New Prediction Methods of Indicators and Costs Capable of Increasing the Efficiency of Pharmacoeconomic Studies for Health Decision Analysis

Cazarim MS[1*] and Einarson TR[2]

[1]*Faculty of Pharmaceutical Sciences of Ribeirao Preto, University of Sao Paulo, Ribeirao Preto, Brazil* [2]*University of Toronto, Toronto, ON, Canada*

[*]**Corresponding author:** Maurilio de Souza Cazarim, Faculty of Pharmaceutical Sciences of Ribeirao Preto, University of Sao Paulo, Ribeirao Preto, SP, 14040-903, Brazil, Tel: +55163315-4236; E-mail: maurilio.jf@gmail.com

Abstract

Like most of the resources we have in the world, health-care resources are also scarce. Thus, pharmacoeconomics is very important to aid health systems into this process. It is noteworthy that new methods are being created to improve pharmacoeconomic analysis efficiency. This paper brings comments about three new techniques incorporated in modelling to measure probabilities: Risk scale, Delphi method, and Bayesian statistics. They represent new methods that can provide the development of pharmacoeconomic studies with a better design due to shortening study time and complexity, ensuring robust results. In this way it should lead to resource savings and increased efficiency in pharmacoeconomic research.

Health Decision Analysis

Like most of the resources we have in the world, health-care resources are also scarce. Therefore the optimization of the use and efficiency of the allocation of these resources has been increasingly necessary and valued in the health area. Along with this reality of endurable resources pertinent to the health area, there are innumerable new health technologies being discovered, renewed, and proposed for incorporation into health systems. Hence, decision-making for the efficient delivery of health services has become increasingly complex, and that without the help of pharmacoeconomics, the difficulties are greater in carrying out actions that are capable of promoting health, while at the same time saving or optimizing resources [1,2].

Decision analysis becomes fundamental within this process, since it involves the systematization of rational processes to select or to base an alternative from several possibilities of choice. In short, it consists of the application of an analytical method that allows systematic comparison of the different possibilities. Some authors define certain steps for its construction that briefly, would be: Identify the specific decision; specify alternatives; chart the structure of analysis; specify possible costs, outcomes and probabilities; and perform the calculations. The structure of decision analysis can be drawn in different ways, one of which is much used in the health area being the decision tree, due to its better adaptation to the application of mathematical models for better outcomes and a broad view of temporal circumstances in the health of individuals [2-4].

Markov modeling is a mathematical model attributed to the analysis of pharmacoeconomic decisions for the purpose of designing health states and treatment paths, e.g. disease complications. This mathematical model has been widely used for chronic diseases, which constitute more complex outcomes over a long period of time. With the application of this model it is possible to attribute the transitions of health states over the years, called Markov cycles, which allows a projection according to the transition probabilities for the allocation of patients in different health states, with a defined time horizon. Each health state can be assigned a cost and then pharmacoeconomic analyses can be performed for different drugs, procedures or interventions [4,5].

When mathematical modeling is used in the methods of the pharmacoeconomic study, it is expected to find in the results outcomes that are only obtained in long-term studies, such as Years of Life Saved (YLS) and Quality-Adjusted Life Years (QALY). YLS represent the longevity of one population relative to another, be it an intervention group and a control group or even two groups treated with different drugs or procedures. QALY represent longevity, but associated with the quality of the years lived. Thus, the difference between the groups expressed by the years lived weighted by quality of life consolidate this indicator. YLS and QALY may come from a longevity analysis, but require follow-up of a cohort of patients and an appropriate study design, which would take a long time to study.

These outcomes are valuable for pharmacoeconomic studies, because the main outcomes for health are death and quality of life. When they are associated with studies of how randomized clinical trials and Meta-analyzes generate results capable of subsidizing decisions based on a high degree of evidence, it is very pertinent in health technologies assessment. It is worth noting that modeling corroborates in this context, since it allows optimization of the duration of pharmacoeconomic studies, fills the shortage of the results of long-term studies in the literature to obtain YLS and QALY indicators, and projects costs in pharmacoeconomics [2,6].

However, the great difficulty of pharmacoeconomic studies that work with projections and modeling is to obtain precise and coherent probabilities with the proposed analysis. Some methods are accurate, but they are time-consuming for research, which often makes research impossible, reduces the breadth of analyzes or the scope of the subject, and also hampers the ability to generate results. These are factors that do not sound very agreeable to the research funders, because they refer to loss of efficiency, and consequently loss of financial resources.

