Introduction

In any economic and/or business decision analysis model, cost is always one of the factors that should be included while its counterpart varies from benefit (in Cost-Benefit Analysis), to effectiveness (in Cost-Effectiveness Analysis), and even to quality-adjusted life years or utility (in Cost-Utility Analysis). Costs can be measured in terms of any type of resource (e.g., time or food), but most commonly they are measured in monetary terms.

The disease burden, which is mainly presented with cost amounts, is a term that encompasses various aspects of the disease impact on population health, ranging from the frequency of the disease, as measured by incidence and prevalence rates, to its effect on (1) longevity, such as case-fatality rate and years of life lost due to premature death, (2) morbidity including decrease in health status and quality of life, and (3) finance, including direct health care expenditures and indirect costs related to lost income from premature death or disability.

Accurate knowledge of the costs of illness is essential in formulating health care policies to prioritize health interventions and research and also to allocate health care resources accordingly and efficiently. Hence, it is important to understand how the costs are defined, classified and measured in order to make informed decisions regarding health care policies. In this paper, we would like to discuss the definitions, categories, types of study approaches regarding costs and cost of illness to finally try to position cost analysis in health economics and healthcare management as a useful tool for decision making process.

Cost-of-Illness Studies: Basic Concepts

As a special aspect in health care science with economic application to set out to measure ‘costs’ of illness or injury, we define Cost-of-Illness (COI) studies or Burden of Disease (BoD) as their close relative. They can relate to a specific disease or injury type, or to broad groupings of such, or to the costs attached to specific ‘risk factors’ such as smoking, obesity, addiction,
etc. The COI analysis represents the earliest structural form of economic evaluation in health care sector. The principal goal is to evaluate the economic burden that illness imposes on society as a whole in terms of the consumption of health care resources and production losses. According to Jefferson et al. (2000), “the aim of COI studies is descriptive: to itemize, value, and sum the costs of a particular problem with the aim of giving an idea of its economic burden.” This requires recognizing, identifying, listing, measuring and valuing the costs generated by an illness.¹

To carry out COI studies, we need to keep in mind that as an underlying assumption that the economic costs of illness represent the economic benefits of a health care intervention if it had eradicated the illness. In this vein, the COI studies generally include some metric of ‘health loss.’ Most commonly the measure is in terms of DALYs (Disability-Adjusted Life Years), but there are other possibilities, particularly total lives lost. In addition, COI studies seek to measure the resource costs of the corresponding illness, measured in monetary values.” These include health-care costs, and occasionally also the ‘lost economic or societal contribution’ from premature death or health impairment. Quite often a monetary value is also assigned to the ‘health loss’ measure, DALYs or Lives Lost, allowing a total ‘cost’ in money terms to be calculated.

Generally, there are two basic elements of estimating cost; measurement of the quantities of resources used and the assignment of unit costs or prices. The measurement of quantities is relatively easy and straightforward with the use of case report forms, case notes, hospital records, or other data collection systems, while unit costs or prices might not always be available and often vary across different regions, countries, time periods, or providers.

Types Of Costs

The Cost-of-illness studies traditionally divide costs into three categories: direct, indirect, and intangible costs. For readers’ better understanding, examples of costs (direct and indirect costs only) associated with health outcomes are presented in the Appendix of this paper.

A. Direct Costs

‘Direct costs’ are borne by the healthcare system, community and family in directly addressing the problem (such as costs of hospital stays, investigations, pharmaceuticals, and outpatient doctor visits), which refer to healthcare and non-healthcare costs. The former is defined as the medical care expenditures for diagnosis, treatment, continuing care, rehabilitation, and terminal care, while the latter relates to the consumption of non-healthcare resources, such as transportation to and from health providers, certain household expenditures, costs of relocating and certain property losses, legal and court costs, and informal cares, which is the time family members or volunteers spend caring for the patient.

B. Indirect Costs

The term ‘indirect’ is used in economics to mainly refer to productivity losses to the national economy due to illness or death, borne by the individual, family, society, or by the employer.² The indirect costs form a part of the welfare losses to
society incurred by diseases. The remaining welfare losses are represented by the losses in healthy time resulting from paid
and suffering caused by diseases, though these aspects are rarely, if ever, valued in monetary terms (Roux and Donaldson
2004). Three common approaches to account indirect costs are through either a human capital method, a friction cost
method or a willingness to pay method.

