



CHAPTER 4

ANALYSIS AND RESULT

According to this study design, the total number of 103 cases who received the Bone Marrow Transplant and Conventional Therapy in the Social Security Scheme, Thailand during 1997 to 2001, but nearly half of them already died before completing the data collection process. The data information derived from their families and supportive persons, while the quality of life collected only from the survival of Bone Marrow Transplant and Conventional Therapy. However, the remaining data could still provide useful information on resource consumption of Bone Marrow Transplant and Conventional Therapy, and results developed in this study can be used as basis information for future study of this subject.

After all data were collected from secondary sources such as King Chulalongkorn Memorial Hospital, Social Security Office, etc and primary data were collected from patients, an analysis for the study attempted to construct a SPSS worksheet using raw data collected from various sources. The analysis method employed different technicalities of descriptive and survival analysis of life-table to calculate and estimate the results.

4.1 General Information of Subjects in the Study

The general characteristics of the Bone Marrow Transplant and Conventional Therapy in table 4.1 show the proportion of females and males patients in this study. The ratio between females and males is 1:1.19 which very similar to the general population ratio in Thailand.

Table 4.1 Gender of Population in This Study

Gender	Frequency	Percent	Cumulative Percent
Female	47	45.6	45.6
Male	56	54.4	100

The average age of population is 30.96 where mode is 27, and median is 30. The most proportion of age is ranged 25-29 (or 29.13%), 30-34 (or 23.3%), and 20-24 (or 15.53%) and 35-39 (or 15.53%) respectively (see table 4.2). The statistics indicate the 83.49% of patients aged between 20 and 39 and is concerned as a major problem. The reason is that the patients aged 20-39 still in the active labor force, and their sickness may affect the entire workforce and labor participation rate of the country.

Table 4.2 Age of Population in This Study

Group	Frequency	Percent	Cumulative Percent
15-19	3	2.91	2.91
20-24	16	15.53	18.44
25-29	30	29.13	47.57
30-34	24	23.3	70.87
35-39	16	15.53	86.40
40-44	9	8.74	95.14
45-49	3	2.91	98.05
50-54	2	1.95	100

The percent of HLA-matching in this study is 50.5% (see table 4.4). The result for HLA-identical is quite high though the size of family is not affecting the percentage of HLA-identical. One study about the percentage of HLA-compatible related donor in Thailand claimed about 34.7% as much as occurring in other countries (Nathalang et. al, 2002). The result may not obviously reflect the real situation of HLA-identical in Thailand. If

the patients acknowledge that they have no HLA-identical related donor before entering into Social Security Scheme, they may not enter into this program. The Bone Marrow Transplant during 1997-1999 shows a very high rate of HLA-matched of over 60% while the last two year the HLA-identical related donor rate dropped to 40% (see table 4.5). Even though the number of patients entering into this program has been increasing year by year, but the number of patients is still inconsiderable significant while the information about the program is also accessible in a close society.

Table 4.4 HLA-Matching of Population in This Study

HLA-Matched	Frequency	Percent	Cumulative Percent
Yes	52	50.5	50.5
No	51	49.5	100

Table 4.5 HLA-Matching of Population in This Study (%)

Matched	1997	1998	1999	2000	2001
Yes	62.5%	73.3%	62.5%	40.6%	40.6%
No	37.5%	26.7%	37.5%	59.4%	59.4%

The university hospitals of Bone Marrow Transplant and Conventional Therapy are available in only four hospitals. Cases in Siriraj Hospital indicate a highest proportion of 47.6% of the total cases where King Chulalongkorn Memorial Hospital, Ramathibodi Hospital, and Pramongkutkloa Hospitals compose 24.3%, 19.4%, and 8.7% of total cases. As the King Chulalongkorn Memorial Hospital reveals a second rank of cases in this program, the cost used in this study for provider perspective can greatly reflect the cost of total providers in Bone Marrow Transplant and Conventional Therapy under Social Security Scheme (see table 4.6).

Table 4.6 Hospital of Population in This Study

Hospital	Frequency	Percent	Cumulative Percent
Pramongkut	9	8.7	8.7
Rama	20	19.4	28.1
Chula	25	24.3	52.4
Siriraj	49	47.6	100

The percentage of different diseases in Bone Marrow Transplant and Conventional Therapy indicates 77.7% in Leukemia where only 17.5% found in SAA (see table 4.7).

