothers in Jeli district have their antenatal checkup at klinik desa and health clinic nearest to their house. For intrapartum care, the mothers have two alternatives i.e ABC or district hospital. The nearest district hospital is Tanah Merah hospital, which situated 50 KM from Jeli town. All mother are advice to call midwifery in charge or go directly to ABC if they have symptoms of labor. Once they arrive at ABC, they are registered in ABC attendance book, examine by staff in charge midwife, community nurse or public health nurse. After explaining the present situation the mothers are given choice either to deliver at ABC or Tanah Merah hospital except for mothers with condition that do not permit her to deliver at ABC, so mothers who wants to deliver at hospital will used both ABC and district hospital resources (Figure 4.1).

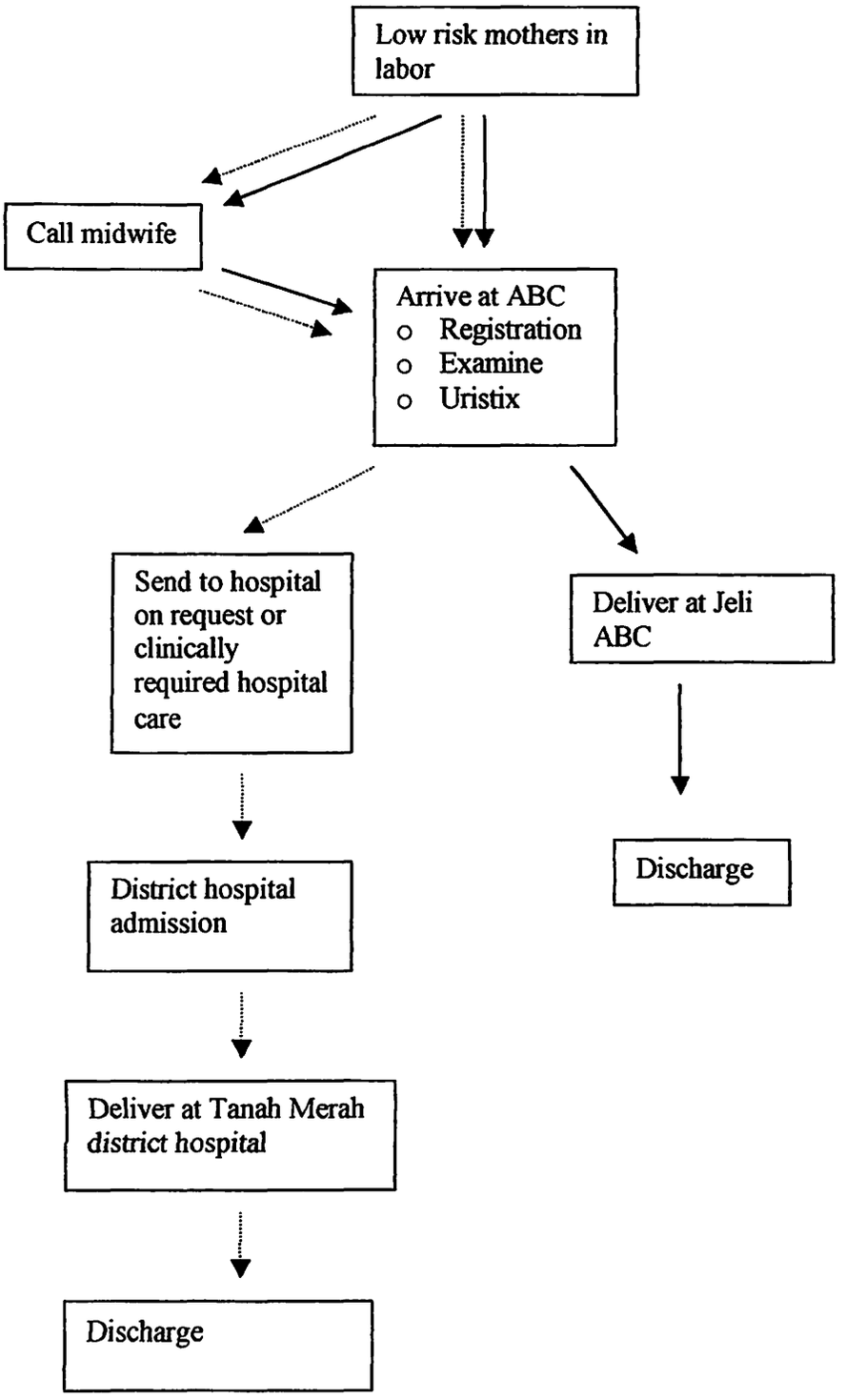

Figure 4.1 Flow of intrapartum care services for low risk mother at Jeli ABC.

