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Master Degree Project in Economics

Is it worth saving your life?

On the inclusion of costs of added life years in health economic analyses

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Abstract

Aim of the study: The aim of this thesis is to, from a theoretical and empirical point of view, critically analyze the Swedish recommendations used by the Dental and Pharmaceutical Benefits Agency, when it comes to the use of costs of added life years in economic evaluations of health care.

Introduction: One much-debated subject is the cost of added life years. Costs of added life years refer to the consumption subtracted by the production during the extra years that an individual lives due to a lifesaving intervention or drug.

Discussion: If following a societal perspective in health economic evaluations all costs and benefits should be included, together with costs of added life years. Thereafter, the additional principles should be implemented in the decision together with ethical viewpoints.

Conclusions: Many theoretical arguments exist for the inclusion of costs of added life years if following a societal perspective. The current estimates for these costs need to be updated and re-estimated. The labor market structure and consumption of pharmaceuticals has changed since the numbers were calculated and uncertainty should be taken into account.

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1. Introduction

A life in good health is a basic need for every human being and the demand for healthcare will always be large. Therefore, healthcare is a huge part of a countries budget and it is where a big part of resources are allocated. To know that these resources are allocated in the right way and because resources are scare there is a need for a system where we can ensure that these resources are used as effectively as possible. This is the reason why we have economic evaluations in health. It is of great importance to include the appropriate costs and outcomes when evaluating a health intervention or a specific medicine. Therefore there has been great debate in the research in health economics whether to include or exclude certain costs and the decision on what costs to include depends on what kind of perspective the decision makers have decided to use in evaluating health. The most often used perspective is that of the society, which means that all costs and all effects should be included in an analysis. Although this description is commonly agreed on the same costs are usually not included in an analysis between countries. The usual guideline for analysts is to include the relevant costs and effects, but what are the relevant costs? It is here the confusion lies and leads to differences between implementation in health economic evaluations. The costs that are usually included are the direct costs that appear due to the intervention, but how about the indirect costs, such as productivity losses or future medical costs? Are these costs really indirect and should they be included?

One of the much-debated costs is the cost of added life years. Costs of added life years refer to the consumption subtracted by the production during the extra years that an individual lives due to a lifesaving intervention or drug. Sweden is the only country where the Dental and Pharmaceutical Benefits Agency explicitly states in their guidelines that these costs should be accounted for when presenting health economic evaluations. Other countries may have the same objective of allocating resources according to a societal perspective but the agency in Sweden actually does account for these indirect costs. (ISPOR) When performing evaluations the agency in Sweden has three guidelines to follow; the cost-effectiveness principle, the need and solidarity principle, and the human dignity principle (TLV). The first principle explains that costs due to the use of a drug should be reasonable from the medical, humanitarian, and societal perspective. The second principle states that the individuals with the largest medical needs should be allocated more resources than other patient groups. The last principle says that the health care system should respect the equal value of each individual. (TLV)

The aim of this thesis is to, from a theoretical and empirical point of view, critically analyze the Swedish recommendations used by the Dental and Pharmaceutical Benefits Agency, when it comes to the use of costs of added life years in economic evaluations of health care. This will be done by studying the following questions:

- What are the theoretical arguments for the inclusion or exclusion of costs of added life years in health economic evaluations?
- Why does the Dental and Pharmaceutical Benefits Agency recommend the use of costs of added life years in economic evaluations?
- What is the impact on the analysis and the decision of reimbursement when including costs of added life years?
- Is it possible to make any improvements to the present estimates that are used by the Dental and Pharmaceutical Benefits Agency?
- Is the inclusion of costs of added life years consistent with the different ethical views when making decisions?

Based on the theoretical viewpoints an explanation on why the Dental and Pharmaceutical Benefits Agency evaluates as they do is presented. This analysis can be done with support from the theory on costs of added life years. The question of why they choose to include these costs is important due to the fact that Sweden is the only country where it is stated that these costs should be included. The present numbers on production subtracted by consumption that are used by the Dental and Pharmaceutical Benefits Agency are presented and explained. Moreover, the impact on the analysis and the decision of reimbursement done by the Dental and Pharmaceutical Benefits Agency is shown by two examples using pharmaceuticals. These pharmaceutical, dabigatran and zytiga, are presented shortly and thereafter, the impact is shown by analyzing the evaluations and decisions. In addition, some ethical viewpoints are used to discuss the inclusion of costs of added life years and thereafter it is concluded whether the inclusion of these costs are consistent with the ethical platform for decision making.

2. Background

In order to get a deep understanding of the theoretical arguments and to present them, a thorough search on PubMed on the research done on costs of added life years and economic evaluations was made in February 2013 by using the following keywords: future medical and non-medical expenditures, future unrelated costs, medical costs in life years gained, survivor costs, indirect costs and benefits, costs of unrelated medical care in life years gained, survival consumption costs, future non-medical costs and indirect medical costs. Although there are a variety of different terms to explain costs of added life years, not many articles on the subject could be found that were relevant. Also, to get more background on the subject some techniques and measurements used in economic evaluations needed to be sorted out.

2.1 Economic Evaluation

The reason why economic evaluations are conducted is to give decision makers some indicator of costs and benefits that emerge due to a change in resource allocation, in health, environment or other sectors of society. When evaluating resource allocations in health a new healthcare intervention or a new drug could be examples of factors being evaluated. Because the healthcare budget is such a large part of the overall budget of a country, and because resources are scarce, these evaluations are important and help the decision makers with a solid background to base their decisions on. The main economic guideline is that a specific intervention or drug should be introduced to the public or subsidized if its benefits are larger than its costs. In addition, the new intervention should be more effective compared to the best alternative available or if this does not exist, it should be compared to no treatment at all. Therefore it is of great importance to include the appropriate costs and benefits in these evaluations. (Rappange et al. 2008) What the appropriate costs and benefits are depends on what perspective one has, which will be discussed in more depth throughout this thesis. Economic evaluations are also needed to ensure the general public that decisions are based on effectiveness and that the taxpayers' money is being used for the most cost-effective treatment.

2.1.1 Evaluating

An economic evaluation is based on costs and outcomes of a certain intervention. There are several techniques available to evaluate medical interventions and the three that are most

frequently used are Cost-Benefit analysis (CBA), Cost-Effectiveness analysis (CEA), and Cost-Utility analysis (CUA), which is almost the same as CEA. In CBA the benefits, or outcomes, from a medical intervention are measured in monetary units through willingness to pay (WTP) and this leads to the costs and benefits being measured in the same terms and thereby making it possible to compare the two sides directly. CBA was first conducted when analysts needed guidelines when markets failed and there were for example public goods or natural monopolies involved. The decision rule in the CBA is to accept the intervention if the net present benefits minus the net present costs are larger than zero. (Liljas and Lindgren, 2001). In addition, CBA is the most frequently used method by analysts that have a welfare economics point of view. In the case of the CEA the costs are measured in monetary terms but the outcomes of the intervention are measured in non-monetary terms, often in quality-adjusted life years (QALYs), and this means that the costs and outcomes in a CEA cannot be directly compared. Instead, the CEA leads to a cost-effectiveness ratio that can be used to accept or reject the intervention. (Liu et al. 2008) The CUA has many similarities to CEA and they both are methods frequently used, often by extra-welfarists, which will be described more in depth later. The CUA and the CEA are different from the CBA when it comes to the question of including productivity and consumption changes. When it comes to the outcome side, the CUA and CEA methods may differ. Here, the outcomes from a CEA are single, unvalued and programme specific while in the CUA the outcomes can also be multiple as well as single, generic and include the concept of value, which in practice means the use of QALY. (Drummond et al., 2005)

2.1.2 Measurements

Willingness to pay, WTP, is as mentioned before, a measurement that is often used when evaluating an intervention, medical or other, with a Cost-Benefit analysis. WTP can be measured through questionnaires or interviews where the respondents state how much they are willing to pay for an attribute, an improvement or a private or public good. By conducting questionnaires and receiving respondents' WTP the analyst obtains the benefits of the intervention in monetary terms. One way of measuring willingness to pay for health consequences is through a so-called revealed preference approach where actual decisions made by individuals are observed. Although this approach is useful in many fields in economics, in health care it is difficult because health is usually not purchased directly on a market. Another approach is the contingent valuation method that measures the expressed

willingness to pay directly through open-ended or close-ended valuation questions in questionnaires. (Johannesson et al., 1996) There are several limitations with the methods that measure WTP and one of them is that is lies on limited sets of assumptions on individual behavior and is not affected by the choice of utility framework. Also, there are doubts whether the respondents' WTP stated in the questionnaire is a good measure of the actual WTP. (Liljas and Lindgren, 2001) The difference between these two values can be affected by hypothetical bias that can arise because the respondent answers the WTP question as he or she would like to be perceived or because of for example influence from family and friends (Ajzen et al., 2004).

Because of the limitations of the WTP approach and the unwillingness to put a monetary value on benefits of healthcare an alternative measure exists; quality adjusted life years (QALY). A QALY is a measure of the length of a person's life and the quality of it. The length is measured in time and the quality is measured on a scale from 0 to 1, where 0 is death and 1 is perfect health, where the numbers describe the "utility" in a health state. QALY has its background in welfare economics and the expected utility theory but has during the years contributed to endless discussions about the appropriate way to use the QALY and what is and what is not included in the QALYs.

