

## CHAPTER 4

### EMPIRICAL RESULTS



#### 4.1 Incidence Rate of Congenital Hypothyroidism

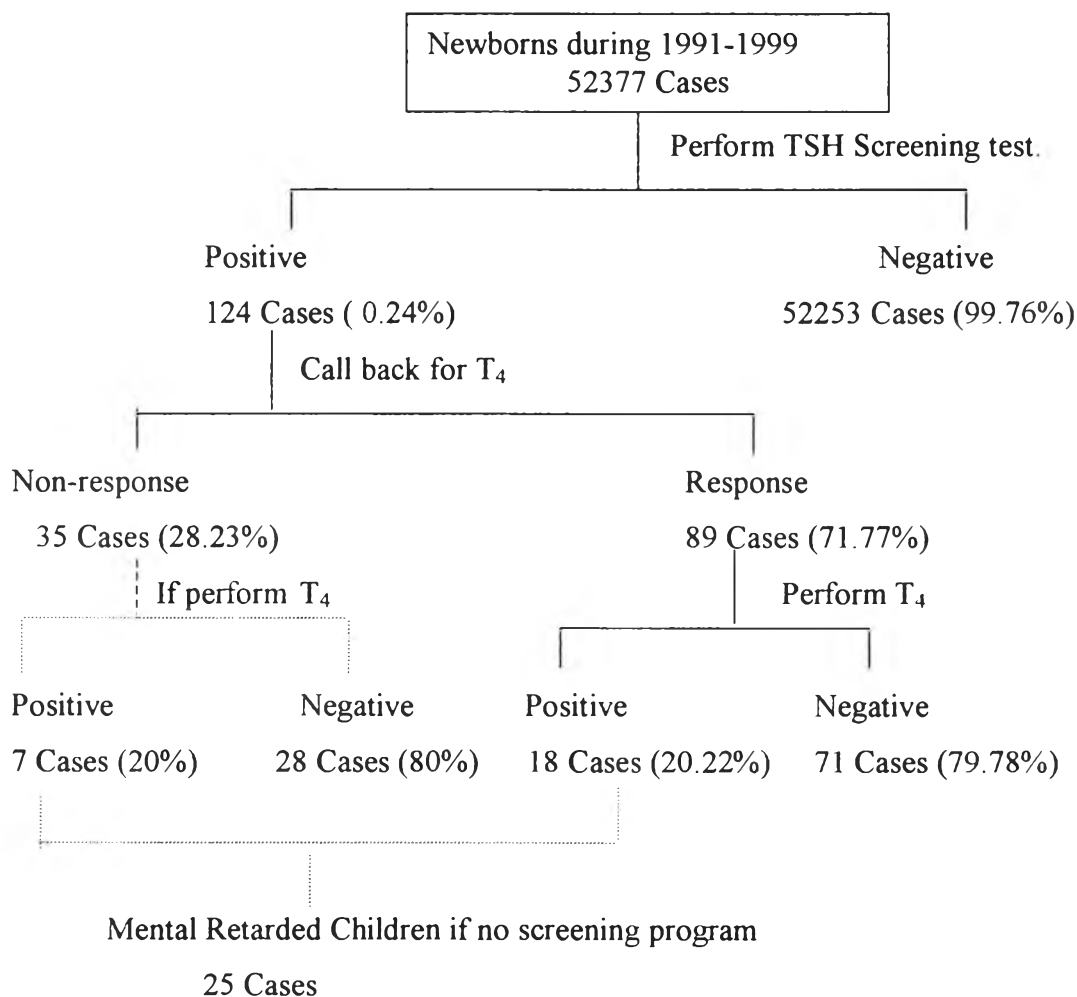
Congenital Hypothyroidism can be detected in newborn after birth 48 hours. From 1991, Chulalongkorn Hospital has started the pilot project of the Congenital Hypothyroidism screening in newborns. The Congenital Hypothyroidism patient can be detected from the result of TSH and  $T_4$  test. As the result, the incidence of the Congenital Hypothyroidism can be calculated by dividing the number of the correctly positive cases in both tests that is shown in table 4.1 by the whole population, which was screened in the period of study time. In this study, the period of study is from 1991 until the end of 1999 and the whole population of the TSH screen is 52,377 cases. All of these cases were examined in the same procedure that proposed in the figure 3.1 and assumed the sensitivity and specificity of TSH and  $T_4$  are the same as the unpublished study in 1991.