Some risk scales have been used, rather than life tables, to generate the probabilities within mathematical modeling for disease prediction over time. For example, the Atherosclerotic Cardiovascular Disease Risk Scale (ASCVD) measures the risk of cardiovascular disease incidence. Its score is generated as a percentage, which is defined as the percentage of risk that the patient has to present a cardiovascular disease over ten years [7].

This risk scale was published in the North American directive (American College of Cardiology/American Heart Association-ACC/AHA) in 2013 and differs from some scales used because it is more sensitive to the incidence of cardiovascular disease and because it is a calculation method that estimates the risk of a 100% chance for cardiovascular diseases in general, not only for coronary diseases. It allows both calculation of the scores for the total risk factors and also only the modifiable factors. For this, it considers the variables: age, sex, blood pressure, Total Cholesterol (TC) and its High-density Lipoprotein (HDL) fraction, as well as comorbidities such as hypertension, smoking and diabetes [7-9].

Different models are used to calculate transition probabilities in modeling, but the ASCVD scale represents a certain advantage over them. Observational studies need to be validated to provide their projection results, thus it is considered a separate study within pharmacoeconomic study, and it means more time to obtain the modeling result. The Framingham risk scale assumes its results based on a primary prevention study in a healthy population, evaluates only coronary heart disease, and classifies the risk in degrees based on the score, which is poor for probability calculation because calculated risk is not validated for different populations, considering ethnic differences (Figure 1).
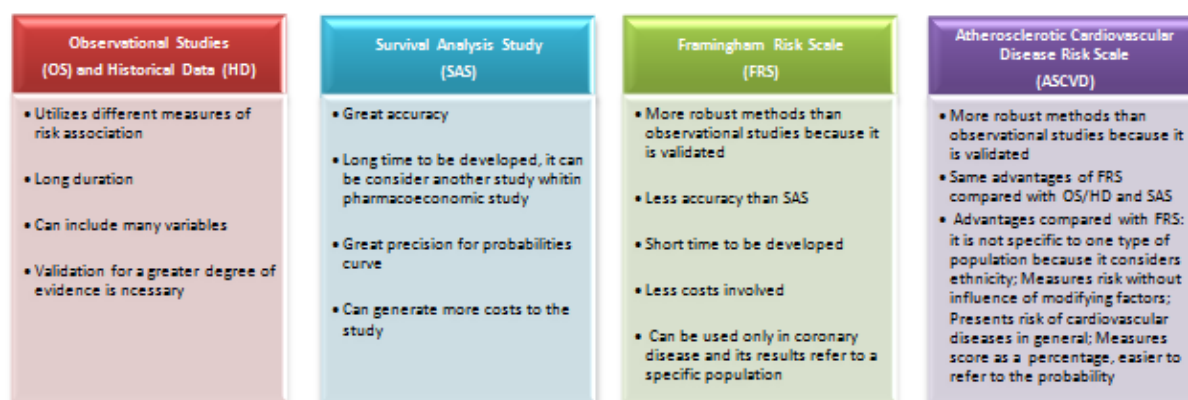

Figure 1: Difference between conventional methods and risk scale as techniques used to obtain the modeling transition probabilities in the example of cardiovascular diseases. ASCVD: Scale for the risk of atherosclerotic cardiovascular disease; CVD: Cardiovascular Diseases. Historical Data has contemplated the life table techniques.