2.1.3 Computation of QALYs

There are three commonly used techniques to compute QALY-weights for different medical interventions: standard gamble (SG), time trade-off (TTO), and Visual Analogue Scale (VAS). These techniques can be used when the individuals are evaluating their own situation or the general public is trying to estimate hypothetical health states. The Standard Gamble (SG) technique is directly related to the expected utility theory and the respondent evaluates the expected utility of a health state through a comparison with a game. In this game the respondent chooses between living in a certain health state, which could be a hypothetical state or the state that the respondent actually lives in, for a certain amount of years with a probability of 100 percent, and receiving some kind of treatment which will lead to a certain amount of years in full health with a probability (p) and dying immediately with a probability of (1-p). (Torrance et al., 1972) The QALY-weight will for example be 0.80 if the respondent is indifferent between living in the current health state and the alternative to receiving a treatment and thereby having a probability of 80 percent of living in full health and a

probability of 20 percent of dying immediately. This means that the higher the risk of dying the respondent accepts the lower the valuation of the health state. The main drawbacks with the SG technique is the fact that respondents may have a hard time understanding and relating to the probabilities as well as the fact that different people have different risk aversions. (Bernfort, 2012)

When using the time-trade off technique (TTO) the respondent is asked to envision a certain health state, or the current health state of the individual, and the respondent is told that he or she will live in this state for a certain amount of years, often ten years. Thereafter, they are told that there is a treatment that will make them live in perfect health but for a shorter period of time. The important question here is then how many years the respondent would trade for a life in full health, thereof the name time-trade off. If the respondent is indifferent between living for five years in full health and living ten years in the current health state the QALY-weight is 0.5, which is calculated by dividing five by ten. Drawbacks of the TTO technique is that is does not relate to economic theory as the SG technique. Also, there is no factor of risk present and usually people are risk adverse so these attributes are not captured when using the TTO technique. (Bernfort, 2012)

The third technique used when calculating QALY-weights is the Visual Analogue Scale (VAS) that is considered to be an easier technique than the two previous ones. Here, the respondents are asked where, on a thermometer like scale from 0 to 10, they think that their current health state is. The main disadvantage of the VAS technique is that the respondent does not have to make any choices and therefore the technique does not measure utility in terms of preferences and also the fact that the respondent is hesitant to choose the extreme points on the scale and tend to choose numbers that lie in the middle of the scale instead. (Bernfort, 2012)

2.1.4 How much is a QALY allowed to cost?

The National Board of Health and Welfare in Sweden present in their guidelines an overview over how cost per QALYs can be categorized (Socialstyrelsen, 2008). It is explained that cost-effectiveness ratios vary considerably among different studies and the costs per QALY presented on a scale from low cost to very high cost should give a good approximation of the size of the costs for every study. The cost per QALY that lies under 100 000 SEK per QALY

is considered to be low, the cost per QALY that lies under 500 000 SEK per QALY is considered to be moderate, the cost per QALY that is less than or equal to 1 000 000 SEK per QALY is considered to be high and the cost per QALY that is over 1 000 000 SEK per QALY is considered to be very high. (Socialstyrelsen, 2008)

2.1.5 Maximizing

The key question of what factors are being maximized is one of the important sources of the discussions behind what costs and what benefits to include in an economic evaluation. The reasoning of what to maximize is in itself a question of which theory the analyst uses, and there are several aspects that can be maximized in evaluations, especially in health. In practice, when using CEA, the factors that are being maximized are health benefits subject to some limited health resources (Weinstein et al., 1996). These benefits, or utilities, can be maximized through the Social Welfare Function (SWF). The classical utilitarian SWF is usually the basis when summing up individuals' WTP or QALYs but there does also exist other functions, such as the Rawlsian SWF (Rawls, 1971), which measures only the individual in society who is worst off. In the utilitarian SWF the changes in utilities, but not the absolute levels of utilities, need to be cardinally comparable among individuals. The main goal of this SWF is to maximize utilities overall i.e. it does not matter who gains or who loses from a specific medical intervention as long as the total gains from the intervention are larger than the total losses. In the SWF that is more concerned for equity the absolute levels of the individuals' utilities need to be cardinally comparable and the health intervention preferred is the one where the sum of equity weighted gains in utilities are larger than the sum of equity weighted losses. Following the importance of equity in health care some analysts (for example Sen, 1985) prefer to maximize considering interpersonal comparisons based on, not utility, but functionings and capabilities of individuals i.e. non-utility information. The Kaldor-Hicks welfare criterion is based on the idea that the gainers of some intervention compensate the losers of the intervention and thereby contribute to some balance in society. (Liljas and Lindgren, 2001) There is also a belief that there exists a maximum of years in full health that an individual is entitled to and this principle is called the fair innings principle (Williams, 1997). When maximizing something, whether it is utility, profits, health or other factors, it is inevitable not to have some kind of budget constraint. What kinds of benefits are being maximized and what budget constraints there are depends on the view that the analyst has. When having a societal perspective all the benefits and costs should be taken into account

but the constraint could be a regional health care budget, the health care budget of a certain hospital or the national health care budget. When having a decision maker's perspective the appropriate budget is dependent on what the decision maker deems as suitable. Also, when maximizing individual utility we could only maximize this will respect to the individual's own budget constraint, the disposable income.

2.1.5 Related and unrelated costs

There exist several "related" and "unrelated" costs that are either medical or non-medical surrounding a medical intervention and that need to be considered in an economic evaluation. Direct medical costs are the costs that are directly related to the intervention and these costs are for example drugs, costs of testing and other hospital materials. Usually there exists direct non-medical costs as well and these are travelling costs due to the patient receiving care, patient time or adjustment in the patient's environment due to the intervention. In addition to these direct costs there are indirect non-medical costs and indirect medical costs. Indirect medical costs are the medical costs from other diseases that do not relate directly to the intervention in question but emerge because the patient lives longer. These unrelated medical costs could increase the quality of life as well as the duration of life of an individual (van Baal et al., 2007). Lastly, the indirect non-medical costs are the costs referred to as cost of added life years in this study, together with the unrelated medical costs, and it is here the controversy lies. These costs denote the productivity gains that a person who lives longer will produce as well as the consumption costs that emerge due to this life-increasing intervention. (Rappange, 2008) If consumption subtracted by production is negative for an individual that individual is a net contributor to the society and if it happens to be the other way around the individual is a net gainer of the society.

Table 1. Direct and indirect costs

Direct medical costs *- Drugs, testing, hospital costs etc.*	**Indirect medical costs** *- Costs of unrelated diseases due to prolonged life of the patient.*
Direct non-medical costs *- Travelling costs, patient's time, and adjustments in environment.*	**Indirect non-medical costs** *- Productivity due to illness and productivity and consumption changes due to prolonged life of the patient.*

2.1.6 Production

When calculating production in added life years in an economic evaluation there are two main methods that can be used: the human capital-cost approach and the friction-cost approach. The former has been given a foundation in economic theory from a societal perspective and the latter is a relatively new way of estimating these costs. The cost for productivity losses used in the human capital-cost approach is the opportunity cost that exists due to reduced paid production because of the individual ‘s disease. This opportunity cost is the value of the best alternative use of resources. One disadvantage using this approach is the exclusion of individuals’ contributions outside the labor force such as those from students, elderly and stay-at-home moms. This problem can be solved by using lost gross value that is lost from usual activities due to the disease, instead of wages, and the result will be the inclusion of all indirect costs. Another disadvantage of the human capital-cost approach is that it ignores the fact that the absent worker can be replaced by someone in the workforce and that is why the friction-cost approach has been developed (Koopmanschap et al., 2013).

The main thought behind the friction-cost approach is that unemployment due to diseases are quickly fixed because there is always an unemployed individual that will take over the job of the individual on long-term sick leave. The reasoning is that when a person is absent from work for a short period of time the workload handled by that person would be taken care of by either the same person when he or she returns to work, or by another employee. The first situation would result in no changes in production or costs and the second situation would result in no changes in production but higher costs because of the colleagues working overtime (Koopmanschap et al., 1995). The long-term sick leave would be solved, after a “friction” period, by replacing the absent person with someone else from the labor force. The only costs that would appear would be the “friction” costs such as searching for and training new employees, the loss of production in the friction period and also some others costs related to the friction period. The problems with the friction-cost method are that it is not founded in welfare economic theory and also there are discussions regarding the estimation of indirect and direct costs. (Liljas, 1998) It is important to remember that these two approaches are different methods of calculating productivity losses and will produce different results based on what method is chosen. These different methods for calculating the productivity costs and gains in additional years of life lead to inclusion of different costs and different magnitude of these costs.

3. Welfarism and Extra-Welfarism

3.1 Welfarism and Extra-Welfarism

In order to understand the different viewpoints on whether to include the cost of added life years or not in an analysis the terms welfarism and extra-welfarism need to be sorted out. The two viewpoints have different ways to reason about how an individual's benefit or utility from an intervention or medicine should be calculated and thereby leading to a discussion about what costs and what benefits that should be included in an analysis.

