Review article ■

QALY - Measure of Cost-Benefit Analysis of Health Interventions

Aleksandar Višnjić[1,2], Vladica Veličković[1], Nataša Šelmić Milosavljević[1]

[1]*University of Niš, Faculty of Medicine, Serbia*
[2]*Public Health Institute Niš, Serbia*

SUMMARY

For the purpose of economic evaluation in the health economics, several analytical techniques that are designed for comparing two or more health interventions in terms of costs and effects are used. Cost-benefit analysis provides the opportunity of comparing values of alternative health interventions that have very different health benefits, which significantly facilitates comparisons. The purpose is to assess the relationship between the cost and utility of health interventions in terms of the patient's number of years in full health. The most commonly used measure in these analyses is QALY (Quality-adjusted life-year). QALY is a measure of the impact of health interventions and treatment that combines two dimensions of health outcomes: the degree of health improvement and the time period for which the improvement of health is exhibited, including the length of life. Determining the QALY is one of the most effective ways of decision-making about distribution of resources in the health care system. The method is designed to distribute resources in such a way as to be spent where they will bring the maximum possible benefit for the patient. If we have to make decisions how to direct funds from limited budgets, then each and the lowest cost has to correlate to the maximum possible benefit and these methods are the best tool under such conditions.

Key words: QALY, cost-benefit analysis, decision-making, health economics

Corresponding author:

Vladica Veličković •
phone: 064/118 45 37 •
e-mail: velickovic@inbox.com •

INTRODUCTION

For the purpose of economic evaluation in the health economics, several analytical techniques that are designed for comparing two or more health interventions in terms of costs and effects are used. These techniques enable decision-makers in health systems to allocate resources more efficiently and achieve the best possible results or outcomes for patients with the least possible cost. Formally, there are three basic techniques of complete economic evaluation: cost-effect analysis, cost-benefit analysis and cost-utility analysis. However, some authors mention cost minimalization analysis as well. The difference between these techniques is in the way the results or outcomes are measured (1).

Cost-benefit analysis provides the opportunity of comparing values of alternative health interventions that have very different health benefits, which significantly facilitates comparisons. The purpose is to assess the relationship between the cost and utility of health interventions in terms of the patient's number of years in full health. Ultimately, this analysis can be considered a special case of cost and effect analysis the aim of which is to measure the impact of intervention on the quantitative and qualitative aspects of health (morbidity and mortality) (2). Intervention is considered to be productively efficient in relation to alternative interventions, if greater or equal benefit for the patient is achieved at a lower price. Guided by this principle in the area of decision-making in health system, optimal decision would be selection of those health interventions that have the lowest cost-benefit ratio, i.e., the one that will lead to the best outcome for the patient at the lowest possible cost (3). The most commonly used measure in these analyses is QALY (Quality-adjusted life-year).

QALY CONCEPT

Measure of cost/ benefit analysis of health interventions - QALY was designed by two experts in the area of health economics in 1956: Christopher Cundell and Carlos McCartney. This technique has been widely used in health systems worldwide for the last thirty years.

QALY is a measure of the impact of health interventions and treatment that combines two dimensions of health outcomes: the degree of health improvement and the time period for which the improvement of health is exhibited, including the length of life. (4) Thus, what the QALY is meant for is the impact of a health intervention on the quality and length of life of the patient. This implies that one intervention may help in extending life, but also leads to serious side effects; on the other hand, another intervention may improve quality of life, however, without affecting the life span. By means of QALY, we can quantify these factors and compare different health interventions under the same or different conditions. So, it is not only prolonging life that is taken into account but also appropriate quality of life of the

