The International Journal of Social Sciences
30th March 2014. Vol.21 No.1

ISSN 2305-4557
www.Tijoss.com

DEVELOPMENT OF INDONESIAN HEALTH RELATED QUALITY OF LIFE (INA-HRQOL) MODEL ON COST UTILITY ANALYSIS

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Abstract

Background: The problems that are faced especially in Indonesia, is that there has not been any measurement model in health status related to the quality of life. Considering the above problems, the Development of INA-HRQoL model was carried out by referring to the Health Utility Index and EuroQol-5-Dimension.

Methods: Started with the validity and reliability of INA-HRQoL which was continued to the measurement of the Utility, Time Preference and QALY's on 232 respondents using treatment for the infectious disease (TBC) and 261 respondents using the treatment for the non infectious disease (Hypertension) at Cipto Mangunkusumo National General Hospital.

Results: Using T test (T-0,05) there was a significant difference between the TBC and the Hypertension group respondents to the Mobility Attribute (p=0,01); Social Activity (p=0,03); Sight (p=0,00); Hearing (p=0,04); Emotion (p=0,04); and Utility (p=0,00) as a whole. Cost Utility Analysis on the treatment of the infectious disease (TBC) showed the ratio of 4.664 while on the non infectious disease (Hypertension) showed ratio of 4.964.

Conclusion INA-HRQoL only consisted of 10 attributes, 1) .Individual Activity; 2).Sight; 3).Hearing; 4).Communication; 5).Social Activity; 6).Taste Sensory; 7).Speech; 8).Mobility; 9).Pain and 10).Emotion.

Key Words: Cost Utility Analysis, Indonesian - HRQoL.

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Introduction

As a developing country, Indonesia also experiences epidemiology transition infectious diseases, acute respiratory infection, TBC, Malaria, etc to non-infectious diseases such as, coronary heart disease, hypertension, diabetes, etc. This phenomenon is called protracted transition, where the increase of non-infectious diseases rate is also followed by the non infectious diseases rate[1].

On one side the cost of health support is still much used for infectious diseases, while on the other side the cost of support for non-infectious diseases needs also a serious attention. Both infectious and non-infectious diseases need good and serious managements[2,3].

In today's healthcare paradigm, the aspect of quality of life as an outcome of intervention programs need to be considered first, is the concept of quality of life itself. Actually, measuring the quality of human life associated with health had been already started from year 1963 till now, among others, Health Utilities Index Mark 3 (HUI-3) of Torrance, 1972 & Center for Health Economics and Policy Analysis of Mc Master University – Hamilton, Canada with the attributes: (1) Vision, (2) Hearing, (3) Speech, (4) Ambulation, (5) Dexterity, (6) Emotion), (7) Cognition & (8) Pain[4]. On the other hand the measurement model

The International Journal of Social Sciences
30th March 2014. Vol.21 No.1

ISSN 2305-4557
www.Tijoss.com

of the quality of human life associated with health had also been developed by Rosser, 1982 (*Rosser's Index*) and enhanced again by the Center for Health Economics, York University – York, UK, 1994 with EuroQol – 5D (EQ-5D) which leads to the measurement of five health status people, namely : (1) Mobility, (2) Self-Care, (3) Usual Activities, (4) Pain/Discomfort & (5) Anxiety/Depression[5-7].

By only referring to the existing measurement model of EQ-5D and HUI-3 researcher have tried to develop a model of measuring the quality of human life associated with Indonesian Health, called the Indonesia-Health Related Quality of Life (INA-HRQoL, *Rivany*, 1999) which resulted in 12 attributes of health status that consists of two major parts namely the physical attributes: (1) Mobility, (2) Activities / Personal Activities, (3) Activities / General Activities/Social, (4) View / Vision, (5) Hearing, (6) Smell, (7) Taste of Food, (8) Speech / Communication, (9) The movement of the hands, fingers and feet, (10) Pain and added with two non-physical attributes, namely : (1) Emotion and (2) Memory[8-10].

