CHAPTER 3
RESEARCH DESIGN AND METHODOLOGY

This research is a descriptive study using the retrospective database in year 2001. According to cost analysis in economic evaluation methods, cost comparison of the alternative treatments is needed [11]. This study will identify and compare such costs of 2 alternatives between ERIG and HRIG.

3.1 Conceptual Framework

This study explores the cost and its composition of ERIG and HRIG utilization. After expose to rabies from the suspect rabies animal, people seek for the medication and treatment. Rabies immunoglobulin is one of the necessary treatments that will be offered to the patient. With two kinds of medication with the same protective effect against rabies, ones incurred different cost.

This study gathers another aspect of cost rather than cost of production, direct cost, alone. With two plants for each product, they generate different production cost. HRIG direct cost is the real cost of production in year 2000. ERIG direct cost is the expected cost of production according to the plan of TRCS to produce ERIG in year 2002.

With limitation of production potential and product specification incur different indirect cost. The cost of morbidity, the cost of mortality and complication is added up here to clarify the picture of rabies immunoglobulin use in Thailand.

The direct cost and indirect cost are summed up to obtain the total cost for each product. These total costs are proportional according to the volume of production to get the unit of each rabies immunoglobulin.

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                    ┌─────────────────────┐
                    │ Rabies post-exposure │
                    │       cases          │
                    └─────────────────────┘
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                                                        ┌──────────────────┐
                                                        │ Cost of imported │
                                                        │      ERIG        │
                                                        └──────────────────┘
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┌──────────────┐      ┌──────┐        ┌──────┐      ┌──────────────┐
│ Cost per unit │ ◄── │ HRIG │        │ ERIG │ ──► │ Cost per unit │
│   Of HRIG     │      └──────┘        └──────┘      │   Of ERIG    │
└──────────────┘                                     └──────────────┘
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                    ┌─────────────────────┐
                    │  SAME EFFECTIVENESS  │
                    └─────────────────────┘
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                    (     Cost Comparison     )
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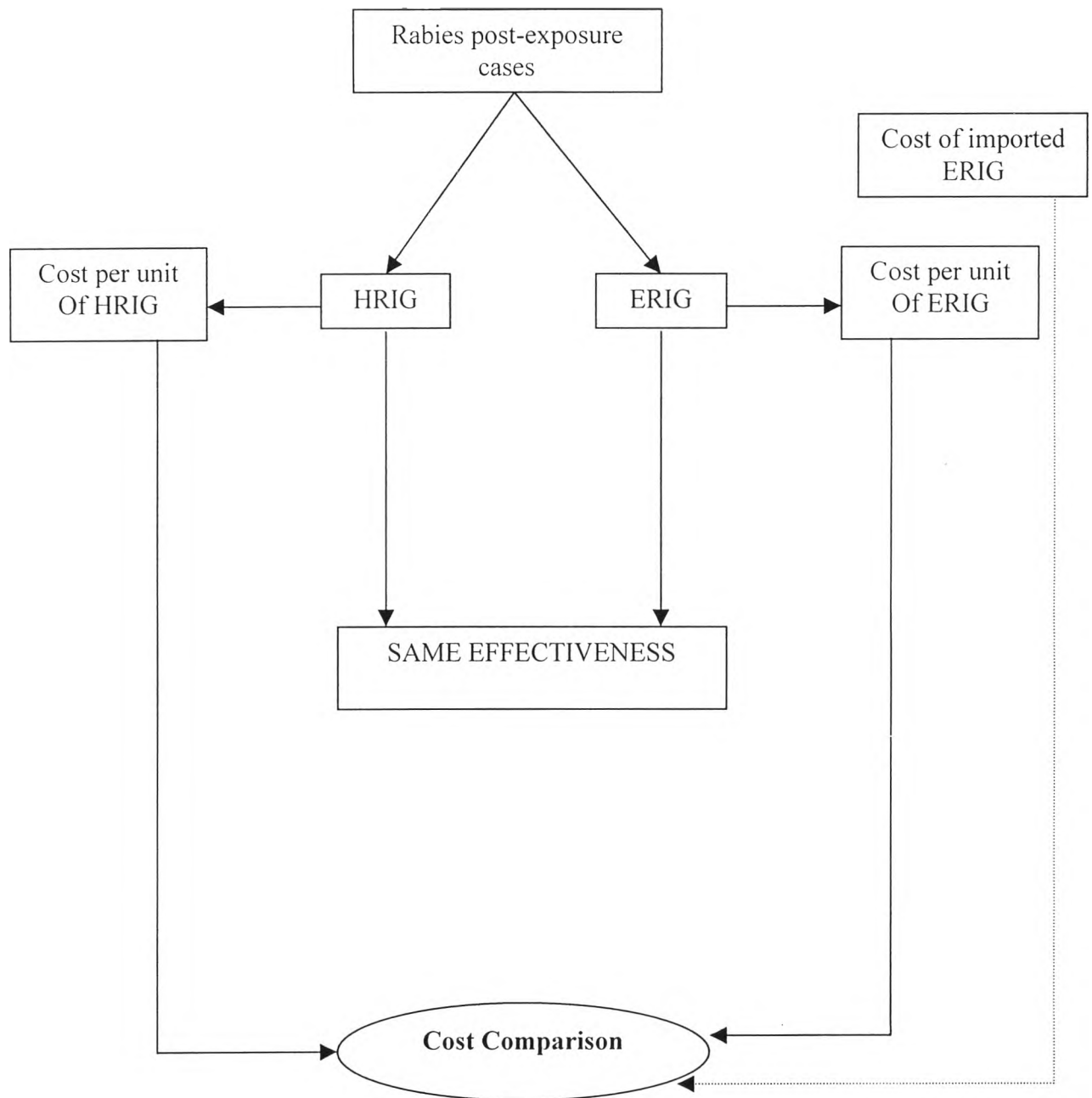
Figure 3.1: Main conceptual framework: in post-exposure case, patient seeks for RIG. ERIG and HRIG have difference cost per unit but yield with same effectiveness. This study tries to compare their unit costs.