3.1.1 Welfarism

The well used theory that is called welfare economics, which originates from the objective that individuals are the best judges of their own welfare (Drummond et al. 2005); thereof the name, can be divided into two parts: classical and neo-classical. The classical tradition believes that utilities among individuals are cardinal and to be able to reach the socially optimal level of welfare these utilities need to be summed together and maximized. Meanwhile, the neo-classical tradition is built on four parts: the utility principle which means that individuals rationally maximize their own welfare by ordering options and choosing the preferred option, individual sovereignty which means that individuals themselves know what is best for them and how much utility every choice gives them, consequentialism which tells us that an individual receives utility from the outcomes of what he or she does and not the process itself, and lastly, welfarism which means that whether a situation is good or bad is judged by the amount of utility and nothing else. Thereafter the neo-classical tradition can be divided into two separate parts, namely the Paretian tradition and the Bergson-Samuelson social welfare function. The Paretian tradition builds on the Pareto principle that we are in a socially optimal point if no individual can be made better off without making anyone worse off. The Bergson-Samuelson social welfare function makes room for comparisons between individuals and selects a preferred distribution of welfare on a welfare frontier. Although there are several different mindsets in the practice of welfare economics the concept of utility is the common factor in all of them. Utility is often thought of as being a term for "happiness" or "satisfaction" which is partly true but usually the amount of utility represents an individual's preferences from a bundle of goods or services or states of the world and if an individual chooses one good over the other it is assumed that the chosen good gives the

individual more utility. We now turn to extra-welfarism to see how they perceive the term utility. (Brouwer et al., 2008)

3.1.2 Extra-Welfarism

The founder of what is now called extra-welfarism is Sen (1985, 1995) and extra-welfarism is based on his capabilities approach. In the capability approach there are capability sets where the sets represent what freedom individuals have and this freedom is not only enjoyed by consuming goods but also arises from achievements. The achievements represent a vector of an individuals' functionings. According to Brouwer et al. (2008) there are four major differences between welfarism and extra-welfarism. Firstly, extra-welfarists accept the use of other outcomes than utilities. Secondly, others than the affected individuals may value the outcomes. Thirdly, weighting of outcomes may be done by other principles than the preference-based principle and lastly, they make room for comparisons among individuals, using other factors than utility, when it comes to welfare. The extra-welfarists believe that there should be another measure for individual welfare apart from utility that is drawn from the goods and services consumed by individuals themselves and this is also the most apparent difference between the two mindsets. The other measure of utility is not explicitly stated anywhere but is explained as non-good characteristics that should be a complement for the widely used concept of individual utility. These non-good characteristics could be whether the individual feels happy, physically mobile, honest or out of pain. As stated before the sources of valuation can be others than the affected individuals, for example stakeholders or the general public. The reason for this is that then socially optimal situations would not be determined by individuals' utilities but individuals that would never consume the good or service would be more relevant sources of valuation. In addition to differences in measurement of utilities, the extra-welfarists believe that a society should have "higher goals" than just individual preferences, for example the society probably cares more for the handicapped population or attaches more weight to future effects than the individual does (Brouwer and Koopmanschap, 2000). Also, in extra-welfarism there are no weights that are commonly used but there is an agreement among extra-welfarists that the weights do not have to be utilities and that health does not need to be weighted in utilities either, rather incorporating equity and ethical considerations. This is what Brouwer et al. (2008) say is the "extra" in extra-welfarism. One further distinction between the two approaches is the fact that welfarists do not, as stated above, make interpersonal comparisons but extra-welfarists try to

do so. These comparisons are not done in utilities but in capabilities and characteristics such as health, schooling or handicap.

3.1.3 Welfarism, extra-welfarism and the QALY

One of the main differences between welfarism and extra-welfarism is of course their background; welfarism often leaning on strict welfare economic theory with utility maximizing and extra-welfarism wanting to include something more and often focusing on the ethical part of things as well, but also how they interpret QALYs is a prominent difference between the two viewpoints. Liljas (2011) explains that differences in viewpoints between different sides exist because either the analyst uses cost-benefit analysis, where QALYs are interpreted somewhat as utilities, or cost-effectiveness or cost-utility analysis where QALYs are interpreted as health. If QALY is interpreted according to welfare economics the measure should represent preference-based utility and it should fulfill the following requirements: the length of life and the quality of life should be mutually independent, the amount of years a person is willing to sacrifice for a better health state should be independent of how many years the person has left to live, and the person should have risk-neutrality over the amount of years left to be lived. The current methods used for health economic evaluation are often not satisfying the above requirements fully and therefore a new theoretic approach has been developed, namely extra-welfarism. In extra-welfarism the QALY measure is not explicitly measuring utility but instead its measuring health and thereby it can be used in health economic evaluations. (Bernfort, 2012) Another way of measuring QALYs is described by Cookson (2005) in his article, where he interprets the QALY measure in the extra-welfarism way as measuring a person's "capability set" where the set consists of functionings the individual is capable of achieving, which is closely related to the theory by Sen. In practice though, whether the analyst is a welfarist or a extra-welfarist, there is a common understanding that QALYs are not perfect measurements of utility.

4. Theory of cost of added life years

4.1 Costs of added life years

As explained before, costs of added life years refers to the net costs that appear due to the fact that an individual lives longer because of a medical intervention or a certain drug. These costs

are often considered as unrelated to the medical intervention or drug and are usually costs of consumption minus production during these additional years. The consumption can be medical, the medical expenditure spent on other diseases that occur due to the prolonged life, or non-medical, all other expenditures both private and public. There are several different viewpoints on whether to include or exclude these costs that occur due to longer life and several of these are presented below.

4.2 For inclusion of costs of added life years

4.2.1 Meltzer's theory

One of the most important contributions to the research on cost of added life years is the research done by Meltzer (1997). His views are based on utilities and utility maximization and therefore he can be seen as a welfare economist. In his paper he explains that cost-effectiveness is only consistent with utility maximization if all future expenditures are included in the analysis. He models the effects of changing medical expenditures on lifetime utility by using an expected utility function that looks as follows:

$$EU = \sum_{t=1}^{T} \beta^t S_t(m_{11}, \dots, m_{kt-1}) U_t(c_t, H_t(m_{11}, \dots, m_{kt-1}))$$

Where β^t is a time preference discount factor, U_t is the utility at a certain age that depends on the level of health H_t and consumption in a certain period c_t and S_t is the probability of surviving to a certain age. m_{kt} is the expenditure on medical intervention k at time t and the survival probability as well as the health level of the individual are assumed to be affected by these expenditures in the model. The reason for consumption being included in the model for expected utility, and being dependent on medical expenditure, is according to Meltzer (1997) to explain that people do not spend their entire income on health care. Following standard microeconomic theory Meltzer (1997) also has a resource constraint incorporated so that expenditures on consumption and medical care do not exceed the sum of earnings and endowments. In order for this to be true the expected expenditures need to equal the expected resources, so:

$$\sum_{t=1}^{T} \left[\frac{1}{1+r}\right]^t S^t(m_{11}, \dots, m_{kt-1})(c_t + m_{kt}) = \sum_{t=1}^{T} \left[\frac{1}{1+r}\right]^t S_t(m_{11}, \dots, m_{kt-1}) i_t$$

Where r is the interest rate from resources that are saved during one period instead of consumed and i_t is the income earned in each period. After differentiating the expected utility function with respect to the resource constraint there appears some important implications for Meltzer's point of view. The equation that results from maximizing expected utility with respect to consumption indicates that the discounted expected marginal utility of consumption at each age equals the discounted expected cost. The second equation, which is the maximization of expected utility with respect to medical expenditure, shows that expected utility from medical expenditure equals the expected cost from the intervention. The importance in this equation is that medical interventions affect expected utility both by changing survival probabilities and by changing the level of health. The cost side to this also has two implications: direct costs from the intervention and net expenditures generated because the survival probabilities have changed directly changing the length of the individual's life. Further, Meltzer (1997) claims that costs of added life years, both related and unrelated, should be included in a cost-effectiveness analysis because the benefits of extending life include the utility that comes from these future expenditures and therefore the costs used to obtain this utility must be included. Not including these costs would mean ignoring the opportunity cost i.e. that the resources could have been used for other purposes.

Meltzer's additional argument for the inclusion of costs of added life years is that the cost-effectiveness ratio can be seen as a sum of one component consisting of current costs and another component consisting of costs of added life years. Therefore the omission of these costs will lead to a bias in the calculation of cost-effectiveness and will not lead to a ranking of medical interventions that is consistent with maximization of utility. Also, the bias is zero when there are no changes in survival of the individual. This means that when ignoring costs of added life years in an analysis the entire set of costs are accounted for in the interventions that improve the quality of life but not the interventions that extend the length of life meaning that the analysis will favor latter interventions. A downside that results from the inclusion of consumption and earnings in added life years is that interventions saving the younger population will be prioritized over the interventions that save the older population. Meltzer (1997) addresses this concern and explains that the reason for this can be that the work outside the market, for example the elderly taking care of children or other activities at home, are not taken into account and therefore some productivity will be lost in the calculations. To deal with this he suggests integrating leisure in the utility function and letting it explain leisure in the traditional sense as well as work outside of the market where both of these can

increase utility. A shortcoming with this new addition to the utility function is that it does not capture other people's utility, such as the society's or relatives' utility, of the out of market activities done by the individual and this could be a large and important part of the analysis. Meltzer (1997) concludes his reasoning by stating that because of the magnitude of the consumption and earnings from added life years they could possibly affect the cost-effectiveness of common medical interventions substantially, especially the interventions that affect life expectancy more than the quality of life. The exclusion of these costs will then lead to artificially favoring interventions that increase the length of life instead of the interventions that improve the quality of life.

4.2.2 Supporting views

Another article defending the inclusion of costs of added life years, especially future unrelated medical costs, is the one by van Baal et al. (2011). Their arguments are mainly focused on how these costs should be included and not on the question of why they should be included. They present an equation that is used to calculate individual lifetime healthcare costs which looks as follows:

$$lhc(g) = \sum_{a}^{n-1} \sum_{i} sc_i(a, g) + \sum_{i} dc_i(n, g)$$

Where the dependent variable is lifetime healthcare costs for an individual, g is the gender of the individual, a is age in years, n is age at death, dc are the decedent costs, sc represents survivor costs, and i is the index for diseases. The above equation can be seen as lifetime health expenditure if the current health expenditure would remain constant. Thereafter they present an additional equation that would be applicable if there existed an intervention that increased the life of the patient and influenced the health expenditure for Z that is a set of related diseases. Then, the costs of all other diseases could be estimated by summing over the remaining disease categories:

$$\sum_{a}^{n-1} \sum_{i \notin Z} sc_i(a, g) + \sum_{i \notin Z} dc_i(n, g)$$

Where Z is the set of related diseases. By dividing lifetime health expenditures into disease components the costs of certain diseases can be excluded and thereby avoiding double counting of costs. This leads to a possibility of including future unrelated medical costs in analyses.