Issues

In fact, Cost Utility Analysis has rarely / never been done in Indonesia, although in theory and actual operational Cost Utility Analysis, it is expected to provide added value in the decision-making processes that lead to quality of life (*Torrance et al*, 1972; *Drummond*, 1987; *Bootman et al*, 1990; *Jones-Lee*, 1990; *Kaplan et al*, 1982; *Keeney et al*, 1976)[4-10].

Research Objectives

The general objective of the research is to obtain a model of health status measurement that leads to the quality of human life associated with Indonesian health (INA-HRQoL) that can be used as a base for the calculation of Cost utility Analysis in Health Economic evaluation technique in Indonesia. The specific objective is to: 1)Determine Validity & Reliability of attributes INA-HRQoL; 2)Determine the correlation that occurs between the attributes INA-HRQoL; 3) To Know the sensitivity of the attributes of INA-HRQoL; 4) Getting Value of Utility, Time Preference & QALY's treatment of patients with infectious (tuberculosis) and non-infectious (Hypertension) diseases; 5) Obtain an average cost (unit cost & cost of illness) from patients with the treatment of infectious (TB) and non-infectious (Hypertension) diseases; 6) Getting a picture of the ratio for cost per utility (QALY's) to be in the treatment of patients with acquired infectious diseases (TB) and non-infectious diseases (Hypertension).

Framework Concepts

The concept framework of this research consisted of two stages. The first stage was to create a model of measuring the quality of human life associated with the Indonesian's health (INA-HRQoL, *Rivany*, 1999), where the model's formation was based on the study of model-EuroQol-5Dimension (EQ-5-D) from the EuroQol Group, 1994 and Health Utility Index 3rd version (HUI-3- from Torrance et al, 1972). The Validity and reliability test were carried out to see the steadiness of the instrument in the values of cultural and socio-cultural of the Indonesian society as shown below[11-16].

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ISSN 2305-4557
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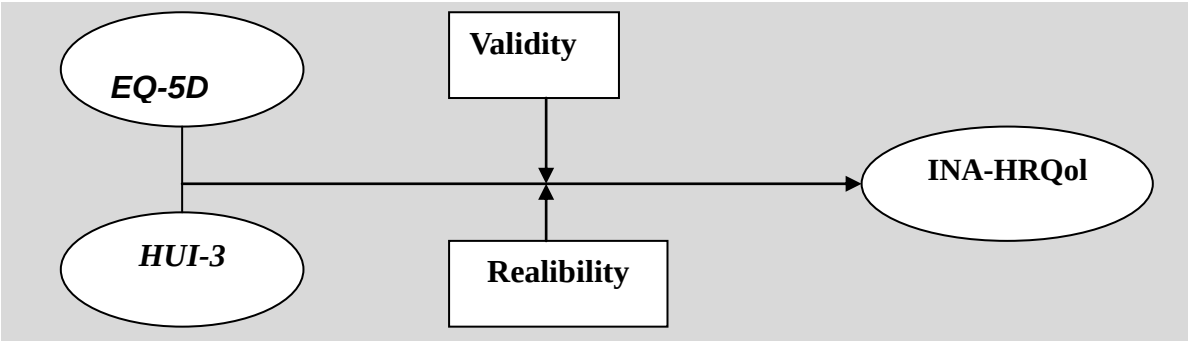
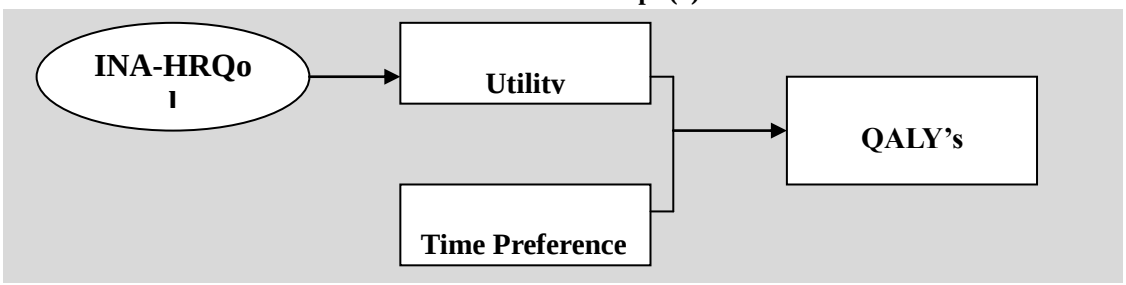
Framework Concepts (1)