1) Human Capital Method

The human capital method is an approach to estimate the productivity cost in the absence of market prices. This method
estimates the value of human capital as the present value (to be discussed) of an individual’s future earnings. As indicated
by its name, the human capital consists of individual assets such as knowledge, skills, and other characteristics (less genetic
factors) contributing to the individual’s ability to produce. Only assets such as education, work training, and health that have
been obtained by investment contribute to human capital.

The productivity losses associated with death, illness, or injury using human capital method is the ‘market value’ of that
individual’s future contribution to production if s/he had continued to be in full health. In using this method, the underlying
assumption that the human capital of an individual equals the individual’s expected future productivity is rather unrealistic in
many settings. One issue arises when we use future earnings as a proxy for future production. In many cases future earnings
do not reflect future production. Furthermore, the human capital method is not consistent with general welfare economics
since it does not take into account the value of leisure time and other activities. Besides, the method has been criticized
because of the underlying assumption that a worker cannot be replaced even if the unemployment rate is significantly high.
This method would in this respect overestimate the value of forgone production (Johansson 1995, Mincer 1958, and Pauly
1996).

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2) Friction Cost Method

Being raised as an alternative approach to the human capital method, friction cost method estimates the value of human
capital as another worker from the unemployment pool replaces the present value of a worker’s future earnings until ill and
absent worker returns or is replaced. Consequently, the friction cost is restricted to the short-term consequences of illness,
injury, or premature death. This short-term is called the ‘friction period’ and is defined as the period needed to replace the
sick or impaired worker. The length of the period depends on the general unemployment level, the efficiency of the matching
process between job seekers and vacancies, as well as age, sex, and education.

The loss in human capital will be more or less the same in the short-term perspective. However, the friction cost method
will result in a cost estimate lower than the human capital method in the long-term perspective. Since the friction cost
method assumes that illness, injuries, or premature death will not affect the total productivity following the friction period,
the controversial conclusion from this will suggest that illness, injuries, and premature deaths would reduce the total

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3) Willingness to Pay Method

The willingness to pay (WTP) method measures the amount an individual is eager to pay in order to reduce the
probability of illness or mortality (Hodgson and Meiners 1982).

There are various methods of determining an individual’s

supporting and overhead activities that need to be shared among the user units. For this reason, it has been suggested to substitute the term
indirect with ‘productivity costs’ which are associated with morbidity and mortality (Gold et al. 1996).
willingness to pay, including surveys, examining the additional wages for jobs with high risks, examining the demand for products that leads to greater health or safety, and other related methods (Hirth et al. 2000). They are collectively called conjoint analysis, and contingent valuation method (CVM) is the most commonly used among conjoint analysis methods. The purpose of CVM is to elicit utility and finally determine an individual’s maximum WTP for some good that usually does not have a market price (e.g., health improvement) through hypothetical survey questions.

4) Advantages and Limitations of the Three Methods

The human capital method is the most common approach used to calculate the indirect costs. A criticism of this approach is that certain groups are assigned a higher value than others, which may create a statistical bias. Because the human capital approach uses wage rates and employment rates (often by age or sex), certain groups with less earnings are consequently assigned a lower value (Drummond 1992, Hodgson and Meiners 1982, Hodgson 1983). The willingness to pay approach, usually with higher estimates of the value of life than the human capital approach (Hirth et al. 2000), attempts to ameliorate these problems. However, this approach is often difficult to implement in cost-of-illness studies. For specific diseases, extensive surveys of people’s preferences are needed to conduct WTP analysis such as CVM or DCE (discrete choice experiments), although the results heavily depend on people’s responses to very specific hypothetical questions about their willingness to avoid certain illnesses (Rice et al. 1990). Thus, the willingness to pay method is often not feasible for a cost-of-illness study.