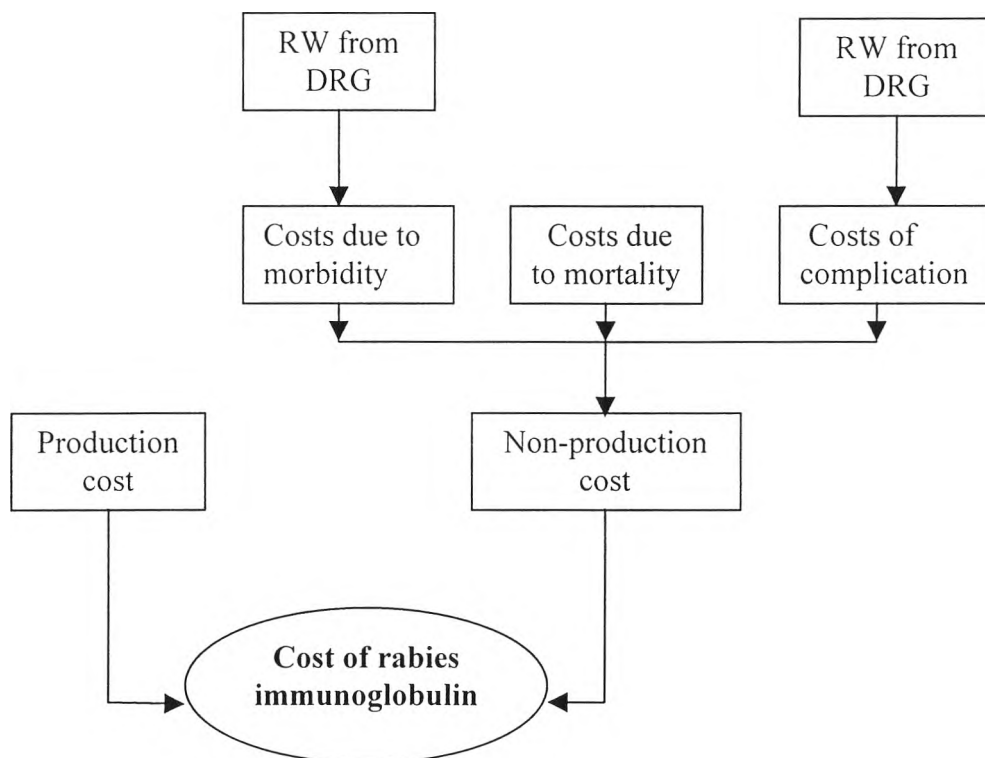Remark ········· ► Need further information of imported ERIG cost