The second stage of the framework concept of this research was the expansion of the INA-HRQoL model that had been tested before, so that it could be used to measure the Utility and Time Preference variables in order to obtain the value of outcomes of The Quality Adjustment life Years (QALY's) as a unit to be designated as common denominator.

Framework Concept (2)



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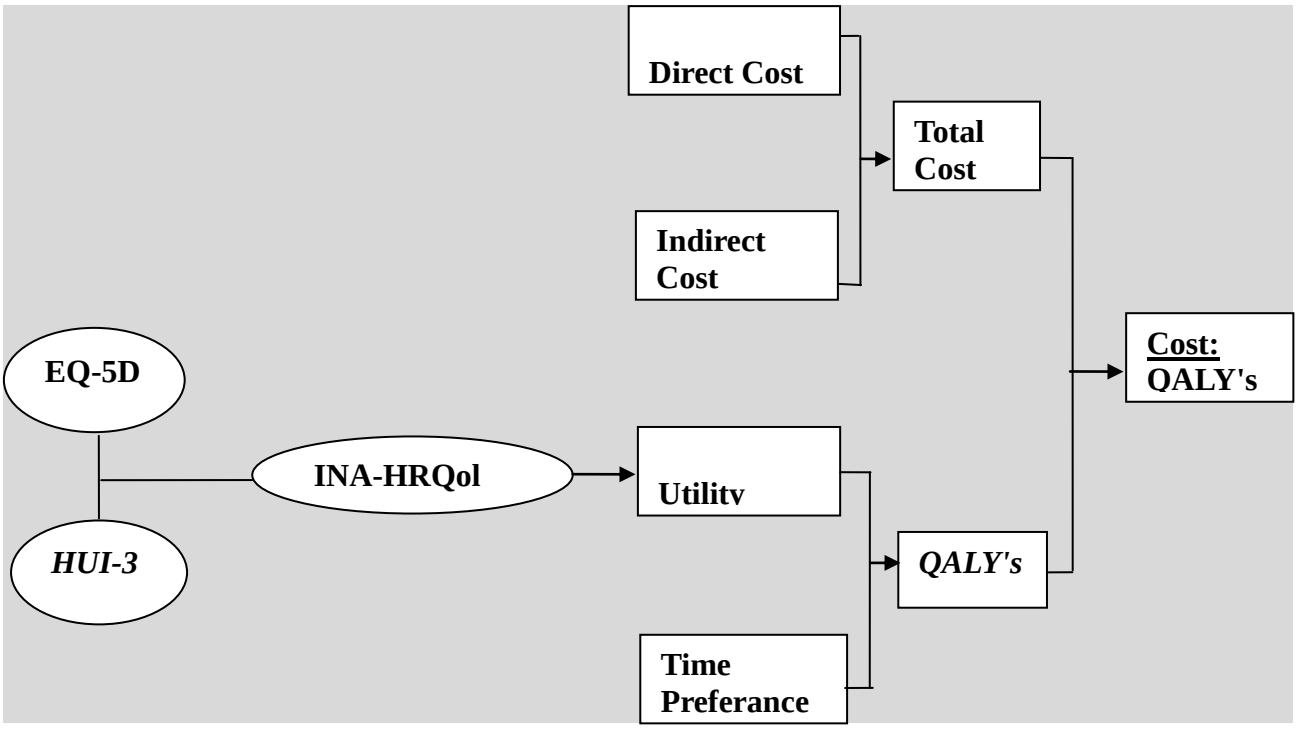
ISSN 2305-4557
www.Tijoss.com