patient, which is especially important in the treatment of chronic diseases. In doing so, the quality of life is measured by health status of the patient on a scale of 0 to 1, where 0 represents the worst possible condition or death, and 1 the best possible condition. Once the patient's health condition is determined using this scale, it is multiplied with the time period spent under this condition and the QALY value is obtained. For example, one year of the best possible health (utility value on a scale 1) is equal to 1 QALY. If the utility value of health is 0.75 for a two-year period, the QALY value is 1.5 or 1.5 years of the best possible health. This method gives us the possibility of quantifying the monetary value of different health interventions in the same units, that is, QALY, and thus obtain a universal measure that can be widely applied (5). That is, QALY provides information concerning comparative effectiveness of health interventions within a single therapeutic area and in various therapeutic areas. For each intervention in which we can calculate the costs we can perform cost-benefit analysis and express it in monetary units of 1 QALY. In other words, we assess how much it would cost to provide the best possible year of health or one year of prolonged life after appropriate medical intervention. This means that this assessment is the measure of the value of the costs of health interventions. Costs can be expressed as average or extra. Average costs are calculated when average costs of an intervention are divided by QALY of the same intervention. However, in practice, it is much more useful to express costs per QALY through extra costs where we focus on additional costs and benefits compared with other health interventions and thus make decisions easier (6,7).

Calculation and implementation of QALY

One of the first challenges of such measurement is a method by means of which we will perform evaluation of the utility value of the patient's health status and therefore ranking on the scale from 0 to 1. According to Meltzer, there are three basic methods of evaluation of the utility value of certain health conditions: expert opinion, assessment of the utility value of health status determined by previous studies and research (direct and indirect). The most frequently used method in practice are direct and indirect researches (1, 8).

In direct research we differentiate between three techniques: time trade off, standard gamble and rating scale. Most often, the first two techniques are used. Time trade off (TTO) has the scale from 1 to 10, and the scale value is divided by 10 in obtaining utility value of health state. For example, a patient in such health condition that enables him to live for ten years longer with restrictions and life quality provided by such health state is asked to determine the number of years in complete health on the scale from 1 to 10 that would have the same value as ten years spent in present

health state. This number is divided by 10 and TTO value is obtained (9). Standard gamble is a technique where patients are asked to choose between risk and certainty. That is, they are asked to choose between remaining in a state of ill health for a period of time, or choosing a medical intervention which has a chance of either restoring them to perfect health, or killing them (10). Rating scale (including visual analogue scales) is used for determining or comparing present patient's health state. This means that patients are asked to determine the intensity of pain on the scale from one to ten (11). These scales are often considered to be inferior to previous two techniques. However, they are neither subject to cognitive affection as compared to SG, nor time-dependant as compared to TTO.

In addition to direct reserach, indirect research uses questionnaires for health state in several domains (social, cultural, perception of one's own health, etc). On the basis of answers from all domains unique index is constructed.

Once the utility value of health state is determined, QALY is calculated according to the following formula:

$$QALY = t*Q$$

where Q stands for utility value of health state, and t stands for the time period spent in a given state (12). Changing of Q requires that QALY be redetermined, and for a longer time period where Q would change, we can determine unique QALY by simple sum-up, for erxample if t=1 year).

$$QALY = t*0,5 + t*0,8 + t*1 = 2.3 \text{ QALYs}$$

Therefore, the purpose of the QALY value is to facilitate decision-making to a manager in the health system and provide a reliable guideline for the allocation of resources. We shall provide an example how the results obtained in this way would have impact on decision making in real situations (13, 14).

Example 1: A patient XY is in a bad and life-threatening condition. If the patient continues to use standard therapy (standard health intervention) he will live for one year, and his life quality according to QUALY is 0.4. However, if a patient is administered a new drug (new health intervention), he will live for one year and three months (1.25 years) with the life quality of 0.6. When these two health interventions are compared, the following is obtained:

- Standard health intervention1 (year of prolonged life) x 0.4=0.4 QALY
- New health intervention 1.25 (year of prolonged life) x 0.6=0.75 QALY

So, using a new health intervention we obtain the improvement of QALY for 0.35, and then calculate costs per QALY. If a new drug therapy costs 10 000 €, and standard therapy costs € 3,000 we obtain a difference in costs of 7000 € as is necessary to get improvement of QALY for 0.35. So, a new drug therapy requires addi-

tional costs of 20 000 € per QALY. And this should be a useful fact in helping a manager of a health institution decide whether the available resources can allow such change of health intervention (15).