Table 4.7 Diagnosis of Population in This Study

Diagnosis	Frequency	Percent	Cumulative Percent
ALL	2	1.9	1.9
ANLL	24	23.3	25.2
CML	54	52.4	77.7
NHL	5	4.9	82.5
SAA	18	17.5	100

4.2 Cost of Bone Marrow Transplant and Cost of Conventional Therapy in each perspective

- Provider

The study employed a formula of present value $PV = FV_n(1+r)^{-n}$ with 3% of discount rate which PV = present value, FV = future cost at year n, r = discount rate and the based year is 2001, to overcome the finished year of study in cost analysis of patients services: DRG, at King Chulalongkorn Memorial Hospital (see table 4.8, table 4.9).

Table 4.8 Provider Cost of Bone Marrow Transplant

Cost	1997	1998	1999	2000	2001
Cost	2,429,396.21	5,958,888.2	5,809,831.7	7,165,897.43	7,737,892.64
PV of Cost	2,734,306.87	6,511,438.03	6,163,650.45	7,380,874.35	7,737,892.64

Table 4.9 Provider Cost of Conventional Therapy

Cost	1997	1998	1999	2000	2001
Cost	655,924.59	669,330.12	759,468.66	1,597,624.68	2,358,317.07
PV of Cost	738,248.90	731,395.09	805,720.3	1,645,553.42	2,358,317.07

- Patient

The cost of patient's calculation was based on year 2001 with 3% discount rate. The cost of indirect cost of patient in Bone Marrow Transplant shows a higher percentage than the Conventional Therapy (see table 4.10 and table 4.11). As the cause of donor and care taker after Bone Marrow Transplant would base fairly on salary, wage and transportation, the patient cost of Bone Marrow Transplant is found higher than the cost of Conventional Therapy (see table 4.12 and 4.13).

The Direct Medical Cost of patients in both programs is zero, so the Direct Cost of patients only comes from the Direct Non-medical Cost which means various categories of transportation, for example traveling expenses, supplemental food, media expenses, supplies and materials associated with Bone Marrow Transplant and Conventional Therapy. Indirect Cost comes from donors of Bone Marrow Transplant and care taker of programs as well as transportation cost, travel expenses, salary, wages, fringe benefit etc.

Table 4.10 The Percentage of Direct and Non-direct Cost of Bone Marrow Transplant Patient

Cost	1997	1998	1999	2000	2001
Direct Non-medical	25%	30%	28%	30%	26%
Indirect Cost	75%	70%	72%	70%	74%

Table 4.11 The Percentage of Direct and Non-direct Cost of Conventional Therapy Patient

Cost	1997	1998	1999	2000	2001
Direct Non-medical	41%	47%	50%	39%	56%
Indirect Cost	59%	53%	50%	61%	44%

The Patient cost in Bone Marrow Transplant had increased respectively from 1997-2001, while the patient cost in Conventional Therapy shows greatest growth in 2000 and 2001. The phenomenon maybe the effect of tremendous increase in the number of patients in 2000 and 2001.

Table 4.12 Patient Cost of Bone Marrow Transplant

Cost	1997	1998	1999	2000	2001
Cost	82,490	244,505	308,490	324,005	434,390
PV of Cost	92,842.5	267,177.22	327,277.04	333,725.15	434,390

Table 4.13 Patient Cost of Conventional Therapy

Cost	1997	1998	1999	2000	2001
Cost	39,710	25,826	48,110	226,780	193,870
PV of Cost	44,693.61	28,220.77	51,039.9	233,583.4	193,870

- Payer

The calculation of the cost of payer perspective from the annual payment during 1997 to 2001, with the 3% of discount rate in 2001 reveals the greater payment of Bone Marrow Transplant than the payment of Conventional Therapy (see table 4.14 and table 4.15).

Table 4.14 Payer Cost of Bone Marrow Transplant

Cost	1997	1998	1999	2000	2001
Cost	3,000,000	6,600,000	6,600,000	9,271,000	9,771,000
PV of Cost	3,376,500	7,211,998.2	7,001,940	9,549,130	9,771,000

Table 4.15 Payer Cost of Conventional Therapy

Cost	1997	1998	1999	2000	2001
Cost	90,000	120,000	578,201	620,090	591,000
PV of Cost	101,295	131,127.24	613,413.44	638,692.7	591,000

For the conclusion (see table 4.16) of Bone Marrow Transplant and the Conventional Therapy (see table 4.17), the cost of Bone Marrow Transplant in provider perspective is lower than the payment from payer side, while the cost of Conventional Therapy reveals the opposite result.