The ASCVD cardiovascular risk scale allied to Markov modeling for the staging in different health states is able to provide a reduction in the time of prospective studies, and allows the independent study of results from the literature or from previous survival analysis and observational studies/historical data. Scales such as these are able to predict the risk over ten years and thus provide the probabilities of modeling. As the ASCVD instrument performs a projection of outcomes over ten years, it is not necessary to apply the 3% discount rate on outcomes, whether the study uses ten years for the time horizon, a rate normally requested in pharmacoeconomic study (Figure 2) [2,6].
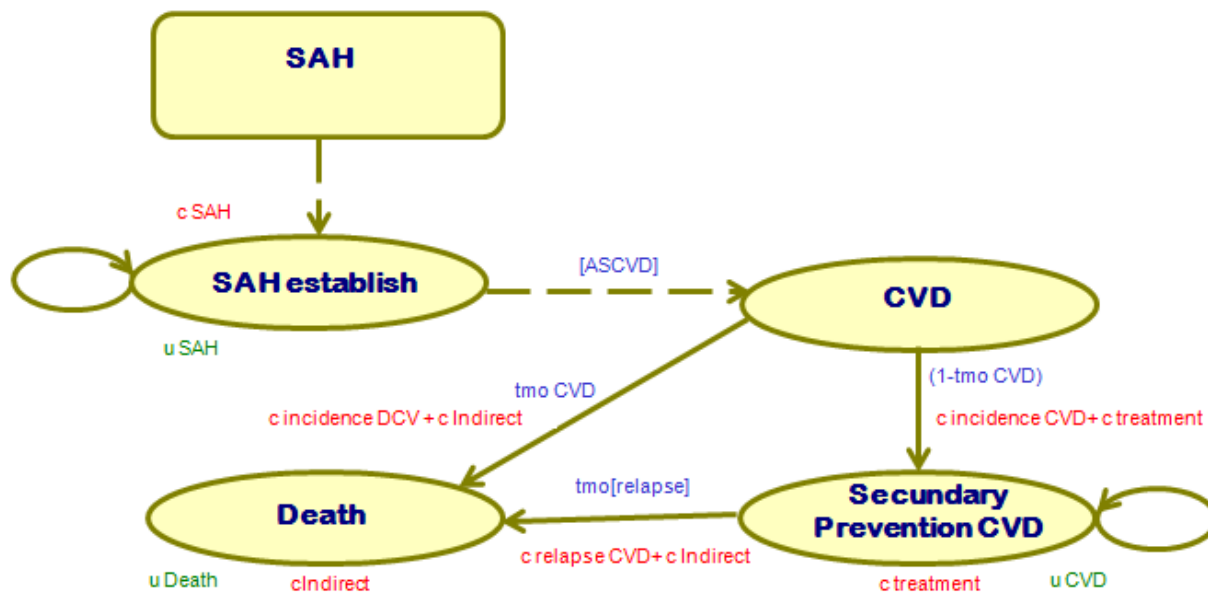
Figure 2: Markov modeling grounded in the ASCVD scale probabilities for predicting health conditions for cardiovascular diseases over ten years. c: Cost; CVD: Cardiovascular Disease; SAH: Sistemic Arterial Hypertension; ASCVD: Probability calculated by the score from ASCVD scale; tmo: Mortality rate; u: Utility.

There is another method of eligibility of probabilities for mathematical modeling of prediction of health states and has been a trend for pharmacoeconomic studies. The Delphi method, which is a model, uses a methodology recommended by the Methodological Guidelines for Elaboration of Assessment Studies of Medical-Assistance Equipment, which presumes that it should consider the opinion of specialists in a certain subject, when there is no unanimity of opinion due to the lack of scientific evidence or when there is little or contradictory information. After collecting the information of the specialists, the descriptive statistic of the data is performed, generating the result of the probabilities to be used in the modeling. This method has the same advantages as risk scales when compared to survival analyzes and observational studies/historical data, with the addition of allowing to collect probabilities for any branch of the decision tree that is destined for different health states, and not restricted only to the incidence of the disease. The scales are only able to provide probabilities for cardiovascular disease incidence [10-12].

There is also the emerging method in mathematical modeling for predicting health states in chronic diseases, which is Bayesian statistics. It allows a probabilistic prediction to be performed according to the course of the disease in time, through a priori data obtained from direct sources such as disease data or even from specialists. Thus, it is possible to place in the mathematical model the probabilities generated by Bayesian statistics to predict the allocation of patients in each health state over time. There are advantages of not having patient recruitment and patient follow-up because they are statistics in which the sample number does not exert a strong influence on the results, as in classical statistics [13].

Using clinical instruments such as the cardiovascular risk scale or Delphi method linked to Bayesian statistics as a probabilities precursor for modeling, has helped to improve the modeling in pharmacoeconomic studies. This fact can represent advances for cost-effectiveness studies. Furthermore, when these instruments are used in modeling along with epidemiological indicators such as the Number Needed to Treat and Relative Risk, and also link them to economic instruments, such as cash-flow, they contribute to confirm an efficient method to calculate return on investment in cost-benefits studies. It is noteworthy this new method can provide the development of pharmacoeconomic studies with a better design due to shortening study time and complexity, ensuring robust results. In this way it sound lead to resource savings and increased efficiency in pharmacoeconomic research.

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