With reference to *Bootman* et al (1996); *Drummond* et al (1987); *Torrance* et al (1972) and INA-HRQoL, *Rivany*, 1999, and overall conceptual framework in the development of model INA-HRQoL in Cost Utility Analysis: The case studies of infectious disease (TB) & non-infectious (Hypertension) treatments in Cipto Mangunkusumo National General Hospital, Jakarta in 2002 were as follows:



Methodology

Research Design

Based on the two conceptual framework stages above, the *research methodology with a basic measurement model and the advance model* to measure utility & QALY's (the research's version) will be applied against the TB disease and Hypertension to compare the cost ratio in their QALY's. In general, the design of this study consisted of variety of designs, among others[5,6,17-20]:

Development of the Tuberculosis Treatment Model

Based on the severity and stages of treatment obtained from general picture of the tuberculosis infection, the TB infection treatment model will be developed in according with the severity and stages of treatments on patients found with TB; 1)TB patients with smear (-) negative; 2)TB patients with smear (+) positive & 3)Former TB Patients[21,22].

Development of the Hypertension Treatment Model

The International Journal of Social Sciences
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ISSN 2305-4557
www.Tijoss.com

Based on the severity and the stages of treatment obtained from the general picture of the non-infectious disease model of treatment of Hypertension, the treatment will developed accorded to the severity and stages of the treatment when the hypertension was found, namely : 1)patients with mild hypertension; 2)patients with severe hypertension & 3).Hypertension with complication[15].

Population and Samples

The population of this research were all the infectious TB patients and non-infectious Hypertension which were treated at Cipto Mangunkusumo National General Hospital, Jakarta, during the year 2000. Samples of the study were the respondents / patients who were selected by simple random sampling from the population and Hypertension TB patients being treated in Cipto Mangunkusumo National General Hospital, Jakarta, during the year 2000 based on the stage where the calculation of sample size was performed prior to the preliminary study. It obtained 234 respondents from TB group and 259 from the Hypertension group[17,18].

Material & Processing The Research Data

Using primary and secondary data's, where the process of statistical data included 1)Validity & Reliability; 2) Pearson Chi-Square; 3) T Test; 4) Pearson Correlation; 5)Sensitivity using the ROC Curve and 6) Factor Analysis.

Research Limitation

From the existing number of respondents, there were only 11 (4.75%) of those hospitalized for TB while for the Hypertension patients only 4 (1.54%) were hospitalized, in which this situation affected the cost calculation on hospitalization care.

Results & Discussion

Validity, Reliability and Factor Analysis of INA-HRQoL Attributes

The researcher here wanted to try to complete the attributes INA-HRQoL (*Rivany*, 1999), which consisted of 10 physical attributes, namely (1) Mobility; (2) Activity / Personal Activity; (3) Activities / General Activities / Social; (4) View / Vision; (5) Hearing; (6) Smell; (7) Taste of Food / Soya Sauce Taste; (8) Speech / Communication; (9) The movement of the hands, fingers and feet, (10) Pain and the two non-physical attributes of Emotion and Memory[3]. For some, testing was done and tried again with the attributes of an improved and eventually obtained with the 10 attributes of the validity values > t Table (0.088) and alpha values > 0.05 (*Zar*, 1999), namely 1) Mobility 90.6003); 2) Personal Activities (0.4904); 3) Social Activity (0.4768); 4) Vision (0.1977); 5) Hearing (0.1700); 6) Soya Sauce Taste (0.1811); 7) Speech (0.3513); 8) Communication (0.3233); 9) Pain (0.3619); 10)Emotion (0.1014), where it was successfully carried out after four times of trials and then the actual data actually taken using the perfect attributes obtained earlier[4,8,12].