Figure 4.2 and 4.3 shows the flowchart intrapartum care of mothers in labor for ABC and Tanah Merah district hospital respectively.

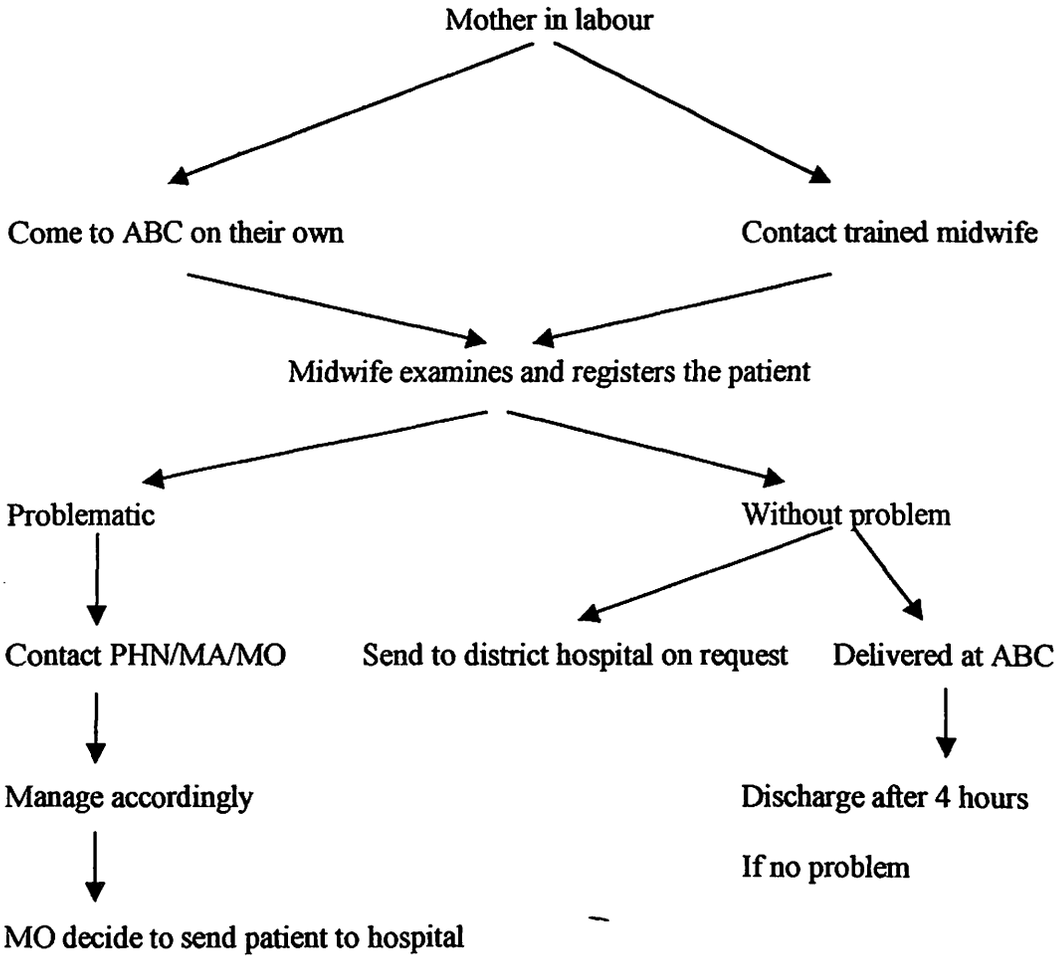

Figure 4.2: Flowchart management of mothers in labor in Jeli alternative birthing center