The calculated cost of Bone Marrow Transplant in provider side is not including the harvest of Bone Marrow from donor side, due to the under-estimated DRG. The payment from Social Security Office is not sufficient for the Conventional Therapy. Look at the patient perspective, the cost incurring in Bone Marrow Transplant is higher than the Conventional Therapy which derived from various sources, dominantly as donor, care taker and family members, and etc.

Table 4.16 Cost of Bone Marrow Transplant

Cost	1997	1998	1999	2000	2001
Provider	2,734,306.87	6,511,438.03	6,163,650.45	7,380,874.35	7,737,892.64
Patient	92,842.5	267,177.22	327,277.04	333,725.15	434,390
Total	2,827,149.37	6,778,615.25	6,490,927.49	7,714,599.5	8,172,282.64
Payer	3,376,500	7,211,998.2	7,001,940	9,549,130	9,771,000

Table 4.17 Cost of Conventional Therapy

Cost	1997	1998	1999	2000	2001
Provider	738,248.90	731,395.09	805,720.3	1,645,553.42	2,358,317.07
Patient	44,693.61	28,220.77	51,039.9	233,583.4	193,870
Total	782,942.51	759,615.86	856,760.2	1,879,136.82	2,552,187.07
Payer	101,295	131,127.24	613,413.44	638,692.7	591,000

Table 4.18 shows the total cost of both programs in perspective of provider, patient and payer, which the payer apparently pays more than provider and patient.

Table 4.18 The total of Two Programs

2 Programs	Provider	Patient	Payer
Total Cost	36,807,397.14	2,006,726.99	38,986,096.58

4.3 Effectiveness of Bone Marrow Transplant and Conventional Therapy

- Number of Life Saved

These numbers counted from the status of patients in each program, Bone Marrow Transplant and Conventional Therapy, and the data collected after receiving the treatment with HLA-identical. The numbers of life saved in Bone Marrow Transplant and in Conventional Therapy are shown in table 4.19 and table 4.20.

Table 4.19 Number of life saved in Bone Marrow Transplant

Status	Frequency	Percent	Cumulative Percent
Alive	21	40.4	40.4
Alive,m39	6	11.5	51.9
Alive,R	1	1.9	53.8
Dead	24	46.2	100

*m39 = the code of payment in Social Security Scheme, the patient paid for the part of employer

*R = the code to indicate that patient left out of Social Security Scheme

Table 4.20 Number of life saved in Conventional Therapy

Status	Frequency	Percent	Cumulative Percent
Alive	13	25.5	25.5
Alive,m39	3	5.9	31.4
Alive,R	6	11.7	43.1
Dead	29	56.9	100

*m39 = the code of payment in Social Security Scheme, the patient paid for the part of employer

*R = the code to indicate that patient left out of Social Security Scheme

After all, the separation of the number of dead and alive in each disease is brought to compare with the same treatment in Bone Marrow Transplant (see table 4.21).

Table 4.21 Report the dead and alive population between Bone Marrow Transplant Group and Conventional Therapy in each Disease

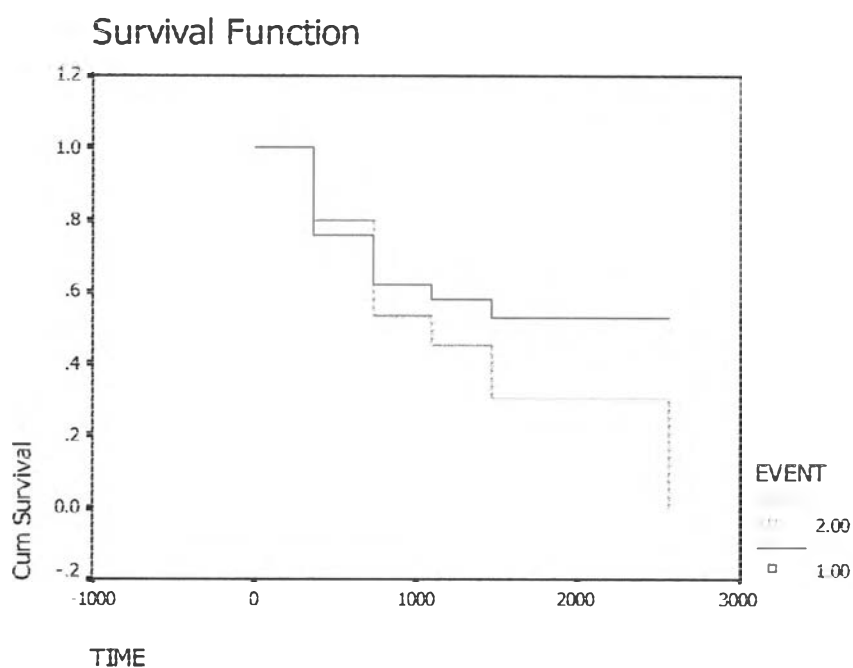
	Bone Marrow Transplant		Conventional Therapy	
	Dead	Alive	Dead	Alive
CML	13	16	13	11
SAA	1	4	7	6
ANLL	7	5	10	2
ALL	1	1	-	-
NHL	3	1	1	-