Respondent's Characteristic

In the group of respondents with TB, most sex was male (55.17%); reproductive age (68.53%); had the highest level in education / academic / college (13.79%); employees (28.69%). The degree of smear negative tuberculosis (60.34%), with inpatient services (4.75%). In the group of respondents with Hypertension (68.59%); Productive age (68.13%); had the highest level in education / academic / college (22.60%); employees (12.27%). The low degree of hypertension (52.34%), with inpatient services (1.54%)

The Characteristics of Average Cost

For the group of respondents with TB it was shown that the average total cost to be incurred by the tuberculosis respondent with BTA (-) was

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ISSN 2305-4557
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1,099,469 IDR. The average cost of outpatient service was 1,129,177.0 USD and the average cost of inpatient service was 5,149,500 IDR. For the tuberculosis respondents with BTA (+), the average cost was 1,797,836 IDR and for former TB respondents the average cost was 1,339,688 IDR. Overall, the average cost of outpatient and inpatient care for TB patients was 1,324,426 IDR.. In the respondents with high Hypertension disease it was shown that the average cost of Outpatient and Inpatient was 1,059,814 IDR, - and for the heavy Hypertension patient the average cost reached a value of 919,626 IDR – where there was no cost for inpatient care.

Average Utility Rate for the Severity of The Types of Diseases

The TB respondents group gave higher ratings than the attributes used by group of respondents with Hypertension : Communication and Emotion; while the Soy Sauce Taste attributes, Speech and Pain assessment with Hypertension respondents group were higher than the TB respondents group. Over all, it showed that the average value of utility in the TB respondents group decrease in the degree of severity of the disease from BTA (-) to BTA (+). To a former tuberculosis patient, which started from 32.89; 31.91 and 31.37. The average value of the three levels produced a utility value of 32.47. On the other hand, this phenomenon happened also in the group of respondents with various levels of Hypertension, starting from the Light, Heavy and the complicated patients where its value decreased from 31.51; 30.08 and 29.50. Just like tuberculosis, then the average utility value of Hypertension respondents was a combination of various levels of the severity of illness which was in the value of 30.84. Here, the utility value TBC (32.47) was in fact higher than that of Hypertension (30.84).

Average Time Preference for the Types of Disease Severity

It was shown there were 359 respondents (72.81%) which could provide a certain number of years in life increase where the rest of 1.82% could not determine 9,73% did not answer, 11,76% did not know and 2,63% said it is up to the Lord. For TBC respondents, those with a smear (-), showed the average preference of the lifetime increase was 12.41 years. For respondents with TBA (+) the average value was *13.62, years while the former tuberculosis patients declared* an average increase in their lifetime was 17.43 years. Overall, the average lifetime increase for those TB group was 13,24 years. Overall, the average value of the lifetime increase for those who were in Hypertension was 14,71 years.

QALY's Average per Types of Disease Severity

Theoretically, the average value of QALY's obtained from the multiplication of the average value of utility with the average value of Time Preference assessments which was obtained from the tuberculosis and Hypertension. In the respondents groups the average value of QALY's was 439.01 which theoretically was the average value from the multiplication of the utility (42.47) with the average value of this Time Preferences (13.24). Here it showed that the average value of QALY's in the groups of TB respondents increasing which started from TB by smear (-) which was 457.82; tuberculosis with BTA (+) was 415.39 and 549.43 was for the former tuberculosis respondents. In the Hypertension respondents group in general, the average value of the QALY's Light Hypertension respondents was 562.06; for heavy Hypertension was 366.21 and 135 for the Hypertension respondents with the complication of the disease.

Cost Utility Analysis

Utility Cost ratio obtained from the average total cost divided by the average QALY's, which were obtained from the multiplication of Utility and Time Preference. In general the *average value*

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ratio on Cost Utility of TB respondent groups showed a figure of 4664 which illustrated that the average cost required to obtain / get the value of one-year increase in quality of life (QALY's) was 4.664 IDR. In contrast the results obtained in the TB respondents groups was different from the average value of Utility Cost Ratio in the Hypertension respondents group was 4.964 IDR. These values represent the average cost required to obtain the increase value in lifetime of one year (QALY's) was 4.964 IDR.