4.3 Against inclusion of costs of added life years

4.3.1 Garber and Phelps' theory

An alternative view on the inclusion of future unrelated costs is presented by Garber and Phelps (1997) and contains an expected utility function different from Meltzer's. The model is made up by three periods where the utility in each period is affected by income net of medical expenditures and it also consists of survival probabilities between periods. In their model medical expenditure in period one only affects probability of surviving to period two but does not affect survival in period three and medical care only affects utility by changing the probability of survival.

$$E(U) = U_1(Y_1 - C_1) + P_2(C_1)U_2(Y_2 - C_2) + P_2(C_1)P_3(C_2)U_3(Y_3)$$

Where U_t is the utility, Y_t the income, P_t the probability of survival and C_t the expenditures on medical care. To be able to increase effectiveness in this model the investment in health care in period one needs to be increased and thereby leading to a higher probability of survival in the next period. After maximizing expected utility with respect to the investment in health care in period one an optimal CE ratio is found:

$$\frac{dC_1}{dP_2} = \frac{U_2(Y_2 - C_2^*) + (P_3^* U_3(Y_3))}{U_1'}$$

This equation says that in order to reach optimum the CE ratio must equal the sum of future expected utility normalized by the marginal utility of income in period one. This result is an argument for Garber and Phelps' (1997) recommendation to exclude costs of added life years from CE analyses. The reason for this is that now it can be seen that when calculating an optimal CE ratio for decision-making by using an expected utility model the inclusion of costs of added life years is not needed. Garber and Phelps (1997) similarly describe the inclusion of these costs being equivalent to including a constant in the optimal CE cutoff and thereby it being useless. They further test for the consistency of using expected utility in cost-effectiveness analysis and conclude that when using QALYs as a measure of utility the optimal CE cutoff is the same for all medical interventions both with and without costs of added life years.

4.3.2 Supporting views

The release of the US Panel's recommendations on what costs to include in a cost-effectiveness analysis was the beginning for the discussion on costs of added life years. In their recommendations they suggest that when it comes to productivity losses, considering the loss of income due to diseases they suggest not including these costs in the numerator if the questionnaire given to respondents when measuring health states has said nothing about this aspect. Instead, the Panel argue that individual's responding to these questionnaires have already taken this into account when answering, and including them would lead to double counting. Considering the unrelated medical costs they advise neither an inclusion or an exclusion of the costs in an analysis and recommend a sensitivity analysis if the analyst has suspicions that these costs may be large and play a big role in the computation of the cost-effectiveness ratio. Also, in favor of the exclusion of the unrelated medical costs is the fact that it is difficult to disentangle unrelated medical costs from related. When they consider the unrelated non-medical costs they conclude that since these costs should specifically be "unrelated" they would only add a constant to the analysis. In addition, the collection of these costs would place a huge burden on the analyst and therefore they do not recommend the inclusion of unrelated non-medical costs that occur due to the prolonged life of an individual. (Weinstein et al., 1996)

4.3.3 But is it all black or white?

Nyman (2004, 2011) is known for the term "internal consistency" which means that when a cost is measured in a cost-utility analysis so should the utility gain, and vice versa. He points out three principles for what should be included in the cost-utility analysis, where costs of resources directly producing utility in the denominator of the cost-utility ratio should be included. Costs of resources that do not produce utility in the denominator should be excluded even though they are casually associated with the intervention and lastly, costs of the resources consumed that are casually related to the intervention, but that have no utility gains, should be included. Nyman (2011) argues that none of the questionnaires designed to give form to the QALY-weights specify the amount of goods and services consumed in a health state and therefore these costs should not be included in the cost-utility analysis. Regarding survivor earnings Nyman believes that if the respondent is taking into consideration the leisure time forgone and the gain in additional earnings then the earnings should be included

in the analysis, but this is hardly the case. Nyman (2004) concludes that if QALYs were constructed so that they include questions on the level of consumption and leisure supplied (and their utilities), then the costs of added life years should be included. Following Nyman's thought of internal consistency Gandjour (2006) arrives at a different conclusion than Nyman. According to Gandjour an individual surviving due to a medical intervention receives utility from primary needs such as food and housing. Therefore, he argues, the utility of the costs of added life years are actually incorporated in QALY-weights and so should the costs.

Liljas et al. (2008) agree with Nyman's (2004) view of internal consistency but they also question whether or not individuals actually do take consumption and production in future years into account when answering questionnaires. They state that although consumption and production are not explicitly included in QALYs respondents could still take these factors into account when reporting QALY-weights and they could affect the respondents stated utility. Further, Liljas et al. (2008) make suggestions of generalizing the utility function that is being used by including consumption and leisure and through this try to study if there are a set of assumptions that makes QALYs give the same expected ranking of health care programs as the suggested general utility function. If there does exist a set of assumptions as these and they are valid then it can be argued that costs of added life years should be included in the cost-effectiveness analysis. Lundin and Ramsberg (2008) are also questioning the conclusions of Nyman (2004), and they are not convinced that individuals' preferences for health and the preferences for other goods are separable and they also do not believe that when individuals are assigning QALY-weights to health states they do not consider consumption of other goods. Furthermore, the authors claim that if QALYs do not measure total utility, where utility from consumption is not included, a large part of consumption expenditures should still be included in the analysis since they are necessary to stay alive and live a normal functioning life. Moreover, Meltzer and Johannesson (1999) warn against the exclusion of costs of added life years due to the fact that they are real costs that actually do arise when interventions save lives and excluding them would create a bias that would favor interventions extending life instead of interventions improving the quality of life, as concluded earlier by Meltzer. An additional perspective on these costs is the one presented by Kruse et al. (2012). They believe that net consumption, consumption subtracted by production, should be included in the numerator of a CUA due to the fact that a positive such number could represent an opportunity cost to society. Further, after empirical work, they conclude that excluding costs

of added life years from a cost-effectiveness analysis will bias the ranking of intervention towards the elderly, which is in line with the findings of Meltzer.

Liljas (1998) believes that the individual only takes into account indirect costs that he or she bears him- or herself when reporting QALY-weights. These costs are relatively small when living in countries where there are functioning health insurances, as is the case in many countries in Europe, and therefore the risk of double-counting, which is a concern for many, would not induce a problem. Liljas suggests the following indirect costs to be included in an economic evaluation if following a societal perspective: the reduce in wage due to the individual's disease, the reduce in other activities due to the individuals' disease, and costs following from informal care by family or relatives. He also suggests using the human capital-cost approach when including production in costs of added life years in evaluating medical interventions, or other economic evaluations, because of the close relationship with economic theory.

A view that supports the discussion on the exclusion of costs of added life years is the one presented by Robert Lee (2008). He claims that costs of added life years should not be included in an analysis because estimates based on earnings overstate costs of added life years and furthermore, there does not exist a convincing argument why these costs should be included in a cost-effectiveness analysis. The latter is supported by Liljas (2011) who argues that no experimental attempts have been made to understand the reasonability behind the assumptions for consumption and therefore the costs of added life years should not be included in a cost-effectiveness analysis. Lee continues by repeating the calculations done by Meltzer (1997) and Garber and Phelps (1997) and concludes that the controversy surrounding the inclusion of costs of added life years originates from the differences in modeling budget constraints. He calls the budget constraint used by Meltzer an Annuity budget constraint, which he criticizes as a budget constraint where consumers choose consumption without taking into account survival probabilities, and the budget constraint used by Garber and Phelps the Conditional budget constraint, where costs of added life years do not need to be included. He then argues for the use of the Conditional budget constraint in analyses and finds that the same rules apply to health maximization and utility maximization and further that including costs of added life years will lead to a bias in cost-effectiveness calculations. Weinstein and Manning (1997) state that Garber and Phelps' viewpoints on the exclusion of

costs of added life years is suitable in theory but in practice it is difficult to disentangle the unrelated costs from the related costs.

It is important to keep in mind that the debate between the inclusion and exclusion of costs of added life years is mainly concentrated on the cost-effectiveness analysis from a welfare economic perspective where QALYs are interpreted as utilities. The inclusion of these costs when using a cost-benefit analysis is more accepted and natural. (Liljas, 2011) Also, the debate has its roots in the disagreement on whether the interventions should be maximized considering the societal perspective, which is often the view of welfare economics, or something else that steps away from the strict utilitarian approach, which is often used by extra-welfarists. But following a societal perspective the inclusion of all consumption and all productions in added life years should be included in an analysis (Johannesson and Meltzer, 1998), or as the US Panel states in their recommendation; all important impacts of human health and on resources must be included following a societal perspective (Weinstein et al., 1996). Van Baal et al. (2011) follow the same trail of thought and recommend inclusion of all lifetime health care costs, which will lead to the distinction between related and unrelated costs being unnecessary, and thereby, according to them; open up alternative ways to estimate health care costs. On another note, Drummond et al. (2005) advise analysts to clearly state which theoretical background they base their analysis on and consider a sensitivity analysis before excluding or including the costs of added life years. The important role of backgrounds in health economic analyses is highlighted by Olsen and Richardson (1999) as well when they discuss whether the differences in social costs should be taken into account when choosing between two groups of patients. According to them egalitarians would choose a equitable distribution and not take social costs into account, while utilitarians would take these costs into account and choose a distribution where total health in a society is maximized.

Debating further on the difference between welfarist and extra-welfarist approaches Nyman (2006) emphasizes the need for a common theoretical framework and states that the problem of an acceptable social welfare function cannot be solved by using an extra-welfarist approach. He further redefines the current CUA method as not being an extra-welfarist approach but instead being a welfarist approach with a number of simplifying assumptions. Nyman then expresses his personal view that CUA needs to be made more consistent by focusing on utility related to health and on expenditures related to health care.