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   ┌──────────┐                              ┌──────────┐
   │ RW from  │                              │ RW from  │
   │ DRG      │                              │ DRG      │
   └────┬─────┘                              └────┬─────┘
        │                                         │
        ▼                                         ▼
 ┌────────────┐   ┌────────────┐          ┌────────────┐
 │ Costs due to│  │ Costs due  │          │ Costs of   │
 │ morbidity   │  │ to mortality│         │ complication│
 └─────┬──────┘   └─────┬──────┘          └─────┬──────┘
       │                │                       │
       └────────────────┼───────────────────────┘
                        ▼
 ┌────────────┐   ┌────────────────┐
 │ Production │   │ Non-production │
 │ cost       │   │ cost           │
 └─────┬──────┘   └────────┬───────┘
       │                   │
       ▼         ╭─────────▼──────────╮
       └────────▶│   Cost of rabies   │◀───────
                 │   immunoglobulin   │
                 ╰────────────────────╯
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Figure 3.2: Conceptual framework 2-Cost Composition of rabies immunoglobulin: costs of rabies immunoglobulin include both direct cost (cost of production) and indirect cost (non-production cost). Indirect cost has three components: costs due to morbidity, mortality and cost of complication.

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┌─────────────────────────┐          ┌─────────────────────┐
│    Capital Budgeting    │          │  Current Plant Cost │
│ (Future Plant Investment)│          │                     │
└─────────────────────────┘          └─────────────────────┘
            │                                   │
            ▼                                   ▼
      Production Cost of                  Production Cost of
            ERIG                                HRIG
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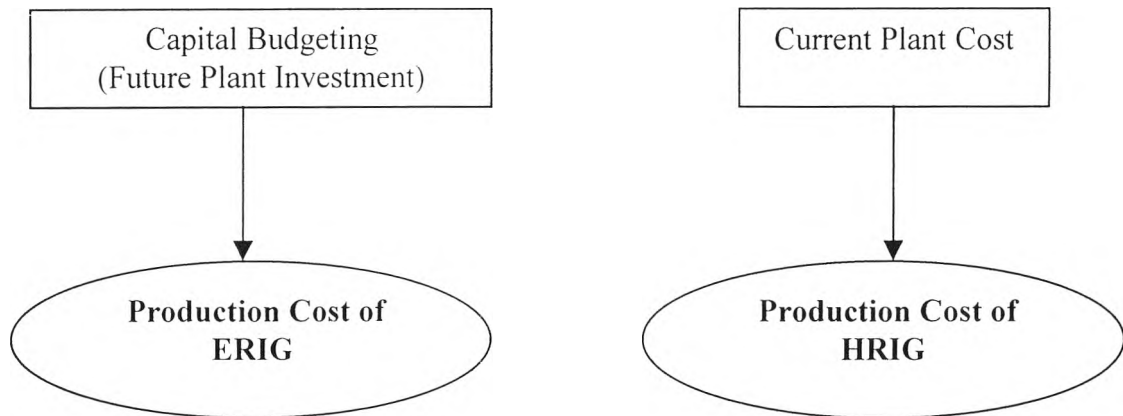
Figure 3.3: Conceptual framework 3-Identifying production cost in each type of rabies immunoglobulin: HRIG production cost is calculated from the present plant, but ERIG production cost is calculated from the prospective plant.

3.2 Methodology

3.2.1 Research Design

This study used a method of descriptive study with the secondary data to identify total cost and cost per unit of ERIG and HRIG.

The key point of this study is to identify the production cost and the indirect cost components of both products. Especially the indirect cost, this includes the cost of life loss due shortage, cost of rabies treatment and the complication cost due to the utilization of product

3.2.2 Data Collection

Which cost should be considered?

The main categories of costs of health care treatment were the costs arising from using of resources within the health sector such as resource that is used by patients and their families and from using resources in other sector [9].

The particular range of costs included in this study is likely to be decided upon as a result of considering points.