After discussing with the doctor, some of the suspected cases, which meant the TSH result was positive and these patients needed the confirmatory test, did not responded with the confirmatory calling. Thus, there are some missing Congenital Hypothyroidism patients that could not diagnose and treat, although, they were screened. Therefore, the calculation of the responded cases is necessary because the successful of the program depends on the responded to the confirmatory calling. In the other words, if the fully responsive-recall rate, the screening program can diagnose and treat nearly all of Congenital Hypothyroidism patients. In the other hand, if the responsive-recall rate is low, this means the screening program can not diagnose and treat some Congenital Hypothyroidism patients and these patients will be a huge burden to their families and to our society.

From the recording primary data at Nursery Department, there are 52,377 newborns, who were screened with TSH test from 1991 to 1999, and 124 cases had the TSH positive result. Only 89 from this group of patient responded the confirmatory calling to confirm with the  $T_4$  test. After confirming these patients, there were only 18

patients who were positive correctly detected cases. All of these data have been shown in figure 4.1.

Figure 4.1: The Summarize Chart of Incidence Rate.



Source: Recording Form at Nursery Department at Chulalongkorn Hospital.

The incidence of Congenital Hypothyroidism from the actual data is about 34 patients in 100,000 newborns or in the other words, in every 2907 newborns, there is only one Congenital Hypothyroidism patient. This number might be underestimated because in the non-responsive group of patient might have the Congenital Hypothyroidism patient. Thus, if we assumed that in the non-responsive group would have the Congenital Hypothyroidism patient in the same proportion with the actual data. As the result, the total Congenital Hypothyroidism patients would increase to 25 cases and the incidence rate would be 0.000477 or 48 cases in 100,000 live births or 1 per 2083 live births

The incidence rate of Congenital Hypothyroidism at Chulalongkorn Hospital is similar to the incidence rate in Thailand by other study. For instance, at Ramathibodi Hospital in 1990 to 1992 is approximately 1 per 2486 – 3843 (Rajatanavin, 1993) and from the Medical Science Department recording in 40 provinces, the average incidence of Congenital Hypothyroidism in Thailand is 1 per 3,329 live births (Chaleornsiriwat, 1999). Therefore, the incidence rate at Chulalongkorn Hospital can represent the country's incidence.

The prior data about the suspected group of patients so we can evaluate the recall rate of TSH test by dividing the number of suspected cases by the total screened cases.

$$\begin{aligned} \text{Thus, the recall rate of TSH} &= 124 / 52377 \\ &= 0.002367 \\ &= 0.24 \% \end{aligned}$$

The recall rate of TSH means the number of patients in suspected group that needs a confirmatory test and the recall rate of TSH shows the suitability of TSH cut off level. In Europe and America, if the TSH cut off level is suitable, the recall rate is around 0.1 – 0.5% that means in every 1000 of newborns, the number of suspected patients, who will be called back to confirm with others test, are 1 to 5 cases (Mahachoklertwattana, 1999). According to the TSH cut off is low and the sensitivity of finding patients is high, the recall rate will increase to 1–5%, as the result, the costs of labor and calling patient back and the most important is the incomplete calling patient rate will be increased. Moreover, the overmuch newborns, who investigated as Congenital Hypothyroidism and treated, will depress the impression of parents especially while waiting for the result beside unnecessary payment.