The conclusion of the entire program for patient under Bone Marrow Transplant and Conventional Therapy indicates that the Bone Marrow Transplant saved 28 lives and Conventional Therapy saved 22 lives. Bone Marrow Transplant shows most successful in CML and SAA than other diseases, while Conventional Therapy returns the number of death rather than living number in every disease.

The calculation of the Life Saved of Bone Marrow Transplant and Conventional Therapy was based on the total number in each program with survival rate from survival analysis of Bone Marrow Transplant and Conventional Therapy. The results will be analyzed and compared among the cost in perspective of provider, patient and payer. Event = 1 refers to patients who treated with Bone Marrow Transplant and Event = 2 refers to patients who treated with Conventional Therapy.

In Bone Marrow Transplant, the probability of surviving at the end is 0.5262 and median survival time for the data is 2190.0+. In Conventional Therapy, the probability of surviving at the end is 0.3207 and median survival time for these data is 885.98+.

From survival analysis, the results show 27.36 lives saved in Bone Marrow Transplant and 16.36 lives saved in Conventional Therapy.



- Number Year of Life Saved

The number year of life saved was calculated from survival rate in survival analysis and expected year $(71.45 - 30.96) = 40.49$ years in this study. A one life contains 40.49 years in Bone Marrow Transplant and saved 1,107.81 year while the Conventional Therapy saved only 662.42 years.

- Quality of Life

In Bone Marrow Transplant group, 6 months outcome follow up in table 4.22 shows higher ratio on some problem of uncomfortable and anxiety while the severe problem found in smaller number.

Table 4.22 Quality of Life in Bone Marrow Transplant after 6 months

	No Problem (1)		Some Problem (2)		Severe Problem (3)	
Mobility	5	18.52%	19	70.37%	3	11.1%
Uncomfortable/Pain	3	11.11%	20	74.07%	4	14.82%
Anxiety/Depressed	4	14.82%	22	81.48%	1	3.7%
Self-Care	10	37.04%	15	55.56%	2	7.4%
Usual Activity	12	44.44%	13	48.16%	2	7.4%

In the Bone Marrow Transplant group, after 1 year treatment (see table 4.23), the higher proportion still in the some problem of uncomfortable and anxiety, but slightly lessen from the 6 months follow up. The number of severe problem has decreased while the number of no problem has gone up.

Table 4.23 Quality of Life in Bone Marrow Transplant after 1 year

	No Problem (1)		Some Problem (2)		Severe Problem (3)	
Mobility	18	66.67%	8	29.63%	1	3.7%
Uncomfortable/Pain	15	55.56%	10	37.04%	2	7.4%
Anxiety/Depressed	12	44.44%	14	51.86%	1	3.7%
Self-Care	22	81.48%	5	18.52%	-	-
Usual Activity	19	70.37%	8	29.63%	-	-

The long term follow up, in table 4.24, shows the result of only 1 patient (age >40) on no problem complains about a little knee pain and 1 patient complains discomforting walk.

Table 4.24 Quality of Life in Bone Marrow Transplant, currently (before February 1, 2004)

	No Problem (1)		Some Problem (2)		Severe Problem (3)	
Mobility	26	96.3%	1	3.7%	-	-
Discomfortable/Pain	26	96.3%	1	3.7%	-	-
Anxiety/Depressed	27	100%	-	-	-	-
Self-Care	27	100%	-	-	-	-
Usual Activity	27	100%	-	-	-	-

In Conventional Therapy group, 6 months follow up (see table 4.25), reveals the highest some number of no problem group, where the some problem reveals the second and the severe group reveals the lowest.

Table 4.25 Quality of Life in Conventional Therapy after 6 months

	No Problem (1)		Some Problem (2)		Severe Problem (3)	
Mobility	12	75%	3	18.75%	1	6.25%
Uncomfortable/Pain	9	56.25%	5	31.25%	2	12.5%
Anxiety/Depressed	8	50%	4	25%	4	25%
Self-Care	13	81.25%	3	18.75%	-	-
Usual Activity	11	68.75%	3	18.75%	2	12.5%

In the 1 year follow up (see table 4.26), the result is greater with decreasing number of some problem and severe problem.