4.3.4 Final remarks on the debate

As seen by the different viewpoints presented previously, the inclusion or exclusion of costs of added life years is anything but straightforward. Often guidelines state that a societal perspective should be used in economic evaluations, meaning all costs and effects should be included, but often there is no common agreement as to what these costs and effects are. In addition, the terms “related” and “unrelated” are often difficult to disentangle leading to a wide spread of interpretations. The Dental and Pharmaceutical Benefits Agency in Sweden chooses a strict societal perspective (TLV), and a welfarist approach, by including all costs and effects of an intervention or a drug. The inclusion could lead to a decision of reimbursement being accepted or rejected i.e. the costs having a large impact. The inclusion could also be in conflict with the other principles that the Dental and Pharmaceutical Agency should take into consideration when evaluating. Also, it may lead to the defying of ethical principles and can according to some lead to discrimination. This has been a topic in media recently where the decision on zytiga has been criticized of discriminating the elderly. (SvD, 2013)

5. Consequences of including costs of added life years

What consumption costs are included in the approximation of the consumption that an individual does when living longer? What are these costs for different age groups? Who are net contributors and who are net gainers? These questions are answered by presenting the numbers from production subtracted by consumption used by the Dental and Pharmaceutical Benefits Agency when evaluating pharmaceuticals. Factors that are missing or numbers that seem to need re-estimation in the current estimates are presented and re-estimated to give rise to alternative interpretation of for example informal production. When the costs of added life years are included in a health economic evaluation all the consequences and impacts of this inclusion should be known. If the impact is large enough it could determine whether a pharmaceutical is reimbursed or not and therefore it is interesting to see how large this impact actually is. In order to do so two cases with two different pharmaceuticals, dabigatran and zytiga, are presented and this will show how much the costs per QALY differs with and without costs of added life years. The reason why dabigatran was chosen was due to the fact that a model was available where re-estimation of costs of added life years could be made to show the importance of updating the present estimates. The reason why zytiga was chosen

was the simple reason that the decision of reimbursement was among the only decisions where costs of added life years was explicitly stated.

5.1 The Swedish estimates of costs of added life years

The decision to subside pharmaceuticals in Sweden is done by the Dental and Pharmaceutical Benefits Agency. Their goal is to, through a societal perspective, evaluate all costs and benefits of a certain pharmaceutical, (TLV) where all costs means the inclusion of costs of added life years. When these costs are included in an analysis the numbers calculated by Ekman (2002) are the numbers that should be used according to the Dental and Pharmaceutical Benefits Agency. The numbers are a summary of consumption and production by age from 1997 and are then adjusted by CPI, the consumer price index. The whole table can be seen below.

Table 2. Costs of added life years, Ekman (2002)

Age	0-19	20-34	35-49	50-64	65-74	75-84	85+	All
Type of consumption								
Health care	5914	7529	9652	13623	20395	26732	27601	11449
Pharmaceuticals	539	795	1349	2425	3485	3946	3324	1627
Primary and hospital care	4535	5648	7012	9795	15530	21442	22945	8652
Dental care	840	1086	1291	1403	1380	1344	1332	1171
Social services	2138	3417	3417	3417	8159	46113	149219	9486
Elderly care	0	0	0	0	7186	44690	146510	6740
Services to impaired people	2097	3376	3376	3376	710	710	710	2600
Transportation services	41	41	41	41	263	713	1999	147
Education	50502	10865	2807	760	13	0	0	15232
Schools and child care	49962	0	0	0	0	0	0	12181
Universities	403	8274	1555	283	13	0	0	2152
Adult schooling	83	1914	768	105	0	0	0	585
Labor market training	53	677	483	372	0	0	0	314
General public consumption	18330	18330	18330	18330	18330	18330	18330	18330
Other private consumption	56406	87300	80721	105942	95523	71909	49219	80596
Total consumption	133290	127442	114927	142074	142420	163084	244369	135093
Total production	2750	148140	227115	202079	9101	1033	169	113168
Consumption-Production	130540	-20698	-112188	-60005	133319	162051	244200	21925

Production is calculated as total labor cost of the employee from the employer's point of view. Health care consists of pharmaceutical expenditures, which are the per capita sales of prescription pharmaceuticals, primary and hospital care are from southern Sweden and these numbers are used as representative numbers for the rest of the country, and dental care numbers are only for the dental care that is not privately provided. The social services costs are collected from the Swedish Association of Local Authorities and Statistics Sweden. Considering the costs of education no detailed information was found in the university education part and therefore the assumption was made that the intensity of study and cost of study was the same for younger and older students. Also, the lack of information led to an assumption that individuals 65 years and older do not participate in the adult school education. Data on public consumption has been collected from Statistics Sweden and data on other private consumption consists of elderly care fees and disposable incomes for the elderly, data from the family expenditure survey as well as private health care expenditures. (Ekman, 2002)

5.1.1 Analysis

In the analysis of the numbers used for costs of added life years different aspects that seem to be missing or are incomplete are analyzed and if possible re-estimated. The analysis is concentrated on the estimates itself and whether or not they are collected in the right way in the first place will not be questioned.

Production

As we will see below, the inclusion of costs of added life years has a great impact on the cost-effectiveness ratio that will work as a foundation, together with other aspects, for the decision of reimbursement or not. This alone is a good reason to critically analyze the numbers used for costs of added life years. One important aspect not considered in the current estimates is the informal production in the society. The exclusion of these numbers will most certainly lead to favoring of the younger due to the fact that production in the formal sense will decrease as the individual gets older. The informal production in all is hard to get ahold of but there are some good estimates of the magnitude. Formal production is estimated to be not even half of the total production in Sweden, meaning that informal production holds a large part of the total production. The household production is estimated to be 30 percent larger

than the production on the market that is taxed, counted in hours. (Henrekson, 1998) In a study presented by Jegermalm and Grassman (2009) this important aspect is tackled with regards to the informal production by the elderly, which is an essential fact that is missing from the current estimates used. Jegermalm and Grassman (2009) debate that it is wrong to point out the elderly population as merely consumers, especially of health care, and in fact they do produce after the age of 65. Usually the elderly contribute to voluntary work and other informal non-paid voluntary work. The group that produces the most in this sector, according to the article, is women 75 years and older, and men spend two-thirds of the time on informal production that women do. The women spend on average 60 hours per month on activities other than their own household chores, such as transportation, other's household work, looking after others in the society, from the young to the old and spending time with them. There is an increase in the informal production of elderly from 1992 to 2005 and the largest increase is in the care of others, those who are not relatives, where the number has increased from 28 percent to 50 percent in the years observed. In addition, half of the elderly in the country work voluntarily for associations. (Jegermalm and Grassman, 2009) The inclusion of informal production in costs of added life years is supported by Meltzer (1997). Meltzer (1997) wanted to integrate leisure, meaning actual leisure and informal production, in the utility function. This would be done in order to not prioritize the younger population and to show a truthful estimation of the costs. This inclusion of leisure can be done if it is believed that a QALY is founded on expected utility theory. But even if this is not the case informal production is a large part of production made by the elderly and should be included.

Moreover, an additional aspect that has changed from the year when the current estimates were calculated is the formal production produced by the elderly. A study from Statistics Sweden shows that 65 and 66 year olds that are in the labor force has increased in Sweden since 2001, from not even five percent to 22 percent in 2009. One of the reasons for this is a change in the law of employment protection that took place in 2001 and made it possible for employers to work until the month they turn 67. (SCB, 2012) Another aspect when considering changes to the present estimates on production is the fact that there most probably will be an increase in the pension age. According to the current debate and numerous news articles (for example DN, 2013) there is a goal to increase the pension age from 65 to 66 and also increase the opportunity to work from 67 to 69. This would lead to even larger differences in productivity between reality and the current estimates of productivity and would create an even larger bias. Now the age group of 65 to 74 year olds has an estimate of

productivity of 9101 SEK per capita per year and this would clearly be much higher if, and when, the pension age will be increased, and would lead to an even larger need for new estimates for costs of added life years.

The population in Sweden is aging (SCB) and this as well has its consequences on costs and benefits for the society and therefore even on the present estimates. The costs for elderly care will most probably increase together with services to impaired people and transportation services but there is a counterargument for this: if the population is aging it means that we are probably healthier and more able and this in turn points to the health care for elderly *not* increasing as much due to an aging population. Either way, the fact that the population is aging is a fact, and it has aged since 1997 (SCB), when the current numbers were calculated, and this fact should be accounted for in the estimates for costs of added life years.

Re-estimation of production

As stated above, the productivity of 65 and 66 year olds has increased, as well as for older individuals, and according to Statistics Sweden in 2011 13.4 percent of the population in Sweden were 65-74 year old employed individuals, where 65.4 percent of the total population are employed. (SCB, 2012) This means that one in five of the employed in Sweden in 2011 were between the age of 65 and 74. Approximating this production and re-estimating the current estimates was done with a recalculation and a more thorough description can be found in the appendix. The productivity of 20-64 year olds according to the present estimates were multiplied by 20 percent to get the productivity of 65-74 year olds and then replacing the current numbers of 9101 SEK. The new productivity for 65-74 year olds in 1997 SEK was calculated to be 38 500 SEK. Keeping consumption constant and subtracting consumption by production the new cost of added life years for the age group of 65-74 year olds is 103 920 SEK, reducing the costs by almost 30 000 SEK compared to the current numbers.

