

CHAPTER 3

METHODOLOGY



3.1 Study Design

This study is a cross-sectional descriptive study. The information on mammography screening utilization was collected by questionnaire during February – March 2000, including on cost and revenue of mammography incurred at the National Cancer Institute in three fiscal years of 1997, 1998, and 1999.

3.2 Study Population and Samples

On mammography screening utilization, the population includes patients who are users and non- users of mammography at the National Cancer Institute, of whom 896 women were randomized by questionnaires of all patients that access the health services in this hospital between February and March 2000. They are all collected from the hospital-based registry. So, the sample covered 464 women who received mammogram at the Mammographic Unit and 432 women who received other services at the hospital.

For the analysis of cost and revenue of the use of mammography, this study estimated both of them at the National Cancer Institute in 3 fiscal years (1997-1999) and then compared the estimated revenue and the estimated cost, using the cost recovery ratio, marginal cost and break-even analysis.

3.3 Operational Definition

- Mammography screening: The screening test for breast cancer of the women who utilize mammogram at National Cancer Institute and additional with the ultrasound in every cases.
- Mammogram: It is a special kind of x-ray that allows the doctor to see into the breast tissue.

- Mammography: The use of x-rays to create a picture of the breast. It involves two x-rays of each breast, one taken from the side and one from the top. The breast must be squeezed between two plates for the pictures to be clear.
- Early detection: When breast cancer is found and treatment early, a woman has more treatment choices and a good chance of complete recovery.
- User: The women who were registered at the Mammographic Unit and utilize mammogram at National Cancer Institute.
- Non-user: The women who were registered for other outpatient services except mammogram at National Cancer Institute.
- Real cost: All costs are adjusted by inflation rate and valued at 1999 constant price.
- Nominal cost: The cost actually quoted at a given point in time and valued at the current time without a correction for the effects of inflation rate.
- Labour cost: The salary of the staffs in the Mammographic Unit and their fringe benefits such as hospitalization fees, school fees, and child benefit allowance. It is considered to be a variable cost because it varies over the level of mammogram test by using the time spent on this mammography screening to allocate to this cost.
- Material cost: The cost of electricity, water supply, telephone, film x-rays and reagent. It is a variable cost because it varies over the level of mammogram test and the period of operating time per day.
- Capital cost: The cost of equipment, the rent of building of the Mammographic Unit which use to produce mammography screening.
- Variable cost: The cost that varies with the quantity of mammography screening produced. In this study comprises of labour cost and material cost.
- Fixed cost: The cost that does not vary with the quantity of mammography screening produced. In this study comprises of capital cost.
- Total cost: The total cost of mammography screening, composed of labour cost, material cost, and capital cost or fixed cost and variable costs.
- Operating cost: The cost of mammography screening, composed of labour cost and material cost.
- Total revenue: The amount paid by users and received by National Cancer Institute of mammography screening, computed as the unit price charged of mammogram test times the number of patient.
- Average cost: The total cost divided by the number of mammography screening.

- Marginal cost: The increase in total cost that arises from an extra unit of mammography screening.
- Cost recovery: The ratio of the revenue to the cost
- Break even point: The number of case of mammography screening that can make the revenue equal to the cost of mammography screening at National Cancer Institute. So, there is neither profit nor loss.
- Sensitivity analysis: The percentage change of unit price charged and number of mammogram test when can recover the full cost.
- Inflation rate: The percentage change in the general consumer price index for Bangkok and vicinity of personal and medical care group from 1994 to 1999.
- Educational level: The educational level is divided to 3 groups; first, the low educational group includes the patients that their educational level is less than lower-secondary education. Second, the middle educational group is the patients whose the educational level is between upper-secondary to vocational education. And third, the high educational group is the patients whose the educational level is bachelor's and higher.
- Household monthly income level: The household monthly income level is divided to 3 groups: first, the low household monthly income level is the patients that received income less than 10,000 Baht/month. Second, the middle income level is the patient that receive income between 10,000 to 25,000 Baht/month. Third, the high income level is the patient that receive income more than 25,000 Baht/month.

3.4 Conceptual Framework

The conceptual framework proposed to described the factors of patients, both users and on-users of mammography screening, provider features and others factors which describe the utilization pattern of mammography screening (Figure 3.1), and to estimate the total cost, total revenue and the cost recovery of the mammography screening (Figure 3.2).