People who support the friction cost method usually criticize the human capital method for overvaluing the indirect costs, claiming that the productivity losses are often eliminated after a new employee is well-trained enough to replace the former ill or disabled employee. However, the friction cost method is rarely used because it requires extensive data to estimate only the losses during the friction period. Valuation of the productivity losses is further complicated by firms’ use of internal reserves of labor during the friction period, which lowers the estimates of losses even more but can be difficult to calculate (Pagano et al. 1999, Rothermich and Pathak 1999).

The choice of method, however, can result in a dramatic effect on the estimates of indirect costs. A study by Goeree et al. (1999) of the productivity costs of schizophrenia found the productivity costs using the human capital method to be nearly 70 times those using the friction cost method. Because of the potential for such wide variation, it should be clear which method is used to estimate indirect costs, especially with the impact indirect costs can have on the total costs of illness.

C. Intangible Costs

Intangible costs, the third cost category, are non-market effects associated with changes in the quality of life of individuals and caregivers as a result of the illness. They traditionally refer to patients’ psychological pain, grief, and suffering but have seldom been quantified in monetary terms in COI studies due to its measurement difficulty.
Clabaugh and Ward (2008) conducted a systematic literature review of 52 COI studies in U.S. to examine the methods used by researchers.\(^7\) They focused on approaches used in literature in terms of perspective, scope, components of care analyzed in the literature, data sets, and valuation approaches used for direct cost and concluded that ‘analyzing cost of illness presents useful opportunities for communicating with the public and policy makers on the relative importance of specific diseases and injuries.’ However, they also found that ‘COI studies employ varied approaches and many articles have methodological limitations. Without well-accepted standards to guide researchers in their execution of these studies, policymakers and the general public must be wary of the methods used in their calculation and subsequent results.’

The COI methodology has been criticized over the years for a variety of reasons. For example, it takes into account only the costs of resources but not the utility gain of reducing the illness. The approach does not compare alternative uses of resources and therefore may not adequately measure opportunity costs. It does not define choices and cannot help directly in making them. It can place over-reliance on average rather than marginal costs, which can lead to a systematic overestimation of the size of the burden. Furthermore, some of the methods used for calculating indirect costs are questionable.

**Measuring Burden of Disease**

Health outcomes are typically quantified using measures of mortality (for example, lives or life years lost) or morbidity (for example, lost quality of life). Two common measures that combine and standardize outcome measures are the quality-adjusted life years (QALYs) and disability-adjusted life years (DALYs).

QALYs tend to be used to illustrate health benefits. They are life years adjusted by a preference-based quality weight. The quality weight is measured on a preference scale, usually a utility scale, where full health has a score of 1.0, being dead has a score of 0.0, and states worse than being dead can have negative scores.\(^{15}\) A variety of methods determine the social preferences for utility values, including the standard gamble, the person trade-off, the time trade-off, Health Utilities Index, EuroQol EQ-5D, and quality of well-being.

QALYs are increasingly being used in population health. In this field QALYs are used to monitor, report, and compare the health of communities, and countries. WHO is now promoting this approach worldwide, although it calls its version disability-adjusted life years (DALYs).

The DALY is a utility measure that represents the loss of one year of healthy life, so illustrates the negative impact of a condition. DALYs are commonly used to quantify disease burden at a population level. A DALY is a summation of two other health gap indicators: years of life lost (a.k.a. potential years of life lost) and years lost to disability. Years of life lost estimates the social burden of fatal health outcomes. It is calculated by subtracting the age at death from the life expectancy remaining sometimes considered as comprising tangible and intangible costs. In disease-specific COI studies, the tangible costs are generally the comprising (direct) costs related to health care and the (indirect) costs associated with lost productivity and premature mortality. However, in studies of the costs associated with substance misuse, the direct costs include a wider range of social costs, such as the associated costs relating to social services; law enforcement and criminal justice costs; property destruction; and research, policy and prevention.