Therefore, the recall rate at Chulalongkorn Hospital, which is 0.24% is shown the suitable TSH cut off at 20 mU/L. From this figure means in every 1000 newborns, only 2 cases will be called back to confirm other tests. Nevertheless, the successful of TSH screening program depends on the parents' cooperation of the confirming process and treatment. Thus the responsive-recall rate and the compliance rate of patient will be other indicators to show the successful of the program. The responsive-recall rate at Chulalongkorn Hospital is calculated by dividing the number of responded cases by the total recall cases. The non-responsive-recall patients from July 1991 to December.1999 were 35 cases.

Therefore, the responded rate of TSH screening at Chulalongkorn Hospital

$$\begin{aligned}
 &= 89 / 124 \\
 &= 0.7177 \\
 &= 71.77 \%
 \end{aligned}$$

From this percentage means, there is only 72% from the total number of recall cases responded to the confirmatory calling. In the other words, there are around 30 suspected cases from a hundred missed the confirmatory test and they might be a Congenital Hypothyroidism patient, which will cause of mental retardation. Chaleornsiriwat V., 1999, has presented from the recording of Medical Science Department, the responsive-recall rate of the patients in 40 provinces that screened by Medical Science Department is 75.8 %. Therefore, the responsive-recall rate at Chulalongkorn Hospital is similar to other provinces.

## 4.2 Cost Calculation

The cost calculation in this study will be done in three perspective, provider, patient and societal. From provider perspective, the total costs base on the costs at Chulalongkorn Hospital, which is the teaching hospital. All of the cost comes from the recording form, interviewing patient and health personals and some from expert opinions. The process of the screening program includes the initial test, confirmatory test and the treatment. The total costs for each process of each activity is explained in Chapter 3. Total costs for each process of the screening program is shown in table 4.2. The detailed calculation of total costs for each process from provider perspective is shown in Appendix III.

For the patient costs of the TSH screening program come from the interviewing the parents of the positive correctly detected cases, who was diagnosed from Chulalongkorn Hospital. Assumed that they are the representation of the patient costs. From 1991 to 1999 there are 18 positive correctly detected from Chulalongkorn Hospital and the patient compliance rate is less than 5% from the expert opinion. So this study assumed that there is no patient compliance rate. After appointed this entire group, there are 13 patients responded the interviewing, which is 72.22 %. All of them are parents of the Congenital Hypothyroidism patient, who accompany the patient to hospital. Five of these parents have their relative

accompany with them to go to the hospital, which accounted to 38.46%. The general characteristics of the patient parents are presented in Appendix IV. One major characteristic of the patient side is payment mechanism. From the result, there are 10 parents from 13 parents can not reimburse the treatment costs that account to 76.92%. Therefore, in this study is assumed that all of the patient costs can not reimburse. The patient costs base on the actual data from the interviewing 13 parents from 18 parents. Total costs for each process of the screening program and the detailed calculation of total costs for each process from provider perspective is shown in Appendix IV.

The society costs will calculate on the basis of the Chulalongkorn Hospital. Some cost will omit in order to avoid the double counting calculation. The details and processes of calculation have been written in Chapter 3. The total costs are presented in the following table.

Table 4.1: The Total Costs of the TSH Screening Program.

	Provider	Patient	Society
TSH Process (Baht)	677,529	619,300	677,529
Confirmatory process (Baht)	10,069	5,925	10,069
Treatment and follow up (Baht)	101,400	182,712	232,184.42
Average cost per case screened(Baht)	51,169	91833	114,985.71

Note Total screened cases in 1999 = 10,321 cases, 25 recalled cases and 2 positive - correctly cases.

All costs are calculated in Fiscal year 1999.

<sup>1</sup> Present value of the unit cost of the out-patient department in Chulalongkorn Hospital after adjusting into year 1999

<sup>2,3</sup> Present value =  $\sum_{t=0}^1 \text{Future cost at year } t / (1 + r)^t$

From the total cost calculation in all perspective, we can summarize the screened cost in to the table 4.2.

Table 4.2: Screening Costs.