Table 4.26 Quality of Life in Conventional Therapy after 1 year

	No Problem (1)		Some Problem (2)		Severe Problem (3)	
Mobility	15	93.75%	1	6.25%	-	-
Discomfortable/Pain	13	81.25%	2	12.5%	1	6.25%
Anxiety/Depressed	12	75%	4	25%	-	-
Self-Care	15	93.75%	1	6.25%	-	-
Usual Activity	14	87.5%	1	6.25%	1	6.25%

Long term follow up (see table 4.27), as of before February 1, 2004, shows no problem in most patient, but patient who stills anxiety about relapse or refractory period appears only little.

Table 4.27 Quality of Life in Conventional Therapy, currently (before February 1, 2004)

	No Problem (1)		Some Problem (2)		Severe Problem (3)	
Mobility	16	100%	-	-	-	-
Discomfortable/Pain	12	75%	4	25%	-	-
Anxiety/Depressed	12	75%	4	25%	-	-
Self-Care	16	100%	-	-	-	-
Usual Activity	15	93.75%	1	6.25%	-	-

The Bone Marrow Transplant group shows more some and severe problem than the Conventional Therapy in acute and intermediate effectiveness after treatment. However, after 6 months the Conventional Therapy appears to express more severe problem, especially in severe anxiety and pain than the Bone Marrow Transplant. In the long term, the Bone Marrow transplant displays less in some problem than the Conventional Therapy and none of them receive severe problem.

Emphasizing the patients' quality of life, EQ-5D program would be a measure of health status for evaluating health and healthcare. It provides a simple descriptive profile and generates a single index value for health status on where full health refers to "1" and a death refers to "0".

After 6 months of treatment, Bone Marrow Transplant gives result of health status about 0.548 and Conventional Therapy gives about 0.736 while after 1 year of treatment, Bone Marrow Transplant shows incremental to 0.723 and Conventional Therapy shows 0.851. Thus, after treatment until February 1, 2004, Bone Marrow Transplant increases to 0.932 while Conventional Therapy increases to 0.864.

From expert point of view, the evaluation of 6 Hematologist on the quality of life after treatment with Bone Marrow Transplant shows greater results than the whole picture of Conventional Therapy. The reason might be the Bone Marrow Transplant giving more chances of cure with health good new bone marrow cell while the Conventional Therapy the patients still lived with the old cell. Even though after received the treatment, Bone Marrow Transplant still show a minimal chance to relapse or disease progression and it influences the patients to come to see a doctor every 6 month for physical and lab test. Conventional Therapy also urges the patients to come to a doctor after received the treatment every 3 months to follow up the blood picture and have the higher rate of relapse. In conclusion, quality of life of whole life, Bone Marrow Transplant shows 0.85 while Conventional Therapy shows only 0.5 compared with the full health status.

Finally, Bone Marrow Transplant can save 941.638 QALY's without discount rate and Conventional Therapy can save 331.21 QALY's. When applying the 3% of discount rate, Bone Marrow Transplant can save 720.678 QALY's while Conventional Therapy can save only 253.49 QALY's.

4.4 Cost-Effectiveness Analysis and Incremental Cost-Effectiveness Analysis of Bone Marrow Transplant Compared with Conventional Therapy

- a) Number of patients in Bone Marrow Transplant = 52 patients
- b) Number of patients in Conventional Therapy = 51 patients
- c) Survival rate of Bone Marrow Transplant = 0.5262
- d) Survival rate of Conventional Therapy = 0.3027
- e) Life expectancy = 71.45 years old
- f) Means age of patients in both program = 30.96 years old

Table 4.28 Cost-Effectiveness of Bone Marrow Transplant with 3% of discount rate

Type	Provider	Patient	Total	Payer
C/E(life saved)	1,115,795.41	53,194.88	1,168,990.288	1,348,952.146
C/E(no. of yr.)	27,557.31	1,313.78	28,871.09	33,315.686
C/E(QALY)	42,360.34	2,019.5	44,379.84	51,216.45

Table 4.29 Cost-Effectiveness of Conventional Therapy with 3% of discount rate

Type	Provider	Patient	Total	Payer
C/E(life saved)	383,816.31	33,704.63	417,520.93	134,445.441
C/E(no. of yr.)	9,479.29	832.42	10,311.7	3,320.46
C/E(QALY)	24,771.13	2,175.26	26,946.4	8,187.81

Table 4.30 Incremental Cost-Effectiveness of Bone Marrow Transplant

Type	Provider	Patient	Total	Payer
Life saved	731,979.1	19,490.25	751,469.36	1,271,611.524
No. of yr.	18,098.02	481.36	18,559.39	31,405.57
QALY	17,589.2	-155.76	17,433.44	43,028.64

4.5 Sensitivity Analysis

Cost of Bone Marrow Transplant and Conventional Therapy in different discount rate. First cost comes from CPI discount rate in all perspective.