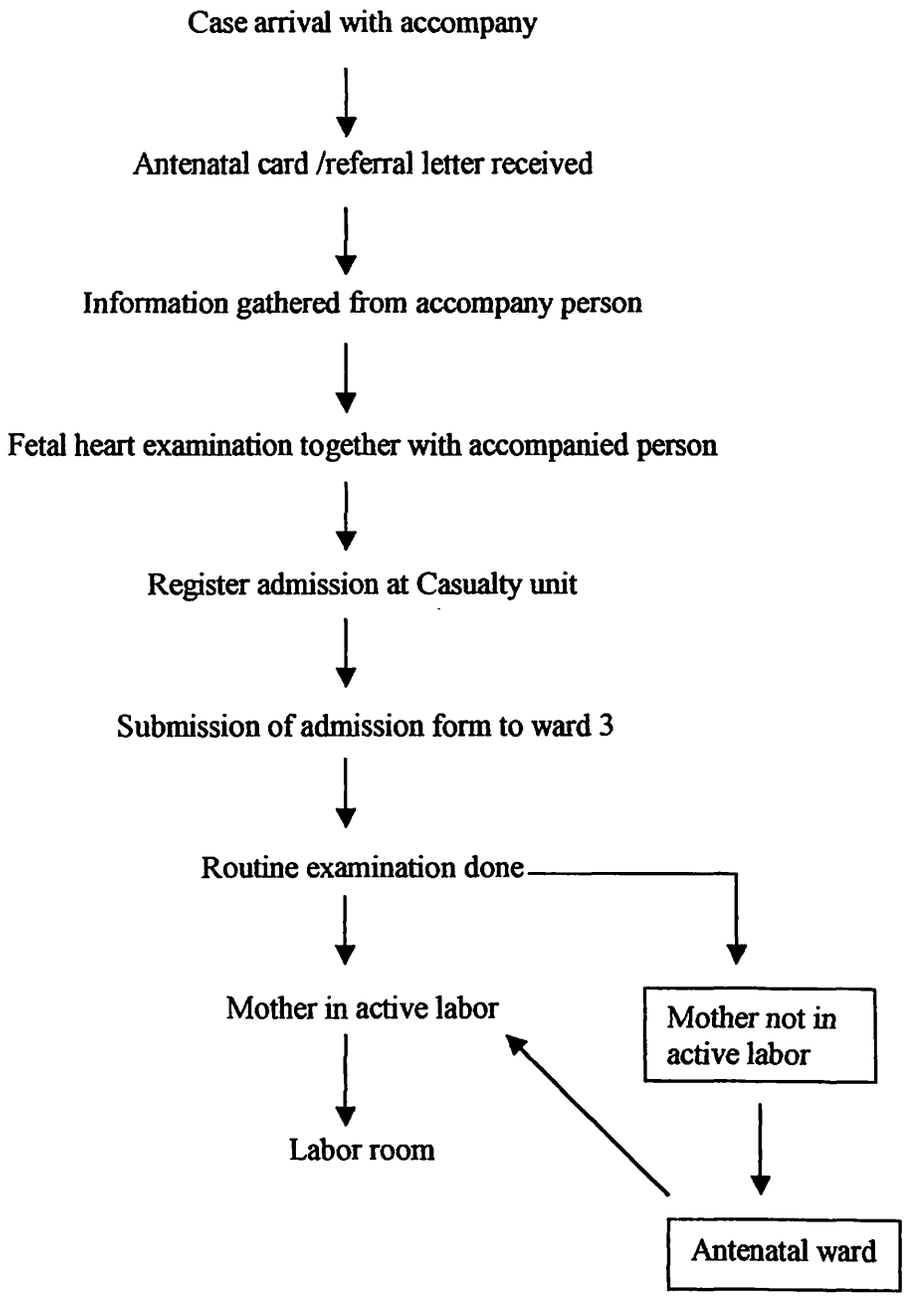

Figure 4.3: Flow chart management of mothers in labor in Tanah Merah district hospital

Research Design

Cost-effectiveness analysis is a cohort study (Dawson & Trapp, 2001) and a full economic evaluation where both the costs and outcomes are examined (Drummond *et al*, 1999). It is the method used to evaluate economic outcomes of different modes of treatment or intervention. In this study we were evaluating the costs and outcomes of intrapartum care for the low risk mother at two different levels of health facilities, namely alternative birthing center and district hospital. The outcomes measured were clinical outcomes and patient satisfaction. The costs were measured by using budget information for the financial year 2001 and the clinical outcomes and patient satisfaction also measured for the same year that was from 1st January to 31st December 2001.

Classifications of costs by input were used i.e. capital and recurrent cost.

Figure 4.4. Component of Cost

Capital cost	**Recurrent cost**
Building	Salary
Equipment	Operation and maintenance
Vehicle	Supplies
	Investigation
	Medicine
	Time
	Travelling
	Fee
	Miscellaneous

The definitions and explainations of every costs is provided in unit 4.4.

Population And Sample

Source population:

Low risk antenatal mother in Jeli,Kelantan

Sampling frame:

Low risk antenatal mother of Jeli health clinic.