<i>Item</i>	<i>Perspective</i>		
	<i>Provider</i>	<i>Patient</i>	<i>Total costs</i>
Screening cost per screened case ( Baht)	66.62	61	66.95
Screening cost per diagnosed case (Baht)	66.77	61	67.10
Screening cost per positive case without treatment (Baht)	343,799	312,613	345,511.50
Screening cost per prevented case with treatment (Baht)	394,499	404,149	460,028.21

From both tables, the screening cost from provider perspective is 66.62 Baht per test, these costs include with the capital, material as well as labor costs. For the patient perspective, the screening cost per case is 61 Baht per test and for the societal perspective, the screening cost per case is about 67 Baht per test. Therefore, the money resource spend for one screened case of the Congenital Hypothyroidism is around 67 Baht.

The screening costs from the patient side means the expenses for the laboratory test at Chulalongkorn Hospital. After interviewing the doctor at Chulalongkorn hospital, we can summarize into the TSH charge are vary from 50 Baht to 100 Baht. And the charge for confirmatory process depends on the result of TSH, which varies between 50 to 300. From this number we can estimate the average TSH charge that is around 60 Baht per test and for the confirmatory process the average expense including the transportation costs is 237 Baht per test. Therefore, the screened costs includes with the confirmatory process is 61 per case and 312,613 per positive case. The meaning of patient cost per positive case is similarly to the cost effectiveness of the TSH screening program in patient perspective, if we define the effectiveness of the program as the correctly detection from the TSH test. Therefore, the cost effectiveness of the TSH screening program in patient perspective at Chulalongkorn Hospital is 312,613 Baht per case because in the year 1999, there is only 2 positive correctly detected cases from the TSH screening program.

The activity of the screening program does not terminate with the screened test, but it includes with the treated procedure because the Congenital Hypothyroidism patients need whole life long hormone supplement. Thus, the completely cost calculation of the screened program must include with the cost of the maintain treatment. The average costs of the TSH screening program including treatment has been shown in the same table as previous. Therefore, from table 4.2, the average cost per case that including treatment process in provider perspective is 51,169 Baht per case and 919,719 and 114,583.71 Baht per case in patient and societal perspective respectively. On the other hand, the screening cost including treatment per prevented case for provider, patient and society are 394,499, 404,149 and 460,028.21 Baht, respectively.

### **4.3 Estimation of Benefits**

The benefit calculations mean the cost saving if there is no screening program. From the literature review, if Congenital Hypothyroidism patients can not suddenly diagnose and promptly treat their brain will be absolute destroyed that causes of mental retardation. So, the benefits in this study mean the cost saving from taking care, special care and welfare for mental retardation. The calculation will be done in the same perspectives; provider, patient and societal. However, in the provider perspective, there is no cost saving because although there is no screening program, the provider still has to provide their facilities. Thus, the benefit calculation will include only patient and societal perspective. The total benefits will be classified and summarized from each perspective. Moreover, the future benefits will be discounted to the present value by using the discount rate at 5 % based on the social opportunity cost of capital. The total benefit for each perspective of the activity calculates from the equation explained in Chapter 3. The detail calculation of the total benefits is shown in Appendix V. Therefore, the estimated benefits of the TSH screening program are summarized in table 4.3 as the following.

Table 4.3: The Estimated Benefits of the TSH Screening Program.

<i>Perspective</i>	<i>Benefit components</i>	<i>Average benefit per case</i>
Provider	No	No
Patient	• Cost saving from lose of patient's productivity.	611,860.48
	• Cost saving from the cost of special education.	42,307.63
	• Cost saving from the lose of parents' productivity.	320,793.90
Society	• Cost saving from general support for mental retarded people.	18,979
	<b>Total Benefit</b>	<b>993,941.01</b>

From the table 4.3, we can analyze the result that if the screened program is successful that means there is fully cooperation between the provider and patient and there is no false negative error, the cost saving from this program will be 993,941.01Baht per case.