Table 3. Increased production for 65-74 year olds

	CAL* w/current numbers	**CAL w/ new production**
Consumption	142 420 SEK	142 420 SEK
Production	9101 SEK	38 500 SEK
Cost of added life years	133 319 SEK	103 920 SEK

*CAL = cost of added life years

To calculate the accurate total informal production of the elderly would be an almost impossible task due to the lack of data but estimations can be done to show the importance of informal production. It is of course the case that the younger population also produces informally but the age group 75-84 was chosen to show the importance of adding informal production in the present estimates as well as giving a more truthful estimate of production for elderly who do not produce formally any longer. As stated before, according to Jegermalm and Grassman (2009), women over 75 years and older spend on average 60 hours a month on informal production and men two-thirds of what women do. It is difficult to estimate the value of this informal production because there is no monetary value attached to it and the intensity and quality of the informal production varies between people of different ages and otherwise. In order to make an estimation of the value informal production has for the society the average hours spent on informal production estimated by Jegermalm and Grassman (2009) was multiplied by an average wage for a health care assistant in Sweden in 2010 (LO, 2010) and these calculations can be seen more in depth in the appendix. The reason why the wage for health care assistants was chosen is because it resembles the informal work done by the elderly after the age of 75. The age group 75-84 was chosen due to the fact that it is less likely that individuals produce, formally or informally, after the age of 85. Therefore, to avoid overestimation the age group was not allocated any additional production apart from the existing numbers. After calculations the yearly average informal production of 75 to 84 year olds was found to be 73 200 SEK. Replacing the current numbers for production of this age group and keeping consumption constant the new costs of added life years is 89 884 SEK, instead of 162 051 SEK.

Table 4. Informal production for 75-84 year olds

	CAL with current numbers	**CAL with informal production**
Consumption	163 084 SEK	163 084 SEK
Production	1033 SEK	73 200 SEK
Costs of added life years	162 051 SEK	89 884 SEK

Uncertainty

An important aspect of cost-effectiveness analyses is uncertainty and according to Briggs (2000) uncertainty should be taken into account. There exists uncertainty in for example methods that are used when estimating resource use and health outcome consequences in an

evaluation as well as in calculation of opportunity costs. A way to deal with uncertainty in cost-effectiveness analyses is the use of sensitivity analyses. A sensitivity analysis can be used to present how results can vary depending on different methods applied or on an even deeper level where effects of unknown parameters are examined. Briggs (2000) suggests having interval estimates together with point estimates of cost effectiveness for different scenarios. Another aspect when dealing with uncertainty is according to Briggs (2000) the importance of patient characteristics. This means that different patient characteristics can affect costs and effects differently in cost-effectiveness analyses and thereby alter the final results. One way that patient characteristics can differ is the different probabilities of falling ill after a certain disease or patients responding differently to interventions and thereby giving rise to different costs. It is obvious that everyone in the society does not consume health care by the same amount and often it is a minority of people that consume a great amount and the majority do not consume at all or very little. Is it then "fair" to use average costs of for example health care consumption and apply it to all people in the society? Also, Briggs (2000) highlights the importance of gender, for example there could be vast differences between men and women in for example health care costs. Briggs uses an example of statin therapy for the reduction of cholesterol levels where the costs of added life years ranges from £6000 for men and £361 000 for women, where the average of £32 000 is used in the analysis, clearly overestimating the cost for men thereby giving them a disadvantage.

Based on only these examples, and there are certainly more, it is clear that the costs for added life years used today need further improvement. These numbers are only an average of the population, and both genders together are included and also the numbers do not take into consideration different patient characteristics. In addition, there does not exist any modeling or inclusion of uncertainty in the calculations. An example of a way to account for uncertainty could be to divide the costs of added life years into subgroups and then calculate different costs for each group. These groups could be divided based on gender, income or other characteristics. Because of these subgroups the incremental cost-effectiveness ratios calculated would vary depending on which group the drug or intervention would be targeting. This would then give a more realistic result and take into consideration the fact that individuals are different. The use of subgroups could also result in considerably more difficulties when taking into consideration ethical viewpoints. If dividing individuals after gender and other patient characteristics the result could be seen as discriminating and not giving health care on the same terms for the whole population. As seen, health care costs can

differ by a great amount depending on gender (Briggs, 2000) and age (Ekman, 2002) and most probably by income as well. Not to consider these differences and to use an average underestimates the costs for consumption for some and overestimates the costs for others. In for example health care there are differences in the extent of the consumption among the population, where some individuals consume large amounts of health care and some close to nothing, as stated previously. Also, there is a correlation between income and health (Yngwe and Burström, 2001) that could lead to different results than the present.

In practice, a probabilistic model could use different health care consumption costs and different private consumption costs and randomly draw observations many repeated times to finally get a confidence interval and produce not only point estimates but a range of consumption costs where individuals could stand. If these factors had been included the values for productivity and consumption would differ significantly by showing a more wide spread and more uncertainty compared to the present numbers used. Also, the costs of added life years used only represent one year and therefore does not show any differences in individuals' consumption or productivity due to crises, environmental issues or the simple fact that as time goes by individuals' change their behavior.

To show how consumption can change from year to year and why it is important to critically analyze the estimates used today, an example can be presented. In order to account for the fact that when years go by the prices differ the Dental and Pharmaceutical Benefits Agency uses CPI to adjust the estimates from 1997 to today's numbers. But does this show the rightful increase of the estimates? The per capita cost of pharmaceuticals, according to the present estimates, was in 1997 on average 1627 SEK. By adjusting 1627 SEK with the CPI between 1997 and 2012 (SCB) the cost for pharmaceuticals should be 1980 SEK per capita in 2012. Studying statistics from 2012 (Socialstyrelsen, 2013) shows that the costs of pharmaceuticals per capita on average was 2653 SEK in 2012 equaling a difference of 673 SEK between the real number for 2012 and the CPI adjusted number for 2012. This example shows that the present numbers are underestimating the cost of pharmaceuticals per capita and this could be the case for the other estimates as well. This result shows that there is need for updates and re-estimations of today's estimates.

5.2 Impact on decisions

5.2.1 Dabigatran

Pradaxa is the sales name of the drug dabigatran. Dabigatran is an oral direct thrombin inhibitor and the effect of the drug is predictable and does not need to be monitored but does not have any antidote. Dabigatran is an anticoagulant drug which means that is prevents the blood from clotting. The drug is used to prevent stroke and thrombosis for adult patients with atrial fibrillation. The patients that dabigatran is designed to help usually use warfarin which needs more monitoring than dabigatran and the sensitivity for warfarin varies between individuals, for the same individuals over time, and also varies because of diets and other pharmaceuticals. (FDA), (EMA)

To study whether dabigatran is a cost-effective drug a health economic evaluation was done (Davidson et al., 2013) by the pharmaceutical company for the Dental and Pharmaceutical Benefits Agency. Here, dabigatran was compared to warfarin, aspirin, and no treatment, in the aspect of the medical effects and costs. When putting together all these effects and costs the study presents a cost of 535 000 SEK per QALY and if the study only takes into account effect data that is statistically significant the cost is 360 000 SEK per QALY (TLV). The medical products agency states that dabigatran is a valuable addition against stroke and thrombosis for patients not responding to anticoagulant treatment in a satisfactory way but for patients that have the opposite the new drug does not seem to have any relevant advantages. The Swedish Council on Health Technology Assessment concludes that dabigatran is not better than warfarin for patients with atrial fibrillation and the risk for stroke when the treatment with warfarin is as good as it is in Sweden. The council further concludes that due to the price of dabigatran and the well-functioning control of warfarin, the treatment with warfarin is the most cost-effective. On the basis of these facts and the law of pharmaceutical benefits, and despite the councils' recommendations, the Dental and Pharmaceutical Benefits Agency decided that due to the diseases' degree of severity the cost per QALY for Pradaxa is fair. (TLV)

To be able to calculate different costs per QALY based on re-estimated costs of added life years a model based on the report by Davidson et al. (2011) was used. The cost per QALY of 535 000 SEK, that the Dental and Pharmaceutical Benefits Agency accepted to be

reimbursed, consists of costs of added life years which cannot be seen explicitly in the decision of reimbursement. The model used indicates that 0,12 QALY and 0,09 life years are won when using dabigatran instead of warfarin and also the avoidance of stroke is 0,05. When calculating the costs of added life years the current numbers (Ekman, 2002) were used and for the case of dabigatran and warfarin the two age groups 65-74 and 75-84 were used. Taking the net consumption for the age group 65 to 74 year olds, which was 133 319 SEK, and multiplying with CPI for the year of the analysis (SCB), 2011, the net consumption becomes 161 183 SEK. Doing the same for the age group of 74 to 84 years olds, where net consumption was 162 051 SEK, the net consumption for 2011 becomes 195 920 SEK. Based on these numbers the cost per QALY *without* costs of added life years is 394 888 SEK. To sum it up, the inclusion of costs of added life years in the cost-effectiveness analysis for dabigatran increases the cost per QALY with 140 112 SEK.

After applying the re-estimated costs of added life years that include both informal production of 75 to 84 year olds and increased formal production of 65 to 74 year olds, multiplied with the CPI for 2011, the new cost per QALY for dabigatran becomes 481 804 SEK. This new cost per QALY is over 53 000 SEK less than the cost per QALY where the present numbers were used. In table 5 below the costs per QALY for different scenarios can be seen.

Table 5. The impact of costs of added life years on the cost per QALY of dabigatran (in 2011 SEK)

	Dabigatran, base case	**Re-calculation of CAL**
Cost/QALY without CAL	394 888 SEK	394 888 SEK
CAL	140 112 SEK	86 916 SEK
Total Cost/QALY	535 000 SEK	481 804 SEK

5.2.2 Impact on cost per QALY for dabigatran

From the case with dabigatran it can be concluded that costs of added life years has a significant impact on the incremental cost-effectiveness ratio. If following the guidelines (Socialstyrelsen, 2008) from The National Board of Health and Welfare in Sweden the cost per QALY for dabigatran would move from a high level, under or equal to 1 000 000 SEK per QALY, to a moderate level, under 500 000 SEK per QALY, if the costs of added life years would be re-estimated to include informal production and increased formal production for 65-

74 year olds. Also, the cost per QALY would decrease even further, but still be at the moderate level, if the costs of added life years would not be included at all in the analysis.