For example, if an individual lived for 10 years in full health, followed by 10 years in a health state with a quality weight of 0.5, followed by death, the individual would have achieved \(10 \times 1.0 + 10 \times 0.5 = 15\) QALYs. Now suppose with a new treatment the same individual could live for 10 years in full health, 6 years in a health state valued at 0.8, 6 years in a state valued at 0.5, followed by death. In this second scenario, the individual would have achieved \(10 \times 1.0 + 6 \times 0.8 + 6 \times 0.5 = 17.8\) QALYs. Note that although the treatment created only 2.0 additional life years (LYs), it created 2.8 additional QALYs. Of course, this will not always be the case. Sometimes the number of QALYs gained will be less than the number of LYs gained. The important point is that the number of QALYs gained captures both the change in quantity of life and the change in quality of life, and the number will, in general, be different from the number of LYs gained. For simplicity, the above example ignored discounting. In practice, it would be normal to discount the future years by an appropriate discount rate.
at that age. Years lost to disability measures non-fatal health disease outcomes. Years lost to disability are a severity adjusted with weightings similar to those used for the QALY.

Collectively, these two measures take into account the burden of both fatal and non-fatal disease states. Dollar values can then be put on lives and life years lost.

Approaches for COI Studies

COI studies can be described according to the followings:

1. Epidemiological data used: prevalence based and incidence based approaches;
2. Methods chosen to estimate the economic costs: top-down, bottom-up and econometric approaches;
3. The temporal relationship between the initiation of the study and the data collection: retrospective and prospective approaches.

A. Prevalence- vs. Incidence-based Approaches

The prevalence-based approach (the most commonly used) estimates the economic burden of a condition over a specified period, usually a year. The incidence-based approach estimates the lifetime costs of a condition from its onset until its disappearance (usually by cure or death), which refers to the new number of cases arising in a predefined period of time.

Because of the nature of long-term conditions (that is, being of a long duration, so requiring long follow-up periods), the prevalence-based approach is often the only practicable way to cost long-term conditions (Jefferson et al. 2000). This approach, however, may not quantify the long-term consequences of the condition (Kortt et al. 1998). Simply put, both approaches will generally be equivalent if the costs all occur in one year. If the costs extend past one year, however, incidence-based approach provides information about the cost of averting a case, whereas prevalence-based approach provides a snapshot of current costs.

It can be said that prevalence-based approach can be particularly useful when the aim of the study is that of:

1. Drawing decision-makers interest for conditions whose burden has been somehow underestimated. Because of the numerical differences between the prevalence and the incidence approaches, the first serves this purpose better than the incidence based approach.
2. Planning cost containment policies. This is because the study provides decision makers with a picture of the global burden and, more importantly, of the major cost components, that is the areas where cost containment policies would have the greatest impact.

Incidence-based approach is particularly useful when the aim is that of:

1. Considering preventive measures. Incidence-based approaches therefore provide an estimate of the savings that potentially accrue if the preventive measure is implemented.
2. Analyzing the management of the illness from the onset till recovery or death. The incidence-based approach allows for disease analysis staging thus showing how costs are distributed while the illness progresses. This could encourage for instance the development of clinical/therapeutic guide lines aimed at increasing the effectiveness and the efficiency of
both the management of the disease as a whole and of each single step of the clinical therapeutic pathway.

B. Top-down vs. Bottom-up vs. Econometric Approaches

Another distinction between the two approaches is that the incidence-based approach requires that the analysis to be performed on the ‘bottom-up’ basis to sum up the lifetime costs of illness. This, in turn, requires that input data be gathered at a level of detail much greater than that employed in the prevalence-based approach where, in general, the analysis is performed on the ‘top-down’ basis to allocate portions of a known total expenditure to each of several broad disease categories.

1) Top-down Approach

The top-down approach, also known as the epidemiological or attributable risk approach, measures the proportion of a disease that is due to exposure to the disease or risk factor (Bloom et al. 2001, Liu et al. 2002). The approach uses aggregated data along with a population-attributable fraction (PAF) known as epidemiological measure to calculate the attributable costs, which was developed by Morganstern et al. (1980). In this approach, the proportion of medical care for disease B attributable to disease A is measured as follows:

\[ PAF = \frac{PAF(\text{RR}_{BA} - 1)}{PAF(\text{RR}_{BA} - 1) + 1} \]

where \( PAF \) is the prevalence rate of disease A and \( \text{RR}_{BA} \) is the unadjusted relative risk of disease B for people with disease A, compared with those without disease A. However, this equation applies only in limited cases where other factors do not affect the association between diseases A and B. Commonly, confounding variables (e.g., age, sex, and other similar variables) may be related to both disease A and disease B. If not controlled for, the confounding variable causes an upward bias in the relative risk and consequently the PAF. Similar to confounding, effect modification exists when ‘a third unknown variable’ affects the association between disease A and B through interaction. For example, as generally known, age is correlated with diabetes and heart disease, but as one gets older the effect of diabetes on heart disease gets stronger. Not only are older people more likely to have diabetes and heart disease (confounding), but as one gets older diabetes is more likely to lead to heart disease (effect modification). As this example shows, it can sometimes be difficult to tease apart how the additional variable affects the association between the two illnesses.