1. Perspective: Textbook and review articles routinely emphasize the importance of selecting the perspective of the analysis. Perspective determines whose costs are counted. The standard recommendation to conduct CEA from the societal perspective means that all cost is included [12]. Critics of recommendations to make the societal perspective the default or principal perspective for CEA often note that analyses are conducted for a variety of reasons. Therefore, this study will include the costs due to the societal perspective.

2. Cost of the two treatments immediately under study: The study which is restricted to the treatments immediately under study, costs common to both alternatives generally need not to be consider as they will not affect the choice between the given programs (elimination of such costs can save the evaluator a considerable amount of work) [9]. However, this study will add these common costs to both alternatives to calculate the real cost per unit.

3. Magnitude of cost: it is not worth investing a great deal of time and effort considering costs that because they are small, are unlikely to make any difference to the study. However, the study will give some justification for the elimination of such cost.

4. Time period [14]: the study will gather all data of cost base in fiscal year 2000.

How should costs be estimated?

Once the relevant range of costs has been identified the individual items must be measured and valued. That is, costing has two elements: measurement of the *quantities* of resource use (q) and the assignment of unit costs or *prices* (p). The measurement of resource quantities often depends on the context or the economic evaluation. Market price will be available or many of the resource items. Although the theoretical proper price for a resource is its opportunity cost, the pragmatic approach to costing is to take existing market price unless there is some particular reason to do otherwise [9]. Although the costing of most resource items is relatively unambiguous, there are some issues those will be clarified more below which include non-market item such as cost of life loss (mortality cost).

1. Explore the production process and input of ERIG production. Right now, there is no commercial production plant for ERIG yet established in Thailand. There is a plan to produce ERIG in year 2002 by Queen Saovabha Memorial Institute, TRCS. Different method of production creates different cost. There are 2 mainly methods of production one the debate right now; one produce from horse serum, another is produce from horse plasma which is the tentative method to do so. The production process and input of production will be identified according to the data from this institute.

2. Explore the production process and input of HRIG production. With the current HRIG production plant of Nation Blood Bank Center-TRCS, there are three products those share some costs together in the unit of HRIG production. They are HRIG, Hepatitis B immunoglobulin (HBIG) and albumin. The study will track cost of HRIG production from the production process and allocate the sharing cost to get the real cost of production of HRIG. [6,7,14]

3. Demand of rabies immunoglobulin. The study uses the demand of rabies immunoglobulin in year 2000 as the assumption basis. The data is from the Department Communicable Disease Control, MOPH.

4. Estimate the total cost of rabies immunoglobulin utilization. The study will amass all types of cost that influences the decision making over these 2 alternatives. This will include both costs that will be incurred and saved (benefit) from rabies immunoglobulin utilization.

The total cost of ERIG and HRIG utilization can be classified into 2 categories.

- Direct cost or production cost includes cost of all inputs in every process of production.

- Indirect cost or non-production cost or the opportunity cost includes cost of treatment, the cost of life loss and cost of complication. Economists use the terms "opportunity cost or economic cost" to describe this approach to costing. It recognizes that even if no money is spent, the cost of using resources that could have been productively used elsewhere [14]. The costs due to morbidity (cost of treatment) are from the medication costs and related cost that is given to patient. This cost is identified from the DRG (Diagnosis Related Group) system. The costs due to mortality (cost of life loss) are derived from the cost of productivity loss in case of shortage of rabies immunoglobulin (in case of use only HRIG). The cost of complication is from the cost of treatment in the patients who develop allergy against rabies immunoglobulin. The cost of complication uses the standard cost of treatment in DRG system.

Generally, the cost of treatment for individual patient who develops rabies after prophylaxis with RIG is the same for both those of ERIG and HRIG, but the cost of life loss and the cost of complication is different. In case of new plant site of ERIG production, the potential of production can

be magnified to meet the demand of rabies immunoglobulin. At this point, there will be adequate of rabies immunoglobulin in Thailand even we use only ERIG. In contrast. The demand of rabies immunoglobulin is more than the supply of HRIG if we use only HRIG. Accordingly, the cost of life loss from shortage rabies immunoglobulin especially in case of solitary HRIG utilization must be calculated. In addition, cost of complication, which is the consequence of rabies immunoglobulin, will be calculated as well. The complication is mostly found in case of using ERIG because of the problem of impurity of horse serum.