Study subject:

Low risk mothers of Jeli health clinic who delivered at Jeli alternative birthing center and Tanah Merah hospital.

Inclusion criteria

a. Antenatal mothers with white and green coded antenatal cards.
b. Antenatal mothers who live in Jeli Health Clinic operational area.
c. Mothers who delivers in 2001.

Exclusion criteria

a. Antenatal mothers who are referred to tertiary hospital.

Sampling Method

Pooling of low risk mothers were done by health clinic they received their antenatal care. In Kelantan there were 10 districts with few health clinics (4 to 6 health clinics) in each district. Every health clinic had their alternative birthing center (2 to 3 alternative birthing center each health clinic). Using multistage sampling, the selected district was Jeli, the health clinic was Jeli Health clinic and the alternative birthing center was Jeli Alternative birthing center. The district hospital that caters for population of Jeli was Tanah Merah Hospital. Therefore the two health facilities that involved in the study were Jeli Alternative Birthing Center and Tanah Merah Hospital. Low risk mothers of Jeli Health clinic operational areas who delivered at Jeli ABC and Tanah Merah hospital were choosen as study subjects with the above inclusion and exclusion criteria.

The selection of subjects were carried out from same primary health care operational area i.e. Jeli Health Clinic as both group of mother will be homogenous in term of geographical factors, accessibility of maternal care and socioeconomic infrastructure.
There were two groups of mothers, those who delivered at ABC in one group and another group whom delivered at district hospital. Patient makes decision on the place of delivery after discussion with staff in charge. In 2000 there were 145 low risk mother delivered at ABC Jeli. By dividing the total numbers of low risk deliveries with calculated sample size, every alternate low risk mother then were taken as samples.

SAMPLE SIZE

Sample size was calculated using specific objective of costing. Formula of different between two means can be applied.

Formula:

$$n = \frac{2\sigma}{} \ (Z\alpha + Z\beta)^2$$

$\triangle^2$

Where,

n : Sample size per group

σ : Population standard deviation

$Z\alpha$: Value of the standard normal distribution cutting off probability $\alpha/2$ in each tail for a two sided alternative (equal to 1.96 for $\alpha = 0.05$)

$Z\beta$: Value of the standard normal distribution cutting off probability β (equal to 0.84 for 80% power)

$\triangle$: Precision = 33%

PS software also can be used to calculate sample size required. Based on Amrizal (2000), mean cost of normal delivery RM1454 and standard deviation of RM487, α = 0.05, m =1, power 80% and (33%) precision, sample size were 46 for each setting. Considering 10% drop out, final sample size were 51 for each setting.

RESEARCH TOOLS

There were 2 types of research tool used in the study, economic evaluation forms for costing and one outcome measurement forms. There were 3 economic evaluation forms and 2 outcome measurement forms. The outcome measurement forms consist of clinical outcomes forms and maternal satisfaction questionnaires. The economic evaluation forms consist of two macro costing forms and one micro costing forms.

Economic evaluation forms

These forms were used to estimate all categories of cost. It consisted of MEV1 (A)(Appendix C), MEV1 (B)(Appendix D) and MEV2 (Appendix E) forms. MEV1 forms were a form used to estimate the macro costs of health facilities, district hospital and ABC. The contents of the MEV1 (A) and (B) were general particular of the health facilities, cost of building, operation and maintenance expenditure of facility, equipments of more than RM500 in the maternity ward or ABC, equipments less than

RM500 by department/unit, consumables by department/unit, category of maternity ward or ABC staff and annual emolument, training attended by staff, category of shared staffs and annual emolument, cost of shared areas and expenditure, vehicles information and maintenance expenditure of vehicle. The information gathered was from the budget year of 2001. The Researcher will complete these forms after visiting the respective health facilities. The forms will be used to estimate capital cost and recurrent cost. The capital cost that included were building, equipment and vehicle cost. The recurrent costs were salary, operation and maintenance and supplies cost. Information was taken from administrative department, pharmacy, kitchen and maternity ward for hospital, administrative unit, pharmacy and birthing center for ABC.

ME2 form was a micro costing form. This form estimated the investigation cost, medication and patient's cost. Patient's costs included were traveling, fees, time cost and miscellaneous cost of patient and family. For patient's cost the assistant researcher completed the form during interview with the respondent. Information on investigation and medication were taken from patient's folders.