Example 2: Choosing between two health interventions:

Health intervention (HI)	Costs (€)	Life-span expectancy	Utility value of health state	QALY
HI 1	20 000	4,5	0,60	2,7
HI 2	10 000	3,5	0,72	2,5

Using these data we can perform cost analysis and use these two interventions per QUALY in the following way:

Cost/benefit ratio=20 000-10 000 €/2,7-2,5 QALY= 50 000 € according to QALY

These will be real costs in choosing health intervention number 1. If we use another method of analysis we will get false picture of real costs, not taking into account patient's life quality. If we use incremental cost effectiveness ratio (ICER) in this case, we will obtain the following ratio:

ICER=20 000-10 000 €/4,5-3,5=10 000 € per one year of life

Therefore, the advantage of measuring by means of QALY is obvious, because this technique combines patient's life quality and real costs of health interventions (15).

ETHICS AND QALY

The method of making decisions based on QALY or selecting interventions based on cost per QALY was criticized and considered to be controversial by some experts, because it implies a quasi-utilitarian calculus to determine who will or will not receive treatment (16, 17).

In addition, the criticism is based on the principle of equality in health care system and the fact that patients with more severe illness should be prioritised over patients with less severe illness if both would get the same absolute increase in utility. Thus, criticism refers not only to the efficiency of the method but on ethics as well, because it is considered that in this way some basic principles of health care such as the principles of accessibility and equality may be violated (18-20).

CONCLUSION

Determining the QALY is one of the most effective ways of decision-making of distribution of resources in health care system. The method is designed to distribute resources in such a way as to be spent where they will bring the maximum possible benefit for the patient. The method has widely been used and accepted in many countries including the USA and the United Kingdom for a very long time. With limited resources, which are inevitable, this method represents one of the most powerful tools that is a prerequisite for proper decision-making in the allocation of resources. Still, managers in health systems are not obliged to use these calculations only.

Their decisions can certainly be affected by some other factors such as health care principles and political objectives. Although it gave rise to ethical debates and even resistance in some scientific circles, it is evident that this type of analysis is still one of the most effective methods. Despite some ethical dilemmas about these types of analyses, we must face the fact that the provision of health services is limited by available resources and that health funds are limited resources. If we have to make decisions how to direct funds from limited budgets, then each and the lowest cost has to correspond the maximum possible benefit and these methods are the best tool in such conditions.

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QALY - MERA ZA ANALIZU ODNOSA TROŠKOVA
I KORISTI ZDRAVSTVENIH INTERVENCIJA

Aleksandar Višnjić[1,2], Vladica Veličković[1], Nataša Šelmić Milosavljević[1]

[1]Univerzitet u Nišu, Medicinski fakultet, Srbija
[2]Institut za javno zdravlje Niš, Srbija

Sažetak

Za potrebe ekonomske evaluacije, u okviru zdravstvene ekonomike, koristi se nekoliko analitičkih tehnika, koje su dizajnirane za potrebe komparacije dve ili više zdravstvenih intervencija u pogledu troškova i rezultata. Analiza odnosa troškova i koristi daje nam mogućnost upoređivanja vrednosti alternativnih zdravstvenih intervencija, koje imaju vrlo različite zdravstvene benefite, što značajno olakšava poređenja. Svrha je da se proceni odnos između cene zdravstvene intervencije i njene koristi u smislu broja godina života bolesnika u punom zdravlju. Najčešće korišćena mera u ovakvim analizama je QALY (Quality-adjusted life-year) - „kvalitetna godina života" ili „godine života korigovane u odnosu na kvalitet". QALY je mera učinka zdravstvenih tretmana i intervencija koja objedinjuje dve važne dimenzije zdravstvenih ishoda: stepen poboljšanja zdravlja i vremenski interval za koji se poboljšanje zdravlja ispoljava, uključujući i dužinu trajanja života. Određivanje QALY-ja je jedan od najefikasnijih načina odlučivanja o distribuiranju sredstava u zdravstvu. Metod je osmišljen tako da se sredstva raspoređuju na takav način da budu potrošena tamo gde će doneti maksimalnu moguću korist za bolesnika. Ukoliko moramo donositi odluke na koju stranu da preusmerimo sredstva iz ograničenih budžeta, onda svaki, pa i najmanji trošak, mora sa sobom da povlači maksimalnu moguću korist i u takvim uslovima ovakve metode jesu najbolji mogući alat.

Ključne reči: QALY, analiza odnosa troškova i koristi, donošenje odluka, zdravstvena ekonomika