2) Bottom-up Approach

In the bottom-up approach, the cost estimation can be stratified into two steps. The first is to estimate the quantity of health inputs used and the second is to estimate the unit costs of the inputs used. The costs are then estimated by multiplying unit costs by the quantities. The major difficulty arises here since the data needed and available will vary with the scope of the study. In a comprehensive study, there are usually national surveys which provide reliable data on medical care utilization. In a more limited study, the investigator may have to collect data which may be a disadvantage even though in doing so he may find more reliable estimates of the different cost components than in nationally collected data.

An often claimed advantage for comprehensive studies is that by allocating total national expenditures among the major diagnostic categories, one can avoid the risk that the sum of treatment costs of individual diseases – estimated through the bottom-up approach – is greater than total health care expenditure in a given country (Drummond 1992). However,
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The top-down approach is likely to present misallocation of costs. Firstly, because using the national health care expenditures may lead to either under or overestimate total direct costs. Second, the exclusion of cost categories that are not included in national health care expenditures (i.e. transports, informal care) also biases the estimates of costs by disease category since different disease categories may absorb different non-health costs. Lastly, another problem with this method is that all costs are attributed to the primary diagnosis. This is a serious problem if we consider that a relevant part of all hospital discharges involve patients with multiple diagnoses.

3) Econometric Approach

The econometric (a.k.a. incremental) approach estimates the difference in costs between a cohort of the population with the disease and a cohort of the population without the disease. The two cohorts are matched, usually through a regression analysis, by various demographic characteristics and the presence of other chronic conditions. Within the econometric approach, there are again two methods of estimating costs: a mean differences approach and a multistage regression approach. The mean differences approach compares the mean costs incurred by each of the two cohorts to determine the incremental difference attributable to the disease of interest. Studies using the mean differences approach sometimes only provide the cost per case of the disease of interest, rather than a total cost estimate.

A multiple-stage regression is typically run if there are a large number of cases with zero costs and a few cases of very high costs. The incremental cost of the disease is measured by comparing the regression estimate with the disease dummy variable turned on to the regression estimate with the disease dummy variable turned off. The multiple-stage regression often uses a two-stage method in cost estimation, although there are many other possible variants of the multiple-stage regression. The approach involves estimating the likelihood of an individual receiving any care and then the excess cost of care if care is received.

Because the econometric approach measures the incremental difference between persons who have the disease and those who do not, it often only requires one dataset. The top-down approach usually requires data on the costs as well as on the relative risks, which are needed to calculate the PAFs. The bottom-up approach often requires data from multiple sources for the unit cost and utilization rate of the different types of care. While each method is valid, the econometric approach has the advantage of requiring less data.

C. Retrospective vs. Prospective Approaches

COI studies can also be prospectively or retrospectively performed depending on the temporal relationship between the initiation of the study and the data collection. In retrospective approach, all the relevant events have already occurred when the study is initiated. This means that the process of data collection must refer to data already recorded. Conversely, in prospective approach the relevant events have not already occurred when the study is initiated. This means that the process of data collection needs to be done by following-up the patients over time. Prevalence- and incidence-based COI studies can be both performed either prospectively or retrospectively.

The major advantage of retrospective approach is that they are less expensive and time consuming than those performed prospectively because all relevant events have already occurred. Thus, the retrospective design is particularly efficient for the investigation of diseases that have a long duration requiring many years to reach the relevant end points. Retrospective COI studies can only be carried out when sufficient data are available, which is not often the case. In prospective approach, however, analysts can design data collection systems they want. Data on the illness and the consumption of health care...
resources are gathered by the analysts on the basis of purposely designed questionnaires submitted to patients and/or providers. This allows for complete data as every action/intervention is registered. In studying a disease with relatively long time span, COI study adopting a prospective, incidence-based approach would be enormously costly and time consuming, where retrospective COI studies may be more efficient in measuring the burden of illness.