5.2.3 Zytiga

Abirateron is the active substance of the drug zytiga. The drug makes the human body stop producing testosterone, which can lead to the growth process of prostate cancer slowing down. Zytiga is used to treat adult men who have prostate cancer and to those where the cancer has spread to other parts of the body. Another drug, prednisone, is used together with zytiga to lower the risks of high blood pressure, fluid retention, and lower levels of potassium in the blood. (FASS)

In the case of zytiga the Dental and Pharmaceutical Benefits Agency declined its reimbursement. In the foundation of their decision it is stated that an indirect cost has been added on these patients and that these costs are production minus consumption, in other words, costs of added life years. These costs are calculated to be 62 000 SEK and will increase the cost per QALY by 177 000 SEK and they state that increased survival for this patient group will lead to increased costs for the society. Together with the costs of added life years the cost per QALY for zytiga was calculated to be 1 160 000 SEK. (TLV, 2012)

Table 6. The impact of costs of added life years on the cost per QALY of zytiga

	Zytiga
Cost/QALY without CAL	983 000 SEK
CAL	177 000 SEK
Total Cost/QALY	1 160 000 SEK

5.2.4 Impact on cost per QALY for zytiga

Similarly to the case with dabigatran, the case for zytiga can be used as an example to show how large of an impact costs of added life years has on the incremental cost-effectiveness ratio. Due to the lack of a model the re-estimated costs of added life years were difficult to include in the analysis. In spite of this, the impact of costs of added life years can be seen from using the current numbers alone. Without costs of added life years the cost per QALY for zytiga would move from a very high level, at over 1 000 000 SEK per QALY, to a high

level, lower than or equal to 1 000 000 SEK per QALY, according to Socialstyrelsen, and this decrease would most probably happen also if the re-estimated costs of added life years were used instead of the present ones. Maybe it could be the case that zytiga would have been accepted for reimbursement if the costs of added life years would not be included in the analysis and thereby lowering the cost per QALY.

6. Ethics

6.1 Costs of added life years and the law of health and health care

The guidelines that the Dental and Pharmaceutical Benefits Agency need to consider when making a foundation for the decision whether to reimburse a drug or not, is called the ethical platform. The ethical platform consists of three principles, which are: the human dignity principle, the need and solidarity principle and the cost-effectiveness principle. (TLV) These principles should be prioritized according to the above ordering, where the cost-effectiveness principle is the last principle that should be taken into account. The Dental and Pharmaceutical Benefits Agency also have to make decisions according to the law of health and health care where in paragraph two it says that the goal for the health care system is good health and health care on the same terms for the whole population. Also, health care should be given with respect to the equal value of each individual and with respect to every individual's dignity. The individual with the greatest need for health care should be given priority. (Hälso- och sjukvårdslagen, 1982:763) From these principles and laws it can be concluded that they stand in contrast to each other and following one principle means bending the other. This is true especially when taking into account costs of added life years in cost-effectiveness analyses where younger are prioritized over the elderly. The law of health and health care explicitly states that health and health care should be given on the same terms for the whole population and that it should respect the equal value of each individual. This stands in contrast to the inclusion of costs of added life years where the younger are being prioritized over the elderly and therefore the population is not being given health care on the same terms and treated equally.

6.2 The principles and ethics

The human dignity principle stands for equal rights to health but is it possible to give everybody in a society equal care when resources are scarce? This is a concern highlighted by

Mooney et al. (2012) and they believe that these questions should be answered by a critically informed "community", here; a community usually meaning a geographical area such as regions or towns, and that this community should know that resources are scarce and that some claims are more important than others and therefore they should give priority and weights to certain health states. Moreover, Mooney et al. (2012) question the need principle where the patients with the largest need for health care should be prioritized. In order to make these decisions a scale is needed that states where different health states are in the "worst-off area" of diseases and thereafter decisions can be made based on which patients are "more" worse off than others. Culyer (2001) also discusses these aspects and raises the question of what utility weights should be given to these worst-off ratings and if the health states are in the future, should they be discounted? In addition, there probably are large differences between how priorities are thought of in theory compared to in practice. According to Cohen (1989) the general view is that health economists wish to maximize social welfare and doctors do not take into account opportunity cost while giving treatment to patients and prioritizing. He states that it is of course not true for all economists and doctors to think in this manner but that these are the majority's thoughts. Cohen (1989) considers the existence of these differing mind-sets to be a problem due to the gap between available health resources and the demand for them and hopes that economists and doctors could learn to think more alike. Also a thought related to the need principle is the question of what "need" is, which is raised by Williams and Cookson (2000). They give examples of need being the person's initial level of health, the person's capability to benefit from health care, and the expenditure needed to equalize health. All these different concepts of health lead to different distributions of health care. Williams and Cookson (2000) also raise the question if health should be the only thing distributed according to need or should other things as shelter, food or employment be distributed according to need as well. In addition, they state that a criticism to the equal rights to health care principle is that it concentrates too narrowly on health care and not on what health actually can do for people. If connecting the Rawlsian objective and the need principle, health care should be allocated to the ones worst off in the society, but is this the same as the patient that is in greatest need of health care? And what happens then to the equal right to health care?

6.3 Ethics and health economics: the individual vs. the society

What perspective should be used when doing cost-effectiveness analyses is an important question. Most often guidelines in different countries state that a societal perspective should be used, which means that all costs and effect of an intervention or drug should be included in an analysis. Although there is common consensus when it comes to the use of the societal perspective, different viewpoints arise when the question of whose preferences should be taken into account surfaces. According to some, especially welfarists, the foundation for maximizing should be the sum of individuals' preferences. But is this the right way to proceed? It could be, and most probably is, that individuals do not take into account the same matters that society would when stating their utility. Do we want the individuals in a society, who may or may not think selfishly, to decide on health care for others or do we want the society as an institution to decide for us? As Brouwer and Koopmanschap (2000) explain, the society is more likely to concentrate on different aspects in resource allocation and in health care than a single individual. The society is probably more concerned for the weaker than the single individual and also the society may attach more weights to future effects and have "higher goals" compared to single individuals.

Because the Swedish guidelines for evaluating health state that a societal perspective should be followed (TLV) both unrelated and related costs are indeed included in the analysis of the Dental and Pharmaceutical Benefits Agency. But how can we know that this is the best way to go? Many countries state that they follow a societal perspective but do not include all costs and effects, especially costs of added life years. Is this then not a societal perspective or is it acceptable to have several interpretations of the societal perspective? Also, the difficulty of disentangling "unrelated" and "related" costs (Weinstein et al., 1996) results in a different variety of costs and effects taken into account between countries. If it is the health of an individual, which is the same for a person in Sweden as for a person in Australia as for a person in Botswana, that is being maximized should the countries not follow the same principles and include the same costs and effects? But, although health is the same for every individual, the cultures for different countries vary and the people may want different things from their own health care systems and according to Mooney et al. (2012) these "wants" need to be defined by the different local communities.

6.4 Ethics in practice

Fair innings, the concept where every human being deserves an equal amount of life in a somewhat good health state where the background of the individual and other not self-inflicted factors count (Williams, 1997), can be compared to the costs of added life years being included in a health economic evaluation. Because the inclusion of costs of added life years does discriminate the elderly it can be viewed from the point of the fair innings principle. The reason why is because the elderly have already had the chance to live their life, had their fair innings, and therefore the younger population should be prioritized. By including an additional cost, the net consumption that is positive for the elderly due to less production on the cost-side in the analysis, maybe a more rightful result will appear according to the fair innings principle. Then, if we would believe in the fair innings principle when making health care decisions, the inclusion of costs of added life years would not be as controversial as now and it would maybe be a given part in the cost-effectiveness analysis. One question worth raising when considering the fair innings principle, and in health care overall, is the question of how much individuals themselves are responsible for their own actions and their health state. (Kneeshaw, 1997) (Dolan and Cookson, 1998) If someone who has smoked all his or her life or in other ways abused their health is prioritized to someone that has exercised and lived a healthy life and this because the first person has not had his or her “fair innings” due to a reduced quality of life, is this “fair”? Or should the principle only prioritize the individuals that have not had their “fair innings” due to reasons they are not in control of, but how do we know what factors actually an individual can control and not control?

Another aspect is that when we include costs of added life years in health economic evaluations we discriminate against the elderly but if we exclude these costs, are we not discriminating against the younger population instead? As Meltzer and Johannesson (1999) stated, the costs of added life years are real costs that do arise because of an intervention or drug saving a life and therefore they should be included in a cost-effectiveness analysis. If following this trail of thought the removal of costs of added life years, that are indeed real costs, would bias the analysis and give the elderly a benefit that they would not have had otherwise.

Studies done on the general population and their view on health care and prioritization in health care have shown that on average the majority would want to prioritize the younger population over the older population together with the argument that the younger have their whole life in front of them and the older have already had the chance to live, clearly in line with the fair innings principle. (Charny et al., 1989), (Nord et al., 1996) If we choose to follow the general populations' viewpoints in decision-making in health care the costs of added life years should then probably be included to prioritize the younger population. If this is true, why does such controversy exist surrounding the inclusion of costs of added life years? Is it because of the fact that in theory it sounds correct to prioritize the younger, but when actually done in practice, it comes done to the fact that it is actual lives that are decided on and that all lives are worth the same?

7. Discussion

The background for the debate on whether or not to include costs of added life years is founded on the different theoretical views that exist. If following a straightforward welfarist view, QALYs should be treated as utilities and to able to reach an optimal resource allocation of health the expected utility function of an individual should be maximized, as in the fashion of Meltzer (1997). The inclusion of costs of added life years is then justified by explaining that the utility of future expenditures due to prolonged life of the patient is included in the expected utility function, thereby a factor that the individual takes into account when answering questions related to QALY weights, and therefore the costs of these future expenditures should also be included in an analysis. Garber and Phelps (1997) also use an expected utility function but arrive at a different result than Meltzer (1997). Instead of letting survival probabilities of an individual be affected by all medical interventions during a lifetime, Garber and Phelps (1997) only let medical expenditure in the first period affect the survival probability in the second period and leaving the third period's survival probability unaffected. This leads to their conclusion of costs of added life years being equivalent to adding a constant in an analysis and thereby them not supporting the inclusion of costs of added life years. If, on the other hand, an extra-welfarist approach is the basis of an analysis the QALYs should be interpreted as, not utilities, but as health or as capabilities, as Sen (1985) advocates. If interpreting QALYs as being health or as capabilities the inclusion of costs of added life years in an analysis is not straightforward anymore and utilities should be based on, not consumption of goods or services, but something else.

