Cost Effectiveness Analysis of an Immunization Program: A Brief Insight

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Abstract

Economic evaluation refers to the process of systemic identification, measurements, and valuation of the inputs and outcomes of two alternative activities and the subsequent comparative analysis of these. Different economic evaluation methods include Cost-benefit analysis (CBA), Cost-effectiveness analysis, Cost-minimization analysis, and Cost-utility analysis. In developing countries with limited resources, every health program cannot be implemented equally well. We have to choose one over another. It not only saves resources but also saves time as well. For doing so, we must analyse its effectiveness justifying its cost. Monetization of health outcomes is not an appropriate tool to evaluate the effectiveness of a health program. For doing so, we use Cost-effectiveness analysis as a method of economic analysis in order to compare the relative cost and effectiveness of two or more health programs. CEA methods are developed and refined by CHOICE (Choosing Intervention that is Cost Effective). Thus it helps the economists in decision making, i.e., making choices between alternatives. However, vaccines in animals are developed using the Cost-Benefit ratio.

Keyword: Cost-Effectiveness; Vaccines, Health.

Introduction

Cost-effectiveness analysis (CEA) is a method of economic analysis that compares the relative cost and effectiveness (outcomes) of two or more alternatives. It is used in health science where it is inappropriate to monetize health outcomes. This is done because we have limited time and resources to provide every possible intervention, so we have to choose one intervention that provides the most benefits. This is called opportunity cost for choosing one; we have to forego the other.

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Methods used in Cost-Effectiveness Analysis

Cost-Effectiveness Analysis (CEA) Methods have been refined and developed by CHOICE. The number of healthy life years, measured in DALYs (Disability Adjusted Life Years), is calculated in a population with no specific intervention, based upon input parameters like disease incidence, remission, cause-specific and background mortality, and health status evaluation. After implementing the intervention, DALYs are calculated using parameters that reflect the intervention's impact or a combination of interventions. A systemic review of previous interventions is made for calculating the Effectiveness data for the specific intervention, where available. The difference in DALYs gained by the population with intervention forms the denominator of CEA, whereas the cost

of intervention forms the numerator of CEA. Here, cost refers to net cost. Sensitivity analysis is carried out on parameters whose value is not precisely known. By calculating the results, we get guidance on prioritizing intervention. Health gain estimates are often calculated with different levels of coverage for intervention (80%, 95%, so on). Sets of interventions that interact in terms of effectiveness are considered together.

Methods of Analysis

ICER stands for incremental cost-effectiveness ratio. It is a statistic used in CEA to summarize the cost-effectiveness of a health care intervention. It can be calculated by dividing the difference in cost between two possible interventions by the difference in their health effects. In other words, it can be written as ICER = (cost A-cost B)/ (Life years A-Life years B).

Need of Comparison

While deciding on implementing a health program, we need to compare it with a different intervention (option B) to think of the incremental cost and Life years. This can be explained from an example, suppose a person takes Drug A, and the cost is Rs 8000, and the person lives 40 yrs we cannot say CEA is 8000/40=200, because without that drug the person still lives 38 yrs. In order to prioritize one intervention, we must compare it to another as by doing so; we can indeed access it; hence it has to b comparative.

The ICER numerator is Net Cost that's different from the cost of implementation, which can be calculated by deducting averted heath care treatment costs such as hospitalization, pharmaceutical costs (cost offsets) from gross intervention cost. However, it is hard to compare health events ex: "measles episode prevented "to "added life year." That is why metrics like DALYs and QALYs are used. DALY stands for Disability Adjusted Life years. It is a measure of the overall disease burden. It considers both factors: healthy life lost due to premature mortality and years lost productive life due to disability. QALY stands for Quality-Adjusted Life Years. It measures disease burden with both quality and quantity of life lived.

Calculation of DALYs and QALYs

For calculating DALYs, morbidity and disability weights are used, whereas for calculating QALYs, utilities are taken into consideration. The disability weight is how much people are disabled by illness, and utility signifies how good they feel. Both DALYs and QALYs on a scale range from 0-1. So a disability weight of 0 signifies that there is no disability and the person is fully healthy. Conversely, utility 1 signifies good health. A QALY value equal to 0 signifies death, whereas one refers to perfect health. If an intervention provides perfect health for one additional year, it will produce 1 QALY; likewise, an intervention providing an extra 2year of life at a health status of 0.5 would be equal to 1 QALY. This is related to cost, e.g., if one intervention provides an additional 0.5 QALY and the cost of treatment per patient is 10,000.

Cost per. QALY is 20,000. DALY is the sum of life years lost (YLL) due to premature mortality and years lived disability (YLD). It can be written as DALY= YLL+ YLD. Years Lived in Disability can be calculated as YLD =I*DW*L where I refers to several incident cases in the population, DW is a disability of a specific condition, and L is the average duration of the case until remission or death. Life Years lost can be calculated by the formula, YLL= N*L, where N refers to the number of deaths due to condition and L is standard Life expectancy at the age of death. So now, ICER can be denoted as ICER=(Added cost)/ (DALYs averted). It can also be written: (net cost A - net cost B)/ (DALYs averted A-DALYs averted B).