Table 4.31 Cost of Bone Marrow Transplant with CPI discount rate

Cost	1997	1998	1999	2000	2001
Provider	2,686,818.53	6,429,561.38	6,109,874.65	7,366,542.56	7,737,892.64
Patient	91,230.76	263,817.65	324,421.66	333,077.14	434,390
Total	2,778,049.29	6,693,379.03	6,434,296.31	7,699,619.7	8,172,282.64
Payer	3,317,884.24	7,121,312.51	6,940,850.4	9,530,588	9,771,000

Table 4.32 Cost of Conventional Therapy with CPI discount rate

Cost	1997	1998	1999	2000	2001
Provider	725,427.27	722,198.33	798,690.66	1,642,358.17	2,358,317.07
Patient	43,917.73	27,865.91	50,594.59	233,129.84	193,870
Total	769,345	750,064.24	849,285.25	1,875,488.01	2,552,187.07
Payer	99,536.53	129,478.41	608,061.61	637,452.52	591,000

Second cost comes from different discount rate in each perspective, MLR for provider, CPI for patient and Interest rate for payer.

Table 4.33 Cost of Bone Marrow Transplant with different rate in each perspective

Cost	1997	1998	1999	2000	2001
Provider	3,224,540.57	7,272,864.02	6,359,587.02	7,470,448.07	7,737,892.64
Patient	91,230.76	263,817.65	324,421.66	333,077.14	434,390
Total	3,315,771.33	7,536,681.67	6,684,008.68	7,803,525.21	8,172,282.64
Payer	3,981,903.68	8,055,345.38	7,224,525	9,665,017.5	9,771,000

Table 4.34 Cost of Conventional Therapy different rate in each perspective

Cost	1997	1998	1999	2000	2001
Provider	870,609.513	816,922.013	831,333.38	1,665,523.73	2,358,317.07
Patient	43,917.73	27,865.91	50,594.59	233,129.84	193,870
Total	914,527.24	867,516.6	1,064,463.2	1,859,393.73	2,402,234.8
Payer	119,457.11	146,460.83	632,913.27	646,443.83	591,000

Discounting the life expectancy, it obviously reduces the value of effectiveness. The table 4.35 and 4.36 show the effectiveness for 4 alternatives life extension: 10 years, 20 years, 30 years and 40 years in term of number of year of life saved and QALY's.

Table 4.35 Cost-Effectiveness of Bone Marrow Transplant and Conventional Therapy in Term of Number of Year of Life Saved with 3% discount rate

Year	Provider		Patient		Total		Payer	
	BMT	CT	BMT	CT	BMT	CT	BMT	CT
10	111,580	38,381.63	5,319.488	3,370.46	116,899	41,752.09	134,907	12,686.6
20	55,789.77	19,190.82	2,659.74	1,685.23	58,449.51	20,876.05	67,453.52	6,343.30
30	37,193.18	12,793.88	1,773.16	1,123.49	38,966.34	13,917.36	44,969.02	4,228.87
40	27,894.89	9,595.41	1,329.87	842.62	29,224.76	10,438.02	33,726.76	3,171.65

Table 4.36 Cost-Effectiveness of Bone Marrow Transplant and Conventional Therapy in Term of Number of QALY with 3% discount rate

Year	Provider		Patient		Total		Payer	
	BMT	CT	BMT	CT	BMT	CT	BMT	CT
10	139,462	76,783.44	6,648.78	6,742.7	146,111	83,526.14	168,619	25,379.88
20	69,731.1	38,391.72	3,324.39	3,371.35	73,055.49	41,763.07	84,309.51	12,689.94
30	46,487.4	25,594.5	2,216.26	2,247.57	48,703.66	27,842.05	56,206.34	8,459.96
40	34,865.55	19,195.86	1,662.19	1,685.67	36,527.74	20,881.54	42,154.76	6,344.97