Statistical Test Pearson Chi-square, Relationship of Respondent's Characteristics and Utility

The relationship between variations in test characteristics of the TB respondent's with BTA (-) to the utility value showed a significant relationship between the variations of the TB educated respondent characteristic of BTA (-) with the utility value (p=0.03). Here it showed that the proportion of Utility values above 32 from the group of respondents who were not educated, and primary, elementary and junior high school educated, was in fact lower as many as 3 person (33.3%) and 21 person (46.7%) compared with the proportion of educated group of respondents who were educated in High School & Collage, which was as many as 45 person (692%) and 14 person (66.7%).

In general, there was a relationship between the characteristic respondents with different levels of severity in TB their with utility values obtained $p < 0.05$ by Pearson Chi-Square, followed by Fischer's Exact Test. In the Utility Test on the characteristics between TB and Hypertension respondents, there were some characteristics of respondents who had significant relationship with the utility value of the age characteristic (p=0.00), education (p=0.02) and employment (p=0.01).

Relationship between Respondent's Characteristics with Time Preference

From the recaputilation of the relation test between the characteristics of all tuberculosis respondents with its value of Time Preference, *the result illustrated no significant relationship between* the characteristics of Sex, Age, Education and Employment of the entire group of respondents with TB disease severity with the value of their Time Preference. The relationship test with $p < 0.05$ between the characteristics of Hypertension respondents which included Gender, Age, Education and Work with Time Preference value, showed there was no single characteristic of Hypertension respondents that had meaningful relationship with their Time Preference value, besides the relationship test between the respondent group with the severity of Hypertension could not be done because of the number of respondents were only two person.

The Relationship of The Respondent's Characteristics to QALY's

Generally, by using all the Hypertension respondents, therefore the recapitalization of the relationship Test between the characteristics of the Gender, Age, Education and Employment of the hypertension respondents with their QALY's value showed there was significant relationship (p=0.04) between each characteristic from the Light Hypertension respondents group with their QALY's value. Overall, there were in fact no significant relationships between the characteristics on Gender, Age, Education and Employment from all the Hypertension respondents when it was related with their QALY's value obtained. In the relationship test between the characteristics of all TB and Hypertension respondent there were in fact a number of respondent's characteristics that had significant relationships with the Utility Value which were Age (p=0.00), Education (p=0.02) and Employment (p=0.01).

Pearson Correlation

In the Hypertension respondents group, it

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showed that the highest correlation was in the General Mobility attribute (p=0.01) which was in fact correlated with the Personal Activity attribute (0.35), Social Activity (0.54), Hearing (0.22), Soya Sauce Taste (0.24), Speech (0.26), Communication (0.21) and Sense of Pain (0.43). The same with the correlation test on the attribute of TB respondents group, there was in fact only Emotional attribute that was correlated with the Sense of Pain attribute with the correlation value 0.31 (middle correlation).

In the correlation test between the attribute of all TB and Hypertension respondents, the correlation obtained showed the result that the General Mobility attributes was the highest correlation ($p < 0.01$) compared with other attributes Personal Activity (0.30), Social Activity (0.43), Sight (0.13), Hearing (0.12), Soya Sauce Test (0.14), Speech (0.13), Communication (0.19) and Sense of Pain (0.31). Especially, the Emotional attribute was in fact only correlated to the Sense of Pain attribute with the correlation value 0.26 (middle correlation).

T-Test of INA-HRQoL Attributes

The result showed there was a significant difference between the measurement / calculation of the attribute from TB and Hypertension respondents which cover the difference between the attributes of Mobility (p=0.01), General and Social Activity (p=0.03), Sight (p=0.00), Hearing (p=0.04), Emotion (p= 0,04) where in fact as a whole their Utility Values also had significant differences with p= 0.00. To see whether there were significant differences on the results of Utility Value, Time Preference and QALY's between the TB & Hypertension respondents group, it showed that the test on the differences was only significant in the Utility Value (p=0.00) from the groups above. From the Time Preference and QALY's values were in fact no significant differences.