Outcome measurement form

The outcomes that were studied are patient's satisfaction and clinical outcomes. Clinical outcomes that were measured were intermediate outcome, comprising of Apgar score (Rowley *et al*, 1995, Waldenstrom & Turnbull, 1998), per vaginal blood loss (Bryne *et al*, 2000) and perineal complication (Rowley *et al*, 1995, Waldenstrom & Turnbull, 1998). These clinical outcomes were gathered using a form that contains detail labor information, Clinical outcomes form (Appendix F). The Apgar score of 8 to 10 reflected the outcome of the baby and Apgar score of 8 to 10 was a normal Apgar score for newborn. Per vaginal blood loss of less than 500ml and absent of perineal complication would indicate the general condition of mother. Per vaginal blood loss would showed that there was no excessive bleeding that could lead to postpartum haemorrhage which is one of the major cause of maternal death. Absent of perineal complication will reflect the prevention of long-term morbidity of the anal sphincter damage (Woolley, 1995).

Patient satisfaction (Rowley *et al*, 1995, Waldenstrom & Turnbull, 1998) was also measured as an outcome for the intrapartum care. To quantify the quality of care in medicine is difficult and it is easier to quantify how patient perceived their medical care, and patients who perceive they are getting good care are more likely to be satisfied with their care, therefore maternal satisfaction were included as one of the parameters of effective intrapartum care. Patient satisfaction questionnaires (Appendix G) was prepared by the researcher. The questionnaires have been piloted at Bachok Health Clinic where 24 randomly selected respondent answer the questionnaires. It consists of 25 questions that were divided into 2 domains, interpersonal and service domains. The content of the interpersonal domain were grouped under psychological and social factors. Staff, transport and equipment factors were grouped under services domain. A Likert scales were used in maternal satisfaction questionnaires, consisting of four scales; strongly agree, agree, do not agree and strongly do not agree.

The pilot project was done to ensure the reliability of the questionnaires and to trained a research assistant how to run the interviewed, anticipated problem that may occur during interviewed and how to build rapport with respondent.

DEFINITION

Economic evaluation

Economic evaluation is the comparative analysis of alternative courses of action in terms of their costs and consequences. The basic tasks are to identify, measure, value, and compare the costs and consequences (Drummond *et al*, 1999). Partial economic evaluation involve only either costs or consequences and full economic evaluation involve both the costs and consequences.

Cost effectiveness analysis

Cost effectiveness analysis is a full economic evaluation. It is a study involves assessing the gains (effectiveness) and resource input requirements (costs) of alternative ways of achieving a specified objective (Creese & Parker, 1994).

Effective intrapartum care

Effective intrapartum care is a combination of clinical outcomes and patient satisfaction, it is to reflect the gains expected of both service provider and patient. Clinical outcomes are the indicators of quality of care from the provider perspective, which are evaluated continuously, but patient satisfaction as a measure of quality of care is seldom

evaluated. In this study, both indicators are combined to reflect the outcome of effective intrapartum care.

Low risk antenatal mother

Antenatal mothers that are coded as white and green using risk color coding. The color codes are paste on the upper right hand border of antenatal home-based card.

Capital costs

Inputs that last for more than one year (Creese & Parker, 1994). The capital costs taken in this study were building, equipment and vehicle cost.

Recurrent costs

Those resources that are used up in the course of a year and are usually purchased regularly (Creese & Parker, 1994). The recurrent costs included in this study were emoluments, operation and maintenance, supplies, investigations, medicines and patient costs.

Building costs

Building costs includes the basic building and electrical and mechanical built-in equipments (Creese & Parker, 1994).

Vehicle costs

Vehicles use in the direct service of the antenatal mother. In this study the vehicles use were ambulances.

Equipment costs

All equipments that cost more than RM500 and in 5 years working lifespan the purchasing price were used. For the equipments that have passed their lifespan, replacement cost was used (Mazlan,, 2000).

Patient costs

Cost that borne by patient in obtaining the services. These costs include time cost, journey or traveling, refreshment and toiletries.

Salary cost

It was a salary for the financial year 2001. Personnel included were those involved directly in providing services to the antenatal mothers and shared personnel from other departments or units.

Operation and maintenance cost

This cost includes both the building and vehicle. The building's operation and maintenance are utility, security, repairs and payment to Radicare Sdn.Bhd. (Bought services). As for vehicle, these involve repairs, services and fuel.

Supplies cost

This cost includes the consumables and equipment that less than RM500. All respective units/department were involved.