**Perspectives of COI Studies**

A COI study may be conducted from several different perspectives, each of which includes slightly different costs. These perspectives may measure costs to society, the health care system, third-party payers, businesses, the government, and participants and their families (Rice 2000, Luce et al. 1996, Hodgson 1994). Each perspective provides useful information about the costs to the particular group. Table 1 presents the costs included in each perspective.

**Table 1. Costs Included in COI Studies by Perspective**

<table>
<thead>
<tr>
<th>Perspective</th>
<th>Medical Costs</th>
<th>Morbidity Costs</th>
<th>Mortality Costs</th>
<th>Transportation/ Nonmedical Costs</th>
<th>Transfer Payments</th>
</tr>
</thead>
<tbody>
<tr>
<td>Societal</td>
<td>All costs</td>
<td>All costs</td>
<td>All costs</td>
<td>All costs</td>
<td>-</td>
</tr>
<tr>
<td>Health care system</td>
<td>All costs</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Third-party payer</td>
<td>Covered costs</td>
<td>-</td>
<td>Covered costs</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Business</td>
<td>Covered costs (self-insured)</td>
<td>Productivity losses (presenteeism/ absenteeism)</td>
<td>Productivity losses</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Government</td>
<td>Covered (Medical Aid)</td>
<td>-</td>
<td>-</td>
<td>Criminal justice costs</td>
<td>Attributable to illness</td>
</tr>
<tr>
<td>Participants and families</td>
<td>Out-of-pocket costs</td>
<td>Wage losses/ Household production</td>
<td>Wage losses/ Household production</td>
<td>Out-of-pocket costs</td>
<td>Amount received</td>
</tr>
</tbody>
</table>

Source: Luce et al. 1996.

COI studies can be conducted from different perspectives. That is, impacts and costs can be assessed from the perspective of the health system, the individual, or the society. In general, the broader societal perspective is preferred, because the impact of a condition is not solely on the individuals or organizations directly involved. The societal perspective can detect ‘cost shifting’ between sectors and account for alternative resources used outside the health sector (Byford and Raftery 1998). However, the individual perspective may be appropriate if there is a lack of societal consensus on the effect of the condition. Aggregating individual preferences can be a theoretical and practical challenge (Byford and Raftery 1998, Goetzel et al. 2004).

Researchers might estimate the more general societal costs but also include the more specific costs to the government. Although other purposes may require different perspectives, the societal perspective is the most comprehensive because it includes all direct medical costs and indirect costs for all members of the society. It does not include transfer payments, such as Medical Aid benefits paid to individuals because they only represent a shift in resources, not a use of them. The societal perspective is often favored because it allows a complete analysis of all of the opportunity costs attributable to a disease and is recommended for cost-effectiveness analysis by Gold et al. (1996). The societal approach, however, requires the most data,
making it difficult to use in certain cases. This is especially true with less common diseases, where data are more limited. In these situations, data from a third-party payer may be the only reliable data available, in which case the societal approach is clearly not feasible. Because of the relatively larger range of costs, the societal and health care system perspectives inevitably tend to result in higher cost estimates than the other approaches.

The perspective of the cost-of-illness study should be made clear because each includes slightly different costs. While the societal perspective is the most comprehensive, the purpose of the study drives which perspective should be chosen. More comprehensive studies may also divide the costs by stakeholder to allow analysis from multiple perspectives, which may be especially relevant for public policy.