The Sensivity of INA-HRQoL

To know which attributes were the most sensitive to the diseases being researched, the statistical test was carried out using the ROC. By only looking at the Sensitivity values with the cut off 3.50 from the INA-HRQoL attributes against all the TB respondents (232)[3,5], it showed that each attribute above had different sensitivity values. It showed here that the Personal Activity attribute had the highest sensitivity value (0.931), where as the Soya Sauce Taste and Emotional attributes had the lowest values (0.04). For the sensitivity test of INA-HRQoL attribute on 261 Hypertension respondents, was in fact shown nearly equal results, where the Personal Activity attribute had the highest sensitivity value of 0.943 whereas the Soya Sauce Taste attribute had the lowest Sensitivity Value of 0.004.

Conclusion

In the accordance with the proposed hypothesis there were a number of conclusions :

a. INA-HRQoL could be used as a measure of health status leading to the quality of life related to the health in Indonesia. This was consist with the Case Studies in the field to the measurement of health status from TB and Hypertension respondents at Cipto Mangunkusumo National General Hospital.
b. By using the statistic test in validity and reliability, Pearson Correlation, Pearson Chi-Square, T Test and ROC Curve for the sensitivities, the 10 attributes of INA-HRQoL that consisted of: 1).General Mobility, 2).Personal Activity, 3).Social Activity, 4).Sight, 5).Hearing, 6).Soy Sauce Taste, 7).Speech, 8).Communication, 9).Sense of Pain, 10).Emotion could be used to measure Utility. Besides that based on the Factor Analysis the 10 attributes could be become only 3 factors ie : General, Social and Specific.
c. In this case study, the Cost of Illness from the 261 Hypertension respondents (USD 1.724.798), showed in fact that it was higher

The International Journal of Social Sciences
30th March 2014. Vol.21 No.1

ISSN 2305-4557
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than 232 TB respondents (Rp. 1. 387.357). The data on this costs was not proportional, where there was no Heavy and Complicated Hypertension inpatient; however it showed that the cost of the health service for the Hypertension (non-infectious) respondents group was higher than the data of the TBC (infectious) respondents group.

d. The Time Preference in the TBC respondents group showed in fact the assumption that the additional of the increase in life time in years in accordance to the characteristic in their illness severity, where the former TBC patient had higher hope 17,43 years compared with the existing TBC BTA (-) respondents (12,41 years). Specifically for each Hypertension respondent group showed that the Hypertension patient with the complication were assumed that their additional life expectancy after the treatment, were only 5,0 years, compared to those with the Light Hypertension status (14,71 years).

e. The calculation of the Utility value from the TBC respondents group showed gradation which in line with the characteristic of their illness severity where the BTA (-) TBC respondents gave higher value (32,93) compared with the former TBC respondents (31,44). This case also happened in the Hypertension respondents group where the respondents with Light Hypertension had Higher Utility value (31.54) compared with the Hypertension respondent with complication (29.50).

f. Theoretically the QALY's value was obtained from the multiplication between Utility Value with Time Preference. In this case study it was shown that the QALY's value from the Hypertension respondents group (470,03) was higher than the TBC respondent group (439,01), therefore the ratio of their Utility Cost Analysis gave higher values also. The Cost Utility ratio from TBC treatment was 4.664 IDR, which mean that the cost of Rp. 4.664 was needed to get each increase in life quality. In general the cost value needed for the treatment of infectious TBC was in fact lower when compared the non-infectious Hypertension treatment diseases which was 4.964 IDR.