Lifespan

Estimated economic useful time for resource in providing the services. For building, 20 years is taken as the working lifespan and 5 years for equipment and vehicle (Creese and Parker 1994).

Discount rate and annualization factor

Discount rate is a difference between interest rate and inflation rate (Creese & Perker 1994). Usually in costing study, 5% discount rate was used. From the annualization table, at 5% discount rate the annualization factor for building is 12.462 and 4.329 for equipment and vehicle.

DATA COLLECTION

COSTING

There are many ways to classify cost. The classification by resources input was used in this study. It distinguished two categories of resources, capital cost and recurrent cost. Capital costs are those resources that last longer than one year. Recurrent costs are those resources that used up in the course of a year and usually purchased regularly (Creese & Parker, 1994). Capital costs were divided into building cost, vehicle cost and equipment cost. Recurrent costs were divided into 6 costs, salary cost, operation and maintenance cost, supplies cost, investigation cost, medication cost and patient cost. Details of the costs studied are shown in Table 4.2.

Figure 4.5 Cost categories and component of costs involved.

COST	COST INVOLVED
Capital costs	
1. Building costs	Building cost of maternity ward and alternative birthing center
2. Equipment cost	Equipment of maternity ward, alternative birthing center, administration unit, pharmacy unit and catering
3. Vehicle costs	Ambulance of health clinic
Recurrent cost	
1. Salary cost	Staff salary from maternity ward, alternative birthing center, administration unit, pharmacy unit and catering unit
2. Operation and maintenance cost	Operation and maintenance cost includes utility, maintenance of health facilities that are engineering (building, equipment and vehicle), cleaning, management of clinical waste and biomedical products, security, linen and laundry, and small repairing of maternity ward and alternative birthing center.
3. Supplies cost	Consumables items from maternity ward, alternative birthing center, administration unit, and catering. These include equipment of less than RM500, stationeries, petrol etc.
4. Medicines cost	Medications given to the patient.
5. Investigation costs	All types of investigation including imaging
6. Patient costs	Costs incurred by patient and family to

	obtain the service. This includes traveling, time, foods and drinks and toiletries.

Macro Costing

Macro costing was used to calculate all categories of capital cost and 3 categories of recurrent cost, which were salary, operation and maintenance, and supplies. ME1 form was used for macro costing. Macro costing will produce unit cost of building, vehicle, equipment, operation and maintenance, salary and supplies. Resources used to provide delivery services to low risk antenatal mother were translated to economic cost by using the ME1 form. Due to shared resources with other antenatal mothers, portioning out of the resources used by the low risk antenatal mother was done by using specific weightages as shown in Figure 4.6 and 4.7.

Figure 4.6 Weightages used in macro costing for district hospital and explanations

Category of Cost	Weightage	Description
Building cost for maternity ward	Jeli White and Green deliveries to Total maternity ward discharge	To portion out the floor space area cost of maternity ward for Jeli low risk antenatal deliveries.
Equipment cost for administration unit	Maternity ward staff to Total hospital staff	To portion out the equipment cost of administration unit for Jeli low risk antenatal deliveries
Salary cost for administration unit		To portion out the salary cost of administration unit for Jeli low risk antenatal deliveries
Supplies cost for administration unit		To portion out the supplies cost of administration unit for Jeli low risk antenatal deliveries
Equipment cost for kitchen unit	Maternity ward discharge to Total Hospital Discharge	To portion out the equipment cost of kitchen unit for Jeli low risk antenatal deliveries

Salary cost for kitchen unit		To portion out the salary cost of kitchen unit for Jeli low risk antenatal deliveries
Supplies cost for kitchen unit		To portion out the supplies cost of kitchen unit for Jeli low risk antenatal deliveries
Consumables cost for kitchen		To portion out the consumables cost of kitchen unit for Jeli low risk antenatal deliveries
Consumables cost of maternity ward		To portion out the consumables cost of maternity ward unit for Jeli low risk antenatal deliveries
Equipment cost for Pharmacy unit	Maternity ward discharge to total numbers of prescription	To portion out the equipment cost of pharmacy unit for Jeli low risk antenatal mother
Salary cost for Pharmacy unit		To portion out the salary cost of pharmacy unit for Jeli low risk antenatal deliveries
Supplies cost for Pharmacy unit		To portion out the supplies cost for Jeli low risk antenatal deliveries
Vehicle cost	Low risk referral to total referral	To portion out the vehicle cost for Jeli low risk antenatal deliveries
Vehicle Operation and Maintenance		To portion out the vehicle operation and maintenance cost for Jeli low risk antenatal deliveries
Maternity ward Operation and maintenance	Maternity ward floor space area to total hospital floor area	To portion out the building operation and maintenance cost in serving Jeli low risk antenatal mother