Even if there exists a common consensus that QALYs are not simply utilities and should not be interpreted as such, there still are disagreements about what is measured when constructing QALYs and what individuals take into account when answering questionnaires constructed to produce QALY weights. According to Nyman (2004) the QALY weights are not constructed so that they include future consumption and production but if they were constructed in this manner the costs of added life years should be included in an analysis. Also, Liljas (1998) is convinced that the individual only takes into account indirect costs that he or she bears him- or herself and that these costs are relatively small. Furthermore, a different view on the costs included in QALYs is presented by Lundin and Ramsberg (2008) and they argue that if QALYs do not measure total utility, where utility from consumption is not included, a large part of consumption expenditures should still be included in the analysis since they are necessary to stay alive and live a normal functioning life. Gandjour (2006) also supports the inclusion of costs of added life years due to the fact that the individual receives utility from basic needs such as food and housing when the life of the patient is extended and therefore the costs should be included.

There are strong theoretical arguments for the inclusion of costs of added life years but the decision whether to include or exclude these costs should be based on the perspective that the society chooses to have when allocating health care resources. If the society chooses to have a societal perspective, as is the case in Sweden and many other countries around the world, all costs and benefits should be included in an analysis according to the interpretation of a societal perspective. In spite of this, Sweden is the only country where it is recommended to include costs of added life years in health economic evaluations. The reason for this, together with other aspects, is the ethical discussions that the inclusion would give rise to as well as the difficulty to disentangle related and unrelated costs. But, according to my view, if it is explicitly stated that a societal perspective should be applied *all* costs and gains should be included, and by all costs and gains I also mean costs of added life years. The inclusion becomes even clearer when having a welfarist background. As Johannesson and Meltzer (1997) stated, these costs are real costs and excluding them would lead to a bias. The cost-effectiveness analysis, with the costs of added life years included, would then be an independent analysis of the cost-effectiveness of a drug or an intervention and should be separated from the ethical platform that also need to be considered. Then, after knowing that all the costs are accounted for and seeing how large the cost-effectiveness ratio is, the human

dignity principle and the need and solidarity principle could be applied and thereafter a decision could be made knowing that all the aspects would be taken into account.

If choosing to have a societal perspective, the estimates used for costs of added life years should be re-estimated and updated. The present estimates used are from one year only, 1997, and the consumption and production has changed since then. According to Statistics Sweden the formal production of 65 to 74 year olds has increased in recent years and taking this into account production increases from 9101 SEK to 38 500 SEK and the estimates for costs of added life years, keeping consumption constant, decreases by almost 30 000 SEK compared to the estimates used today. Informal production is a factor that is completely missing from the estimates of production, most probably due to the difficulty in giving a value to informal production, and a factor that I chose to include in my estimates of costs of added life years. According to Jegermalm and Grassman (2009) women over 75 produce on average 60 hours per month and men two-thirds of this time. When including informal production in the estimates of production for 75 to 84 year olds production increases from 1033 SEK to 73 200 SEK and costs of added life years decrease, when keeping consumption constant, by approximately 72 000 SEK. An additional aspect that needs attention is the inclusion of uncertainty in the estimates of costs of added life years. As shown by Briggs (2000), health care costs can differ with gender and because of different patient characteristics. These differences between individuals lead to uncertainty in estimates and therefore intervals of different costs should be presented instead of just an average to show the diversity and distribution in costs. Similarly, subgroups where individuals are divided according to gender, age, income etc. could be presented in analyses and thereby leading to a more truthful estimation of costs of added life years but also increased difficulties surrounding the ethical viewpoints. There is also uncertainty and a wide spread in the production and consumption for 65 year olds where some could work several more years and others are retired and thereby overestimating or underestimating the costs of added life years for individuals. Another drawback of the current estimates of costs of added life years is the fact that CPI is added to them by the Dental and Pharmaceutical Benefits Agency in order to upgrade the numbers to today's date but consumption of different goods or services could have increased faster or slower than CPI. To investigate this, consumption of pharmaceuticals was chosen as an example of how these numbers can differ, and it was found that according to the current estimates adjusted with CPI the cost of pharmaceuticals per capita on average should be 1980

SEK in 2012 but are actually 2653 SEK. All these examples above show that the current estimates of costs of added life years need to be updated and re-estimated.

In order to show the impact of the inclusion of costs of added life years on an analysis two cases with two different drugs were presented, dabigatran and zytiga. In the case of dabigatran the re-estimated costs of added life years, with increased formal production and with informal production, was used and there was a decrease in cost of added life years from 140 112 SEK to 86 916 SEK where the incremental cost-effectiveness ratio was approximately 53 000 SEK less when using the re-estimated cost of added life years. This moved the cost per QALY, according to Socialstyrelsen, from a high level to a moderate level. In zytiga's case a re-estimation of cost of added life years was not possible but if a cost of added life years of 177 000 SEK was added to the cost-effectiveness ratio the cost per QALY would move from a high level, 983 000 SEK, to a very high level, 1 160 000 SEK, according to Socialstyrelsen. These two examples show how large of an impact cost of added life years has on the analysis and also implicates that because of this impact it is important that these estimates are truthful and well thought-out.

Several ethical viewpoints are in line with the inclusion as well as the exclusion of costs of added life years. First of all, the principles that the Dental and Pharmaceutical Benefits Agency need to consider when making decisions about reimbursement stand in contrast to each other. In the law of health and health care it is specifically stated that the goal of the health care system should be good health and health care on the *same* terms for the whole population (Hälso- och sjukvårdslagen 1982:763). This goal is contradictory to the principle of cost-effectiveness when costs of added life years are included, health care will not be allocated based on the same terms because individuals are divided according to age. There are also questions that make it hard to relate to the principles in question: who is "worst off"?, what is a "need"?, "should other factors be allocated according to need as well?". Then there are some ethical viewpoints that can be interpreted as supporting the inclusion of costs of added life years in analyses. One of them is the fact that if we exclude costs of added life years, are we not discriminating the younger population instead? Also, the concept of fair innings can be seen as standing in line with the inclusion of these costs and the studies on the general population stand in line with the inclusion as well. There is a debate on whether to discount future costs and Culyer (2001) raises the question whether future health states should be discounted and by what discount rate. Meltzer (1997) does include discounting in his

expected utility function but if we choose not to maximize utilities but health, what should the discount rate be?

In this master thesis there are of course some limitations. A choice not to take into account for example the effects and the costs of relatives and others close to the patient when evaluating medical interventions was made. Such costs and others of resemblance would have made the cost-effectiveness ratio lower, possibly leading to different medical interventions being prioritized. The estimates used today for costs of added life years were only critically analyzed based on production, uncertainty and consumption of pharmaceuticals to show how large the need for an update of these estimates is. Other consumption included in the estimates was not considered and how the estimates were collected and calculated was not critically assessed. For future implications a full update and revision of the current estimates for the costs of added life years needs to be done.

8. Conclusions

There is a great debate on the subject costs of added life years and many arguments are presented for both the inclusion and exclusion of costs of added life years. There are strong theoretical arguments for the inclusion of costs of added life years if a societal perspective is applied, as is the case in Sweden. Therefore, the Dental and Pharmaceutical Benefits Agency in Sweden recommends the use of costs of added life years in economic evaluations when making decisions about reimbursement and therefore all costs and benefits of an intervention or a drug should be included in an analysis. There is a significant impact on the analysis when making decisions on reimbursement when including costs of added life years, as shown with the examples of two drugs dabigatran and zytiga. This impact differs mainly with regards to how much the life of the patient is prolonged. Due to the fact that the inclusion of costs of added life years has an impact the estimates used must be as truthful as possible. As seen, after critically analyzing the present estimates of costs of added life years, it is necessary to make improvements to these estimates that are used by the Dental and Pharmaceutical Benefits Agency. These improvements include the re-calculation of formal production for 65 to 74 year olds as well as the calculation and inclusion of informal production for 75 to 84 year olds. Costs for consumption should also be updated since for example consumption of pharmaceuticals has increased more than CPI since 1997 to today. Uncertainty has not been taken into account in the current estimates and only averages are used, which leads to over

and underestimation of the costs for individuals. There are different ethical views that support the inclusion of costs of added life years as well as ethical views that do not support the inclusion. The fair innings principle can be seen as standing in line with the inclusion of costs of added life years together with studies on the general population where the majority would want to prioritize the younger population instead of the older.

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Appendix

1. Calculation of production for 65-74 years olds

Percentage of population who are employed (15-74 year olds): 65.4 %

Percentage of employed 65-74 years old in the population: 13.4 %

Percentage of employed that are 65-74 year olds: 13.4 %/65.4 % = 20 %

Average production of 20-64 year olds according to present estimates used: 148 140 + 227 115 + 202 079 = 577 334

65-74 year olds average production according to Statistics Sweden: 577 334/3 = 192 445 (average production fro 20-64 year olds), 192 445 x 0,20 = 38 500

2. Calculation of informal production for 75-84 year olds

Average wage for health care assistants in Sweden in 2010: 19 500

Average hourly wage for health care assistants in Sweden in 2010: 19 500/160 = 122

Average hours spent per month for women: 60 hours

Average hours spent per month for men: 40 hours

Average value of informal production for both men and women per year: (((122*60)/2)+((122*40)/2))*12 = 73 200