Suggestion

By looking into the results and the discussion which that be obtained, therefore researcher suggested into 2 major parts, both policy and technical aspects. The aspects of the policy include: 1).The implications for the indicator from Healthy Indonesia 2010, where the health status / health degrees were which had been measured all this time by numbers of Mobility / Illness, Mortality, Death Status, and the Nutritional Status of static nature, the consideration should be measured with other dynamic means so it can be used to major the quality of human life related to the health in Indonesia; 2).In measuring the quality of human life related to the health mentioned, it is important to note the use of single measurement such as common perception in the calculation of the Utility value which represent various attitudes in measuring the person health status; 3).The budget allocation available should be further investigated, for the treatment of the infectious diseases compared with the treatment for the non-infectious disease by using the common denominator (QALY's) which look in to the aspect of life quality as the most and an important outcome, so the decision taken can cover both the quantitative and qualitative aspect of the expected outcome.

References

1. Beaglehole, R., Bonita, R., & Kjellstrom, T. Basic Epidemiology. World Health Organization, Geneva, 1990
2. Rivany, R, Iljanto, S., & Bachtiar, A. Studi Implikasi Biaya Penambahan Benefit Pemeriksaan Kesehatan Berkala

The International Journal of Social Sciences
30th March 2014. Vol.21 No.1

ISSN 2305-4557
www.Tijoss.com

Program JPKTK. Health Sector Financing Project, Biro Perencanaa Depkes, Jakarta, 1993

3. Rivany, R. Pengembangan Model Pengukuran Kualitas Hidup Manusia Indonesia (INA-Health Related Quality of Life). FKMUI, Jakarta, 1999
4. Torrance, G.W., Thomas, W.H., & Sacket, D.L. A Utility Maximization Model for Evaluation of Health Care Programmes. Health Service Research 7 1972;2:118-33
5. Drummond, M.F. Principles of Economic Appraisal in Health Care. Oxford University Press, New York, 1980
6. Drummond, M.F., Stoddart, G.L., & Torrance, G.W. Methods for the Economics Evaluation of Health Care Programmes. Oxford University Press, New York, 1987
7. Bootman, J.L., Townsend, R,J., & McGhan, *W.F. Principles of Pharmaco Economics. 2nd edition*. Harvey Whitney books Company, Cincinnati, 1996
8. Jones-Lee, M.W. *The value of Life – An Economics Analysis*. Martin Robertson, London, 1990
9. Kaplan, R.M., & Bush, J.W. Health – Related Quality of Life Measurement for Evaluation Research and Policy Analysis. *Health Psychology I* 1982;**1**:61-80
10. Keeney, R.L & Raiffa, H. *Decision with multiple objectives : Preferences and Value Tradeoffs*. John Willey & Sons, New York, 1976
11. Gudex, C & Kind, P. The Qaly Toolkit, Discussion Paper 38. Center for Health Economics. Health Economics Consortium. University of York, U.K, 1988
12. Baldwin, S., Godfrey, C., & Propper, C. *Quality of Life; Perspectives and Polices*. Routledge, London, 1990
13. Feldstein, P.J. *Health Care Economics. 2nd edition.* A Willey Medical Publication. John Willey & Sons Inc., Canada, 1983
14. Hatano, S., Shigematsu, L., & Strasser, T. Hypertension and Stroke Control in The Community. World Health Organization, Geneva, 1976
15. Jacobs, P. *The Economics of Health and medical care*. An Aspen Publication. Aspen Publishers Inc., Maryland, 1987
16. Jerrold H. Zar. *Biostatistical Analysis. 4th edition*. Prentice Hall International Inc., 1999
17. Leedy, P.D. Practical Research : *Planning and Design*. Mc Millan Publishing Co. Inc., New York, 1974
18. Omran, A.R. The Epidemiologic Transition: a Theory of the Epidemiology of Population Change. Milbank Memorial Fund Quartely 1971;(49);4
19. Raiffa, H. Decision Analysis : Introductory Lectures on Choices : Introductory Lectures on Choices under Uncertainty. Addison-Wesley, Reading, Mass, 1986
20. Shaw, C. *Tuberculosis. Modern Health Series.* Henry Regnery Company, Chicago, 1973
21. Prijono, T. The Economic Benefits from a Tuberculosis Control Program in Indonesia : Effects of Chemotherapy. PhD Disertation, University of Hawaii, 1981