Direct Cost or Production Cost

1. Cost of ERIG production: With no existing production plant, after establishment of tentative method and process of ERIG production, using the concept of capital budgeting and cost analysis will collect the costs of predicted input in each process.

2. Cost of HRIG production: data is collected from the current plant of production, Blood Bank-TRCS. In case of multiple product rather merely HRIG, the overhead allocation concept will be applied to retrieve the cost of HRIG production. [6,7,14]

Indirect Cost or Non-production Cost

1. Cost due to mortality (cost of life lost, income foregone loss)

With respect to the costs and benefits of such projects, it has long been recognized, of course, that the task of correctly capturing the corresponding welfare effects of a change in mortality or morbidity may pose specific problems. As is well-known, the literature up to now has focused mainly upon the discussion of two approaches, that is, the willingness to pay approach on the one hand, and the human capital approach on the other. By working out the effects of a project on the present value of and individual's earnings, the latter offers the advantage of yielding "hard data" which can be obtained at

reasonably low cost in the majority of cases. Conversely, the willingness to pay approach is grounded firmly in welfare economic theory in that it supplies, at least at the conceptual level, the correct measure of either individual benefit or cost. This study uses the concept of human capital approach to retrieve cost of life loss.

For the purpose of program evaluation, the human capital approach is often embedded in a somewhat wider approach which additionally takes into account the impact on medical care resource use.

1.1 Data source: from the annual epidemiological surveillance report year 2000.

1.2 Estimation of cost of life loss

The cost of life loss or income foregone loss can be calculate from the formula below.

$$\text{Income Forgone Loss} = \sum_{n=1}^{n=60-y} \frac{I*(1+g)^n}{(1+r)^n}$$

I = average income of Thai population

g = income-increasing rate of the population

r = discount rate

y = age at death

n = number of year of the premature death before retirement

1.2.1 Year loss: the initial step is to convert the year loss into working year loss that is equal to time (year) between age at death and age at retirement. The patients who died after age of 60 do not include in this study to calculate the income forgone due to retirement age at 60 even though there are productivities in this group. Therefore, there will be no income foregone for this group

of people. In addition, the age to start calculating the income loss is 13 according to the Labor Force Act 1998. [16,17]

$$Number\ of\ death\ in\ each\ age\ group * working\ year\ loss$$
$$= Working\ year\ loss\ in\ each\ group$$

1.2.2 Earning loss: in economics future year's earnings is less than current year's earning. Concept of *"Discounting annual earning loss"* is used in this study. Because of the fluctuation of economy in the country, this study will use the average of GDP growth to represent g.

r is the value which is used to discount over times. This study uses average fixed deposit of 1-year interest rate to represent r. Since one particular number of discounting factors may not reflect the real opportunity cost. Thus, to understand the effect of change in r, this study uses the 3 discount rates (6, 7 and 8%) simultaneously to perform sensitivity analysis.

The income-increasing rate (g), this study uses the average of Gross Domestic Product (GDP) growth rate to which show the average rate of productivity increasing.

1.2.3 Converting year loss into costs: this study uses the average growth of GDP during 1993-2001 to represent I.

2. Cost of treatment of rabies (morbidity cost): this sort of cost is from the relative weight (RW) of rabies in Diagnosis Related Group. RW is the average cost of treatment in that particular disease compare with the overall diseases. RW of rabies informs the standard average cost of rabies treatment in Thailand.

$$RW \text{ of rabies} = \frac{Average\ cost\ of\ treatment\ of\ rabies}{Average\ cost\ of\ treatment\ of\ every\ disease}$$

$$1\ RW = 4,000\ baht$$

*Cost of RW is subject to change according to the policy and regulation of MOPH. In year 2000, one RW was equal to 4,000 baht