**Present Value With Discounting**

Discounting is an economic method that captures an individual’s preference for income today rather than income in the future. This time preference is often explained by the opportunity cost of interest. Income earned today can earn interest through investment. For example, given an interest rate of 3 percent, a payment of $100 today is worth more than the same payment in one year because $3 of interest can be generated if the payment is received today. Discounting allows us to calculate the present value of payments (or costs) that occur in the future. The present value of $100 received \( n \) years in the future when the discount rate (which is closely related to the real interest rate) is \( r \) is given by the formula of:

\[
pV = \frac{\text{Payment}}{(1 + r)^n}.
\]

Discounting is relevant for direct and indirect costs that accrue past the first year. Numerous possible discount rates can be used to discount future costs, with each representing a slightly different approach. The discount rates range from zero percent to 10 percent. Gold et al. (1996) suggested a cost-effectiveness analysis discount rate of 3 percent. Given that cost-of-illness studies can provide a basis for cost-effectiveness studies, the 3 percent discount rate represents a good starting point. Other discount rates can be applied to determine their effect on the cost estimates.

**Conclusion**

Cost-of-illness studies can be a good economic tool to inform decision makers if it is considered from another perspective. COI is a descriptive study that can provide information to support the political process as well as the management functions of multi-level health care organization. To do that the design of the study must be innovative, capable of measuring the true cost to society, to identify the different subjects who bear the costs and to explain cost variability. Observational studies—either incidence-based or prevalence-based, prospectively or retrospectively designed—with a bottom-up approach and with the measurement of costs based upon accounting principles can fulfill these goals and are therefore put forward as the studies that can interpret the decision makers needs better that the traditional ones.

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**Note:** In Korea, 5% of discount rate is commonly used in most cases.
Appendix. Examples of Costs Associated with Health Outcomes

DIRECT MEDICAL COSTS
- Institutional inpatient care
  - Terminal care
  - Hospice
  - Hospitalization
  - specialized unit (ICU, CCU)
  - Nursing home
- Institutional outpatient service
  - Clinic
  - Emergency room
- Home health care
- Physician services
  - Primary care physicians
  - Medical specialists
  - Psychiatrists
- Ancillary services
  - Psychologists
  - Social workers
  - Nutritionist
  - Physical therapy
  - Ambulance
  - Volunteer
- Overhead allocated to technology
  - Fixed costs of utilities
  - Space and storage
  - Support services:
    - laundry, housekeeping, admin
    - Capital costs (depreciation)
    - Construction of facilities
    - Relocation expenses
    - Device or equipment cost
- Variable costs of utilities
- Medications (prescription and non-proscription)
- Drug costs
- Treating side effects of toxicity of medications, prophylaxis of side effects, ordering and inventorying preparation
- Training in new procedures
- Dispensing and administration
- Monitoring
- Devices and applications
  - Prostheses, glasses
  - Hearing aids
  - Ostomy supplies
  - Hypodermic needles, home urine and blood testing equipment
  - Ordering and inventorying
- Drugs, supplies, devices provided by household
- Research and development
  - Basic and applied research
- Diagnostic test
  - Community screening program
  - Consumable supplies, personnel time, equipment
  - Imaging
  - Laboratory testing
  - Costs of false-positive and false-negative cases
  - Treating sequelae of undetected disease
- Treatment services
  - Surgery, initial and repeat
  - Recovery room
  - Anesthesia services
  - Pathology services
  - Acquisition costs for organ transplant
  - Consumable supplies, personnel time, equipment
  - Treatment of complications
  - Blood products
  - Oxygen
  - Radiation therapy
  - Special diets
  - Prevention services
  - Screening space
  - Vaccination, prophylaxis
  - Disease prevention in contacts of known cases
  - Rehabilitation
  - Training and education
  - Health education
  - Self-care training for patients
  - Life-support skills for general population

DIRECT NONMEDICAL COSTS
- Public awareness programs
- Social services
  - Family counseling
  - Retraining, re-education
  - Sheltered workshops
  - Employment services
- Program evaluation
- Monitoring impact of program or technology
- Data analysis
- Repair of property destruction
  - (alcoholism, psychiatric illness, drug addiction)
- Law-enforcement costs
- Care provided by family and friends
- Transportation to and from Medical services
- Time spent by patient seeking medical services
- Childcare
- Housekeeping
- Modification of home to accommodate patient

INDIRECT COSTS
- Change in productivity resulting from change in health status
- Morbidity
- Mortality
- Lost productivity while on the job
- Absenteism
- Foregone leisure time
- Time spent by family and friends attending patient (hospital visitations)
Reference