Figure 1.1 Conceptual Framework: Factors associated with Utilization pattern of mammography at National Cancer Institute, Thailand.

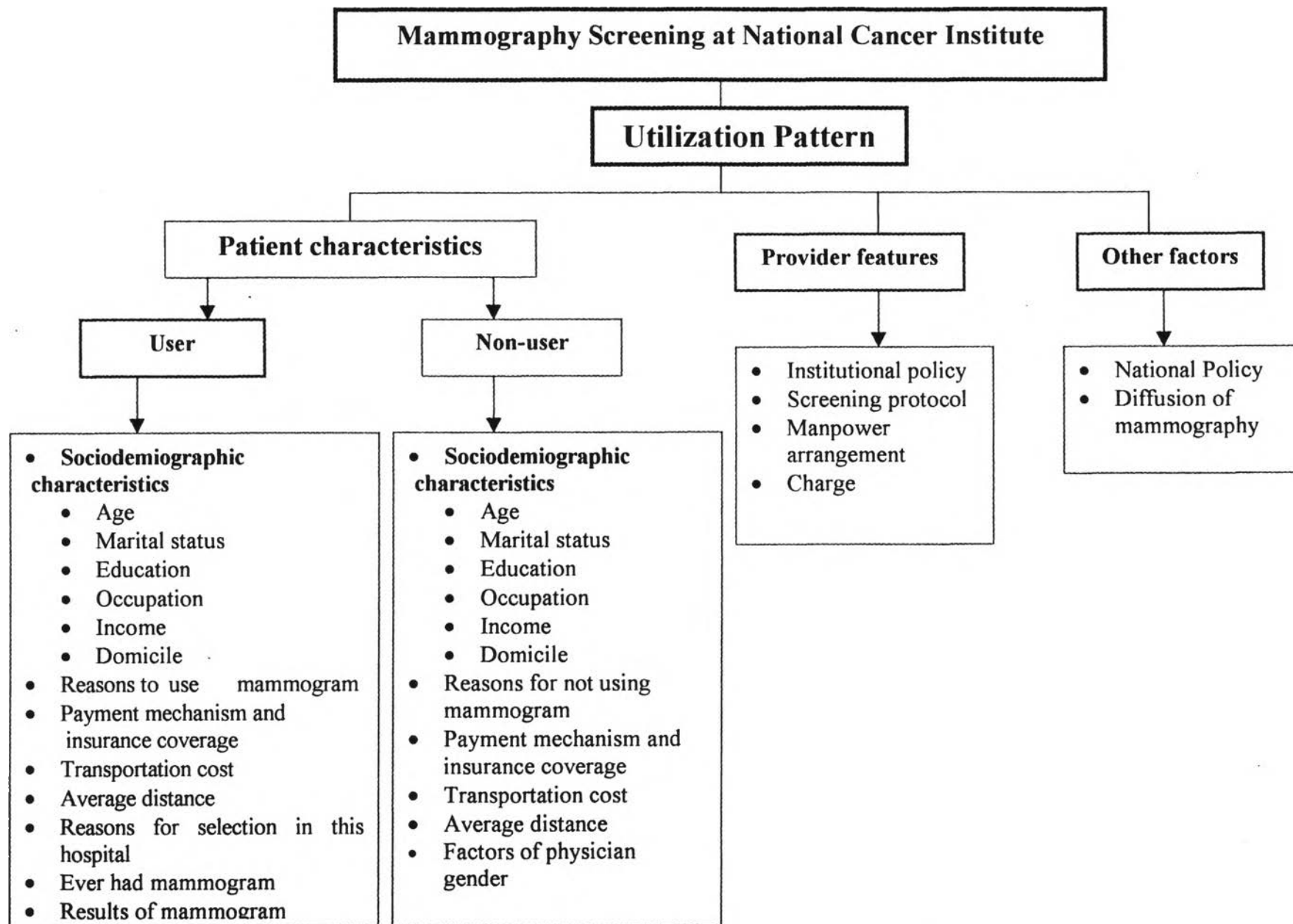
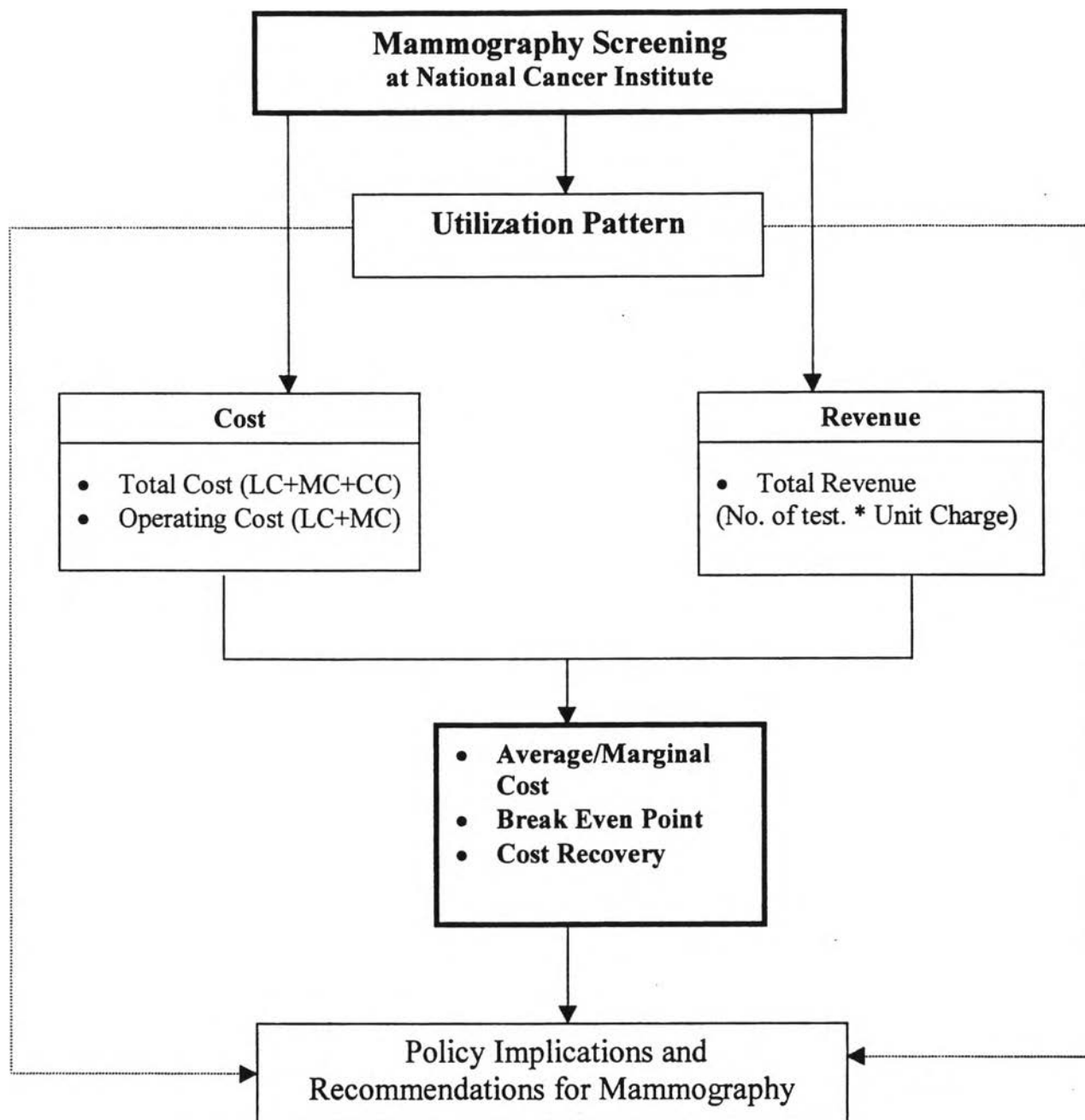