#### 4.4 The Present Value of Benefit and Costs

The benefit cost ratio will calculate base on the base case at Chulalongkorn Hospital and on the national policy scenario. The total costs of the screened program will base on all of the cost items that incur to the provider patient and societal perspectives. To compare with the all of cost saving items that would be burden to patient and family and society, if they did not have a screened program. All the expected future costs will be adjusted by the inflation, which was forecasted from the Exponential Smoothing (the more details in Appendix I), and all of the future costs and benefits will be discounted to the present value. The inflation rate for all calculation to the future costs is 3 % per annum and the discounting rate that bases on the real interest rate is 5 % annually. The details of calculation appear in Appendix VII. The results of each scenario are shown in table 4.4.



The benefit cost ratio at Chulalongkorn Hospital will be calculated from the actual total population that screened, diagnosed and treated in Chulalongkorn Hospital. All of these figures are shown in figure 4.1.

For the national policy scenario, the population of the calculation is assumed that there are 1,000,000 live births per year and the responsive-recall rate and recall rate are the same as actual data in Chulalongkorn Hospital. For the details will be shown in table 4.4 as following.

Table 4.4: The Present Value of Benefit Cost Calculation at Chulalongkorn Hospital and the National Policy.

Scenario	Base case at Chulalongkorn Hospital			National Policy.		
	Benefit (Baht)	Costs (Baht)	B/C ratio	Benefit (Baht)	Costs (Baht)	B/C ratio
Provider	24,848,525	11,362,936	2.19	481,067,448	178,321,603	2.70
Patient	24,848,525	11,768,948.07	2.11	481,067,448	192,438,619.36	2.50
Society	24,848,525	12,521,363.85	1.98	481,067,448	215,909,996.44	2.23

The provider present value of benefit cost ratio from the actual data from Chulalongkorn Hospital is 2.19 that means, the Chulalongkorn Hospital receives the benefit of the TSH screening program in monetary unit is 2.19 Baht from investing the money 1 Baht for the TSH screening program. The benefit cost ratio from Chulalongkorn Hospital differs from the benefit cost ratio in national policy because of some cost items at national policy. If the government invest the unit money in the Congenital Hypothyroidism screening, the benefit from this program will be 2.70 monetary unit. For the patient side, the benefit cost ratio from the program is 2.11 in the base case and 2.50 in the national policy. The benefit cost ratio of national policy in patient perspective probably is lower than the actual because all of patient data comes from the Chulalongkorn Hospital base case so the patient costs probably is higher than the whole country.

#### 4.5 The Sensitivity Analysis

The sensitivity analysis will be done base on the provider side and on the uncertain variable to ascertain the effects of using different discount rates, correctly diagnostic cases that really need the whole life treatment, responsive recall rate, compliance rate of patient as well as different probabilities of forgone money, which dues to parental productive losing. Special attention will give to the discounting rates. So we can summarize the variable that will be done sensitivity analysis into

- Discounting rate
- Responsive-recall rate.
- Compliance rate of patient.
- The number of whole life treatment.

First sensitivity analysis is the discounting rate. In this study, the discounting rate bases on the social opportunity cost of capital that refers to the prevailing real rate of interest. However, there are many arguments about the discounting rate in health because health investment is not the same as the wealth investment. Thus, some health economics have agreed with the low discounting rate in health investment. As the result, this study will be done the discounting sensitivity analysis in no discounting rate. Furthermore, if the meaning of social opportunity cost refers to the real interest rate and the average interest rate of Thailand in the past was around 10%. Therefore, the discounting sensitivity analysis will be done in the high discounting rate that is 10%.

For the internal factor, the responsive recall rate, the compliance rate of the patient as well as the number of patients who need whole life treatment have a remarkable impact on the economic evaluation analysis. Since the parental education and the communication system and incorrect address are the major issue of the responsive-recall rate and the compliance rate of the patient. The base of the responsive- recall rate and compliant rate of patient will be used the figure at Chulalongkorn hospital. Not for all of the primary Congenital Hypothyroidism that can be detected by TSH test need the whole life treatment. There are around 80 to 95% of primary Congenital Hypothyroidism, which causes from thyroid dysgenesis, will need a whole life thyroid

hormone treatment (Chearsrikrew, 1993). Therefore, the sensitivity analysis will be done in the aspects as the following.