Sensitivity Analysis

As the economic models tend to report a single summary, such as incremental cost per incremental life year, the interpretation of those results will largely depend upon the level of confidence or uncertainty in various factors. An example can explain this that if a reviewer of a model suspects that one particular value is too high in the model, in this case, the reviewer may wish to know the likely impact of using an alternative value, such an exercise would involve examining the sensitivity of the model to changes in inputs. This can be done in the following ways: one-way sensitivity analysis, Multi-way sensitivity analysis, and probability sensitivity analysis. One Way sensitivity analysis is the simplest form of sensitivity analysis in which, varying one value in a model by a given amount, the impact of change in the model's results can be analyzed. It helps the researcher determine which parameter has the more significant influence on the model. Multiway sensitivity analysis is necessary to examine the relationship of two or more different parameters changing simultaneously. This is done

by multiway sensitivity analysis. It is a more complex method than the previous one as more parameters are involved.

Probabilistic Sensitivity Analysis

In probabilistic sensitivity analysis, computer software (crystal-ball) is used to assign a distribution to all parameters rather than assigning a single value to each parameter. Each time a model is run, the software will select one value for each parameter and record results randomly.

Timing in CEA: Horizon and Discounting

For analysis, we generally try to contemplate and bring a present, past, and future events into a single time frame. The analytic horizon helps to analyze how far the modeling looks into the future. It is significant in analysis because by keeping the horizon too short, one will miss important delayed effects, and too long a horizon may be distracting and introduce error due to faulty long-term projection. Discounting in CEA is meant to adjust future costs and health effects to their present values. It can be calculated by using a standard annual discount rate generally @3%, [present value= future value / (1+r) ^n; where n= years from now.

Relevance in Policymaking

If one uses DALYs averted or QALYs gained as outcome measures, GDP per capita is used as a threshold to determine if intervention under evaluation is cost-effective or not. An intervention is considered highly cost-effective if ICER is less than GDP per capita and cost-effective if ICER is between one to three times GDP per capita. If ICER is greater than three times GDP per capita, then the intervention is not considered cost-effective. (WHO 2015, WHO 2011). CEA is a relatively new tool and is still being refined. In recent years it has been used extensively in vaccination policy. This method also holds significant potential relevance to the environment and health decision making as policymakers are more familiar with assessment methods, and greater resources are directed to quantifying the health impacts of environmental hazards.

Economic Analysis of Animal Disease

CBA (cost-benefit analysis) has been the preferred tool for economic analysis rather than CEA in animal health. Animal diseases significantly impact livestock production through direct costs like deaths, morbidity, and decreased productivity and indirect costs like money invested in prevention and control measures. The economy plays an essential role in implementing a health program in the decision-making process. Economic analysis for a disease is often not available or rarely conducted in developing countries due to a lack of human resources capacity in the health system or veterinary services to conduct economic analysis. Economic analysis is a disciple that helps the supporting stakeholders assess whether a particular investment in the prevention or control of transboundary animal disease (TAD) is likely to result in an overall benefit for society and what the associated intervention may be. It is done in the case of animal diseases under FAO-developed guidelines.

Benefit-cost ratio

The Benefit-Cost Ratio for a health programme can be calculated by dividing the programme's net benefits by the programme's net cost. The result is a summary measure that states that Y dollars are saved for every dollar spent on program X. It is calculated before implementing a health programme/vaccination programme so far as livestock diseases are concerned.

Difference between CEA and CUA

Health effects are usually measured as life-years gained (LYG) or Quality-Adjusted Life Years (QALYs). An economic analysis in which LGYs are used is often referred to as Cost-effectiveness analysis. (CEA),with its parameter of interest being called incremental cost-effectiveness ratio (ICER), whereas analysis in which QALYs are used is called cost-utility analysis(CUA), and the resulting parameter is called Incremental cost-utility ratio (ICUR).

Difference between CEA and CBA

Cost-benefit analysis determines if an investment is a sound, ascertaining how much the benefits outweigh the cost. It is the basis for comparing investments based on the total expected cost and total expected benefits. Whereas by CEA, we can compare the relative cost and effectiveness in terms of health outcomes of two or more alternatives.

Difference between CEA and Cost-Minimization

Cost Minimization is used in pharmacoeconomics to compare the cost per course of treatment when alternative therapies have demonstrably equivalent clinical effectiveness.

Conclusion

In the present era of emerging and re-emerging Zoonotic viruses and drug-resistant pathogens, there is a surge of novel drugs and vaccine development; Cost-effectiveness analysis provides a valuable tool to economically judge the best lead candidate to proceed with based on the health outcomes. However, for animal health diseases, outcomes are measured in production for which a lead candidate is chosen. Thus, greater production over the cost implemented is beneficial and selected with limited availability. Thus cost-effectiveness is a valuable tool for decision making in drug discovery.

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