Figure 1.2 Conceptual Framework: Cost, Revenue and Cost Recovery of Mammography Screening at the National Cancer Institute, Thailand



Note :

LC = Labour Cost
 MC = Material Cost
 CC = Capital Cost

3.5 Data Collection

For mammography screening utilization, the population are the patients who access the National Cancer Institute, both users and non-users of mammography screening. The data were collected from the hospital-based outpatient registry and mammography registry. So, the sample covered 464 women of user group who were registered at the Mammographic Unit and 432 women of non-user group who registered for other outpatient services.

Therefore, the data was collected from two types of sources that include:

Primary data: Data was derived from 2 sources, first from questionnaires that comprised the questions about factors of patients' characteristics that influenced the use and non-use of mammography. The data were collected during February to March 2000 from 896 women, second was from an interview for provider features that influenced the pattern of utilization.

Secondary data: Data was obtained from 2 sources, first from documentary review and the Internet for other factors that influenced the pattern utilization of mammography. Second, data on cost and revenue were collected from the database of the Mammographic Unit, Diagnostic Radiology Division, National Cancer Institute, Department of Medical Services, Ministry of Public Health, during fiscal years 1997, 1998 and 1999.

The variables used in this study both of primary data and secondary data are shown in Table 3.1

Table 3.1 Data Collection for Each Variables.

Objective	Variable	Unit/Scale	Data Source	Instrument
User characteristics	1.Sociodemographic characteristics <ul style="list-style-type: none"> • Age • Marital status • Education • Occupation • Income • Domicile 	<ul style="list-style-type: none"> • Year • 4 types • 7 levels • 7 types • Baht/family • 7 regions 	Primary data	Questionnaire

Table 3.1 (Continue)

Objective	Variable	Unit/Scale	Data Source	Instrument
User characteristics (Continue)	2. Reason for using mammography <ul style="list-style-type: none"> • Routine checkup • BSE and found abnormal • History of BC in a relative • Referred from other hospitals • Abnormal from CBE and referred • Physician recommend • Relative or friend or others recommend 	<ul style="list-style-type: none"> • % of all subjects 	Primary data	Questionnaire
	3. Payment mechanism and insurance coverage	<ul style="list-style-type: none"> • 8 types 	Primary data	Questionnaire
	4. Transportation cost	<ul style="list-style-type: none"> • Baht/case 	Primary data	Questionnaire
	5. Average distance	<ul style="list-style-type: none"> • Km. from BKK 	Secondary data	
	6. Reason for selecting mammogram in this hospital <ul style="list-style-type: none"> • No hospital nearby their houses • No trust in the nearest hospital • Having a relative and someone available here • Trust in this hospital of quality and price 	<ul style="list-style-type: none"> • %of all sample 	Primary data	Questionnaire
	7. Have ever had mammogram <ul style="list-style-type: none"> • If had mammogram, when the patient got it the last time. 	<ul style="list-style-type: none"> • 2 types • Year 	Primary data	Questionnaire

Table 3.1 (Continue)

Objective	Variable	Unit/Scale	Data Source	Instrument
User characteristics (Continue)	8. Result of mammogram (normal, borderline, positive, and tumor)	<ul style="list-style-type: none"> No.of patients 	Primary data	Questionnaire and medical record
Non-user characteristics	1.Sociodemographic characteristics <ul style="list-style-type: none"> Age Marital status Education Occupation Income Domicile 	<ul style="list-style-type: none"> Year 4 types 7 levels 7 types Baht/family 7 regions 	Primary data	Questionnaire
	2. Reason for non-use of mammography <ul style="list-style-type: none"> Expensive Out of pocket, cannot get reimbursed No time Don't know of mammography before Shy and afraid Know well about mammogram but not necessary to do now No family history No probability of getting breast cancer Don't know where to do Not convenient to go to hospital No recommendation from physician, family or friend Do it by themselves Used to be examined by physician and had no problem 	<ul style="list-style-type: none"> % of all subjects 	Primary data	Questionnaire

Table 3.1 (Continue)

Objective	Variable	Unit/Scale	Data Source	Instrument
Non-user characteristics (Continue)	3. Payment mechanism and insurance coverage	• 8 types	Primary data	Questionnaire
	4. Transportation cost	• Baht/case	Primary data	Questionnaire
	5. Average distance	• Km. from BKK	Secondary data	
	6. Physician gender	• 3 types	Primary data	Questionnaire
Provider features	<ul style="list-style-type: none"> • Institution policy • Screening protocol • Manpower arrangement • Unit charge 	<ul style="list-style-type: none"> • No. of pt./day • No. of staff • Baht/test 	Primary data and Secondary data	Questionnaire, interview, and documentary review
Other factors	<ul style="list-style-type: none"> • National policy of mammography screening • Diffusion of mammography 	<ul style="list-style-type: none"> • In the world • In Thailand 	Secondary data	Documentary review
Total cost	1. Labor cost • Salary and fringe benefits	• Baht/year	Secondary data	Record form
	2. Material cost • Electricity • Water supply • Telephone • Film • Reagent	• Baht/year	Secondary data	Record form
	3. Capital cost • Rent of buildings • Equipment cost	• Baht/year	Secondary data	Record form
Total revenue	Total revenue	• Baht/year	Secondary data	Record form

3.6 Data Analysis

3.6.1 Utilization Pattern of Mammography at the National Cancer Institute

The utilization pattern of mammography at this hospital is divided into patient characteristics both of users and non users (supply analysis), provider features (demand analysis) and other factors.