- The respond recall rate will be 100%
- The compliance rate of patient will be 75%
- The proportion of whole life treatment will be 80 %

Table 4.5: The Sensitivity Analysis of Base Case and National Policy.

<b>Variable</b>	<b>B/ C of Base case</b>	<b>B/ C of National policy</b>
Base case	2.19	2.70
No discounting rate	2.75	3.22
Discounting rate 10%	1.51	2.05
100% Responsive-recall rate	5.20	10.84
75% Compliance rate	1.79	1.99
80% of the proportion of whole life treatment.	2.21	2.52

According to changing only the discounting rate in the difference value but other factors is the same, the value of the benefit cost ratio changes in the opposite way, that means if the discounting is increased, the benefit cost ratio will be declined. From the result, if we think that the health investment is not the same as the wealth investment so the discount rate of the health investment should be no discounting rate or the low discounting rate. Therefore, the benefit cost ratio of no discounting rate in base case and national policy increase from 2.19 to 2.75 and 2.70 to 3.22 respectively, which accounted to 20%. If the discounting rate increases to 10%, which follows the WHO recommendation, the benefit cost ratio of the TSH screening program is still more than 1 in both cases. Therefore, the benefit cost ratio of the screening program is not sensitive to the discounting rate.

From the table, the major effect to the benefit cost ratio of the screening program is the responsive-recall rate. As shown in the table, when the responsive-recall rate increases to 100%, the benefit cost ratio increase more than one time, which increase from 2.19 to 5.20 and 2.70 to 10.84 in base case and in national policy respectively.

Therefore, the TSH screening program will have much more benefit, if the patients are more responded to the recall back to confirm testing.

The assumption of the sensitivity analysis calculation of compliance rate of patient is incurring of compliance patient happened before the children age 2 years and this is result in the children brain development. The result of the sensitivity of complaint rate has shown that when the compliance rate of patient decreases, the benefit cost ratio will reduce around 18% in base case and 25% in national policy scenario. So, when the government considers the TSH screening program implementation, the compliance rate of patient should be taken account in the awareness of the program.

In the frame work of the Congenital Hypothyroidism treatment from Chearsrikrew, 1999, at the age 2 or 3 years of the Congenital Hypothyroidism patient doctors will stop treatment around 6 weeks in order to rechecking the thyroid hormone in blood. And if the result is normal, the children will stop the treatment and if the blood result is abnormal, those children need the whole life thyroid hormone replacement. Therefore, in this sensitivity analysis will assume that the number of the whole life treatment changes after the children age 2 year. From the sensitivity result, the number of patient who needs the whole life treatment is very little affect to the present value of benefit cost ratio. So, in this study can be assumed that all of the Congenital Hypothyroidism patients, who are detected from the TSH screening, need the whole life thyroid hormone treatment.

The last sensitivity analysis is done in the part of the different incidence rate of Congenital Hypothyroidism in national policy. From the literature review, the lowest incidence rate that found is 1 per 8,500 live births and the highest is 1 per 687 live births that found in Nan province. This analysis is carried out because if the benefit cost ratio in the lowest incidence rate is more than 1, that means the TSH screening program should be implemented. And if the benefit cost ratio is lower than 1 in the lowest incidence rate, the implementation of the screening program is still questionable and the future study should be done in the sense of human right, the expense will be paid anyway.

Table 4.6: The Benefit-Cost Ratio of National Policy in Differences of Incidence Rate.

<i>Incidence rate</i> <i>Scenario</i>	<i>Baseline</i>	<i>Low</i>	<i>High</i>
National Policy	2.70	1.86	3.25

From the table 4.6, although, the incidence rate of Congenital Hypothyroidism is very low, the benefit cost ratio of the TSH screening program is still greater than 1 analysis, so the government should emphasize on this screening program.