Figure 4.7 Weightages used in macro costing for alternative birthing center and explanations

Category of Cost	Weightage	Description
Building cost ABC	Low risk deliveries to total ABC deliveries	To portion out the floor space area cost of ABC for low risk antenatal deliveries.
Equipment cost for administration unit	ABC staff to Total Health Clinic staff	To portion out the equipment cost of administration unit for low risk antenatal deliveries
Salary cost for administration unit		To portion out the salary cost of administration unit for low risk antenatal deliveries
Supplies cost for administration unit		To portion out the supplies cost of administration unit for low risk antenatal deliveries
Equipment cost for Pharmacy unit	ABC deliveries to total numbers of prescription	To portion out the equipment cost of pharmacy unit for low risk antenatal mother
Salary cost for Pharmacy unit		To portion out the salary cost of pharmacy unit for low risk antenatal deliveries
Supplies cost for Pharmacy unit		To portion out the supplies cost for low risk antenatal deliveries
ABC operation and maintenance cost	ABC floor space area to total Health Clinic floor area	To portion out the building operation and maintenance cost in serving Jeli low risk antenatal mother
Consumables cost for ABC	ABC discharge to total health clinic attendances	To portion out the consumables cost for low risk antenatal deliveries

Economic costs of all categories of cost were calculated. From economic cost, the annual cost can be calculated followed by the unit cost. Details are described individually for each categories of cost.

Building Costs

The cost of building was obtained by estimating the cost per square meter. Current cost per square meter of building a health facility in Malaysia is RM3, 000.00. (Mazlan, 2000) The buildings involved in the building costs were the maternity ward Tanah Merah hospital and alternative birthing center in Jeli. Multiplication of RM3, 000.00 with the space area in meter square and assuming 20 years as the expected working life of a building (Creese & Parker, 1994), will yield 20 years economic cost of the building. To get the annual economic cost for the buildings, this value will be divided with annualization factor at 5% discount rate, 12.462 (Appendix H). The annual economic cost was the total cost for all admission to maternity ward and alternative birthing center. This annual economic cost will be transform to bed-cost per patient by dividing it with total discharge of the maternity ward and alternative birthing center respectively. The unit cost for building then was derived by dividing the bed cost per discharge with average hour length of stay at both health facilities and it was called bed-hour cost. The summary of the calculation as follows:

Figure 4.8 Derivation of unit building cost

(a)	(b)	(c)	(d)	(e)
Floor space area in sq.meter	20 years economic cost	Annual economic cost	Bed cost per discharge	Bed-hour cost per discharge
	(a) × 3000	(b) / 12.462	(c) / Total discharge	(d) / Average hour length of stay

Building cost for each antenatal mothers was calculated by multiplying their length of stay with bed-hour cost. Total building cost presented as follows:

$$TBC_{Hospital} = {}_{n}\Sigma(BHC.LOS)_{Hospital} \text{ and } TBC_{Abc} = {}_{n}\Sigma(BHC.LOS)_{Abc}$$

Notes:

$TBC_{hospital}$: Total building cost for district hospital

TBC_{Abc}: Total building cost for ABC

$BHC_{Hospital}$: Bed-hour cost for district hospital

BHC_{Abc}: Bed-hour cost for ABC

$LOS_{Hospital}$: Length of stay for district hospital

LOS_{Abc}: Length of stay for ABC

n: related admission

The calculation of bed-hour cost per discharge (unit building cost) is shown in Table 4.1.

Table 4.1 Calculation of unit building cost

Facilities	(a) Floor space area Meter sq.	(b) 20 years economic cost (a) × 3000	(c) Annual economic cost (b)/12.462	(d) Bed cost per discharge (c)/Total discharge	(e) Bed-hour cost per discharge (d)/average hour LOS
Maternity ward	590.63	1,771,890	14,2183.43	38.51	1.02
				Unit cost	**RM1.02**
ABC	53.88	16,1640	12,970.63	39.66	8.91
				Unit cost	**RM8.91**

Notes:
Total discharge maternity ward: 3692
Total discharge ABC: 327
Average Length of Stay Maternity ward: 37.68 hours
Average Length of Stay ABC: 4.45 hours

Equipment Cost

Equipments cost can be divided into direct and shared equipment cost. Direct equipments cost was from equipment used in the maternity ward and alternative birthing center. Shared equipment cost were equipments from administration unit, pharmacy and catering unit of district hospital and administration unit and pharmacy unit for ABC. The catering unit was not available in the ABC. All equipments included were those equipment with a unit price of more than RM500.00, which was the cut off point used in the definition of 'Harta Modal' by Ministry of Finance Malaysia (Mazlan, 2000). For equipments, which have passed the 5 years life span, replacement price was used (Creese & Parker, 1994). The replacement cost was the current cost of similar equipment.