The information on utilization pattern of patient characteristics, provider features and other factors (i.e. national policy and diffusion of mammography) of mammography screening provided on the various forms was recorded using a database program, then all of data was extracted and analyzed. The descriptive data was analyzed to demonstrate the association between each variable that influenced the use of mammography screening.

For the utilization pattern, the equity to access the mammography screening should be concern. Under this study, equity in utilization means that all patients can have access to the mammography equally when they need; and the patient characteristics and provider features cannot be the barrier to getting this kind of service.

3.6.2 Cost Calculation

In this study, the cost for mammography screening will be calculated in a provider's perspective for 3 fiscal years, from 1997-1999. The costs in this study were divided into 3 groups as follows:

- 1) **Labour cost** comprises salaries of the staff in the Mammographic Unit and their fringe benefits such as hospitalization fees, school fees, and child benefit allowance. Labour cost (record sheet LC-1) was used to collect data (Appendix B). Labour cost of the staff was calculated by using proportion of time spent on mammogram activity, obtained from an interview with them and from the work schedule of each person and an assessment of their work with the number of patients that they service. So, the percentage of allocation criteria of the staff spent on this activity was up to their duties (Appendix C: Table C.1-C.3).
- 2) **Material cost** comprises electricity, water supply, telephone, x-ray films and reagent costs. The material cost data was collected from the receipts, interviewing and records of the Mammographic Unit. Material cost record sheet MC-1 was used to collect data (Appendix B). Some material cost data, i.e. electricity, were estimated, based on how many hours this hospital operated this machine per day, the amount of watt that this machine used and then changed to the unit of electricity; then multiplied by the unit price plus fuel adjustment and VAT. (Appendix D: Table D.1-D.4). For telephone, the number of times the phone was used at the Mamographic Unit was estimated by interview, then multiplied by 3 baht/time for 1 year (Appendix

D: Table D.5). Water supply in this study was used only for processing mammogram films in each year (Appendix D: Table D.6). Films and reagents were used at the Mammographic unit for each year (or month), which are shown in Appendix D: Tables D.7-D.9. Therefore, the total material cost is the sum of electricity, water supply, telephone, film, and reagent costs (Appendix D: Table D.10 – D.12).

3) **Capital cost** comprises the rent of building and equipment cost of the Mamographic Unit. The capital cost calculation for equipment requires an estimate of annual costs (Appendix E: Table E.1- E.3); and the following information is needed:

- Current value: Estimate the current value of the capital item in each year, adjusted by the inflation rate which was calculated from the consumer price index for Bangkok and vicinity, of personnel and medical care group at the 1994 price. (Appendix E: Table E.4)
- Expected years of useful life of the capital item: In this study, the total number of years of useful life comes from experts' opinions, and standardized for computerized equipment.
- Calculation of annual capital cost is done by dividing the current value of the item with the expected years of useful life, multiplied by the percentage of allocation criteria that the equipment was used for the mammography screening.
- Building rental is calculated by using the rent per unit square meter times the area that the Mammographic Unit use for services for the rent of building, use market rate in Phayathai District, Bangkok).

After analysing labour, material, and capital each year from 1997 to 1999, then adjusted the costs in 1997 and 1998 by inflation rate in order to change the nominal cost to the real cost at 1999 constant price.

Thus, the total cost of mammography screening in each fiscal year at the National Cancer Institute is the sum of labor cost, material cost and capital cost.

$$\text{Total cost (TC)} = \text{Labour cost (LC)} + \text{Material cost (MC)} + \text{Capital cost (CC)}$$

And the operating cost of mammography screening in each fiscal year at the National Cancer Institute is the sum of labor cost and material cost.

$$\text{Operating cost (OC)} = \text{Labour cost (LC)} + \text{Material cost (MC)}$$

3.6.3 Revenue Calculation

Revenue of the Mammographic Unit is the total revenue which is calculated by multiplying the total number of mammography screening in each year by the real unit price charge or the whole revenue that the hospital should get from the patient. For the unit price charge of mammography screening, the hospital charge from the patients in the same rate at 1,000 Baht/test. So, this is a nominal unit charge in each year, then change to the real unit charge with the inflation rate to be the 1999 constant price (see Appendix H: Table H.1)

$$\text{Total revenue} = \text{No. of tests/year} \times \text{real unit price charge each year (Baht)}$$

In this study, only the total revenue was calculated, and it was assumed that the accrual revenue is the same value as the actual revenue, because the loss of revenue from the patients who could pay; from the sample of 464 women utilizing mammography at this hospital, a very small number not more than 10 persons could not pay.