Source: Health Insurance Office, MOPH

3. Cost of complication: this kind of cost refers to the cost that arises from the complication that develops in the patient who was treated with rabies immunoglobulin. This cost mainly includes the cost of treatment of that complication. As well as the morbidity cost, the cost of complication identifies through the RW in DRG system.
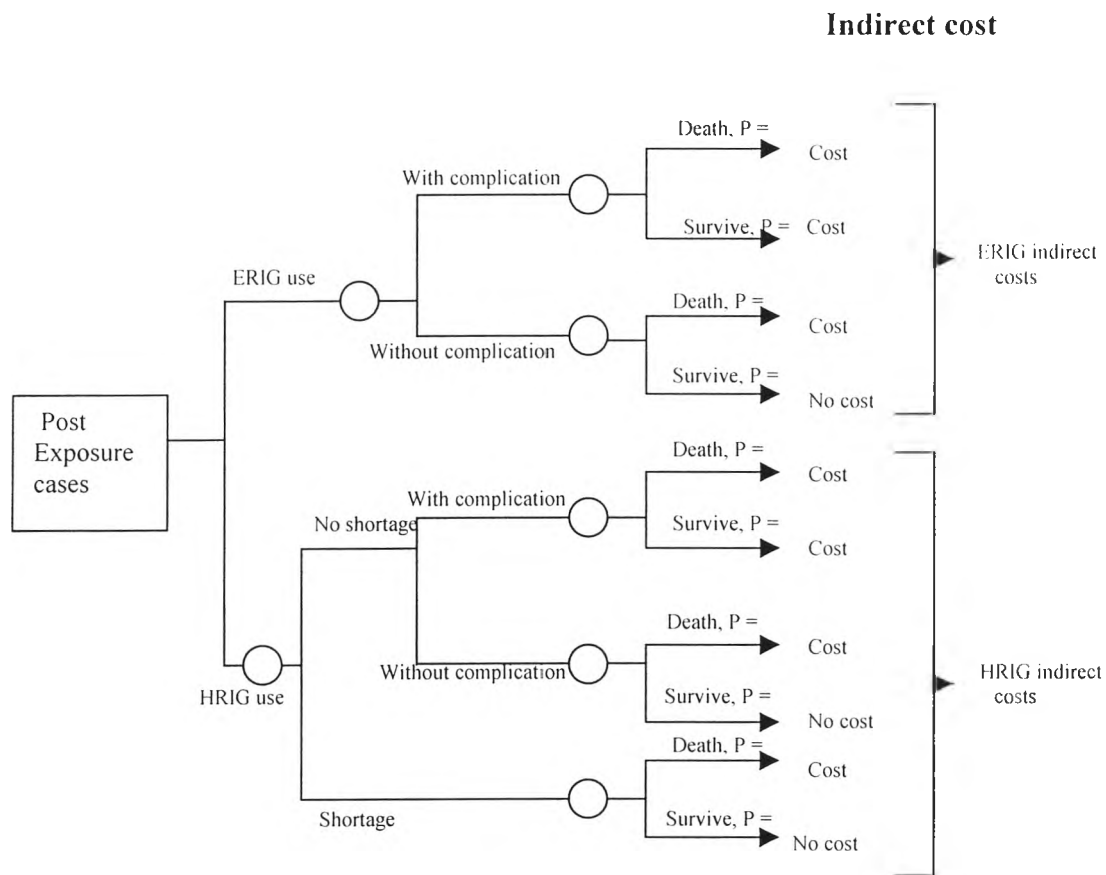
Indirect cost

Figure 3.4: Decision tree, this decision tree show the indirect cost that arise from ERIG and HRIG use. The patient who receives either ERIG or HRIG will have chances of developing rabies and complication. The costs from developing rabies after injection (costs due to mortality and morbidity) and costs of complication will be sum up to get indirect costs for each RIG. The probability of complication and disease occurrence can be calculated from the real data in year 2000. The mortality cost due to the shortage of HRIG when we use strictly only HRIG will be added into the indirect cost of HRIG calculation. This shortage cost reflect as the opportunity cost if HRIG in not available. Nonetheless, the post-exposure patients usually seek for rabies immunoglobulin. So that, this category of indirect cost may not occur.

3.2.3 Data Analysis

1. Calculate the cost per unit of ERIG and HRIG production. At this step, the previous data are used here to calculate unit, average, costs. A unit cost is a kind of simple average cost per unit of output or outcome. The basic calculation of a unit cost (often called " average cost" or AC) is not difficult. Where the total cost (TC), and the quantity of output, etc. (Q) have been found.(14,15)

$$Unit\ Cost\ or\ AC = \frac{Total\ Cost}{Quantity}\ or\ \frac{TC}{Q}$$

   * Q is the Volume of Production

2. Compare the cost per unit of production of ERIG and HRIG.