Direct equipment cost was from maternity ward for Tanah Merah hospital and ABC for Jeli ABC. All equipment cost in these unit were summated to give the direct 5 year

economic cost of the equipments. By using the annualization factor at 5% discount rate the annual economic cost for the equipment was calculated. Equipment cost per discharge was obtained by dividing the annual economic cost of the equipment with total patient discharge. The unit cost was then calculated by dividing the equipment cost per discharge with the average hour length of stay. The direct equipment cost per patient was a product of equipment-hour cost to individual length of stay (Figure 4.9 and Table 4.1).

Figure 4.9 Derivation of direct equipment cost

(a)	(b)	(c)	(d)
5 years economic cost	Annual economic cost	Equipment cost per discharge	Equipment-hour cost per discharge
	(a) / 4.329	(b) / Total discharge	(c) / Average length of stay in hours

For shared equipment cost, the 5 years economic cost of the equipment for each of the unit were obtained by totaling all the equipment cost and multiply with the specified weightage and then, the annual economic cost was calculated using the annualization factor. The annualization factor at 5% discount rate was used (Figure 4.10). The calculation presented below in Table 4.2.

Figure 4.10 Derivation of equipment-hour cost for shared equipment cost

(a)	(b)	(c)	(d)	(e)
Specified weightage for each unit	5 years economic cost for maternity ward or ABC	Annual economic cost maternity ward or ABC	Equipment cost per discharge	Equipment - hour cost per discharge
	(a) × 5 years economic cost for respective units	(b) / 4.329	(c) / Total discharge	(d) / Average hour length of stay

The shared equipment cost for each patient was calculated by multiplying the shared equipment-hour cost and individual length of stay. The total equipment cost are summarized below:

$$TEC_{Hospital} = (\Sigma\ DEHC_n \times LOS)_{Hospital} + (\Sigma\ SEHC_n \times LOS)_{Hospital}$$

$$TEC_{ABC} = (\Sigma\ DEHC_n \times LOS)_{ABC} + (\Sigma\ SEHC_n \times LOS)_{ABC}$$

Notes:

$TEC_{Hospital}$: Total equipment cost of district hospital

TEC_{ABC} : Total equipment cost of ABC

$DEHC_{Hospital}$: Direct equipment-hour cost for district hospital

$DEHC_{ABC}$: Direct equipment-hour cost for ABC

$SEHC_{Hospital}$: Shared equipment-hour cost for district hospital

$SEHC_{ABC}$: Shared equipment-hour cost for ABC

$LOS_{Hospital}$: Length of stay at district hospital

LOS_{ABC} : Length of stay at ABC

N : respective equipment

Calculations of equipment unit costs are presented in Table 4.2 and 4.3.

Table 4.2 Calculation of equipment unit cost for Tanah Merah district hospital intrapartum care

	(a) 5 years economic cost (RM)	(b) Weight	(c) 5 years economic cost maternity ward (a)×(b) (RM)	(d) Annual cost Maternity ward (c)/4.329 (RM)	(e) Equipment cost per discharge (d)/ Total discharge (RM)	Equipment-hour cost per discharge (e) / Average LOS in hour (RM)
Direct						
Maternity ward	104,427.00		104,427.00	24,122.66	6.53	**0.17**
Shared						
Administration	191,647.00	*0.181	34,688.11	8,012.96	2.17	
Pharmacy	125,460.00	**0.061	7,653.06	1,767.85	0.48	
Kitchen	185,212.00	***0.441	81,678.49	18,867.75	5.11	
				26,648.56	7.76	**0.21**
					Unit cost	**RM0.38**

Notes:
*Maternity ward staffs to total hospital staff's ratio
**Maternity ward discharge to total number of pharmacy prescription ratio
***Maternity ward discharge to total hospital discharge ratio
Total discharge maternity ward: 3692
Average Length of Stay Maternity ward: 37.68 hours