3.6.4 Average and Marginal cost

Average cost is the cost per unit of mammography screening at this hospital. It can be calculated by the total cost dividing by the number of mammography screening in fiscal years, 1997-1999; and average for 3 years.

$$\text{Average cost} = \frac{\text{Total cost}}{\text{No. of mammography screening}}$$

Marginal cost is the increase in total cost of producing one extra unit of mammography screening in this hospital. In this study, marginal cost is divided into 3 items:

First, for annual marginal cost (for 3 years), the hospital can produce different amount of mammography screening and use different cost in each year at the point of average of

patients during 3 years. Therefore, the marginal cost was calculated by the formula below:

$$\text{Annual marginal cost} = \frac{\text{Change in annual total cost}}{\text{Change in number of annual mammography screening}}$$

Second, monthly marginal cost (36 months). In each month the hospital provides a different amount of mammography screening at different costs. Therefore, the marginal cost was calculated by using the formula below:

$$\text{Monthly marginal cost} = \frac{\text{Change in monthly total cost}}{\text{Change in number of monthly mammography screening}}$$

Third, a simple four-month marginal cost moving average is calculated. The seasonal and irregular fluctuations of patient number in each month in 3 years, the cost will vary with them as well. In order to solve this problem, this study used the four-month moving average techniques to “smooth” the data, both on patient number and the total cost. The calculation of simple moving average is presented in Appendix I: Table I.3. Then, marginal cost was calculated in the same way as for the second item.

3.6.5 Cost Recovery Calculation

In this study, cost recovery was analyzed to evaluate the efficiency and equity of access this service at National Cancer Institute. The methodology for calculation of cost recovery is shown below:

Cost recovery ratio is the ratio of the revenue to the cost.

$$\text{Cost recovery ratio} = \frac{\text{Revenue}}{\text{Cost}}$$

In this study, the calculation of cost recovery ratio can be divided into 2 items:

- cost recovery ratio of the total cost to the total revenue
- cost recovery ratio of the operating cost to the total revenue

If the result of cost recovery ratio equals 1, this means that the revenue of hospital can cover the cost that invest for mammography screening. At this point, revenue equals cost, the hospital earns zero profit.

If the result of cost recover ratio is less than 1, this means that the revenue of hospital cannot cover the cost. At this point, the revenue is less than the cost, the hospital loss profit.

If the result of cost recovery ratio is more than 1, this means that the hospital got the revenue from the patients more than its investment. At this point, the hospital earns profit.

3.6.6 Break Even Analysis

Break even analysis is calculated by looking at the least number of mammography screening or the appropriate number of cases (N) that can make the revenue equal the cost of mammography at this hospital.

Therefore, the break even point is calculated by using the formulars:

$$\begin{aligned} \text{Total revenue} &= \text{Total cost} \\ \text{Revenue per case} \times N &= \text{Fixed cost} + \text{Variable cost} \\ &= \text{Fixed cost} + \text{Variable cost per case} \times N \\ N &= \text{Fixed cost} / (\text{Revenue per case} - \text{Variable cost per case}) \end{aligned}$$

where fixed cost includes capital cost; variable cost is labour cost and material cost; and revenue per case is the charge for a mammography screening.

3.6.7 Sensitivity Analysis

Sensitivity analysis is a technique designed to allow for uncertainty by testing whether plausible changes in the value of the main variables would affect the conclusion of analysis. It was done based on the uncertain variables, then the sensitivity analysis is conducted on the unit charge and the number of patients.

Therefore, the sensitivity analysis is calculated by using the formulars:

- 1) Given the price is equal the marginal cost, what should be the quantity change. The following sensitivity analysis was done.

$$\text{Number of tests} = \text{Total cost} / \text{Unit charge}$$

- 2) Given the price is constant, what should be the the number of test change.

$$\text{Number of tests} = \text{Total cost} / \text{Unit charge}$$

- 3) Given the number of test constant, what should be the unit charge change.

$$\text{Unit charge} = \text{Total cost} / \text{Number of test}$$