An Approach to Clinical Decision Making

Nural Bekiroğlu, MD[1]; Bedrettin Yıldızeli, MD[2]; Onur Mergen, MD[3]

[1] *Marmara University Medical School, Biostatistics Department, İstanbul, Turkey*
[2] *Marmara University Medical School, Department of Thoracic Surgery, İstanbul, Turkey*
[3] *İstanbul University, Health Sciences Institute, İstanbul, Turkey*

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Clinical decision making is an extension of an evidence-based medicine concept and aims to compare the options for solving problems. It is a method especially useful in challenging clinical situations.

Recently decision trees have became important as predictive modeling methods in health sciences. Physicians are frequently faced with situations where they have to decide which outcome is more likely and then they have to evaluate this probability with all the involved risks and benefits, discuss the options with the patient and decide on an optimal approach. Although the optimal approach is necessary and to the best interests of the patient, the costs associated with this medical care need also be taken into account through a cost-effectiveness analysis (2,7). The aim of this study was to reach an optimal approach which also takes into account the related costs in clinical decision making for patients who have a non-small-cell lung cancer.

Methods

The components of making a decision are (2,5):

Defining the problem, alternative actions and possible outcomes:
The components of the decision tree representing the branches have to be designed and defined. The point of focus on the branch is called a *node*. Nodes are identified by either a square which is called decision node or a circle which is called chance node.

Determining probabilities:
The decision tree has to be developed by assigning a probability for each branch and each chance node.

Deciding on the value of the outcome:
A value or utility has to be assigned to each outcome. The outcomes may be *objective probabilities* such as costs, number of years of life or other variables which have inherent numeric values or *subjective probabilities*. In this case the investigator has to find a way to assign a value to the outcome. This process is known as *assigning a utility* to each outcome.

Thus the actual analysis of the decision tree combines the probabilities of each action with the utility of each so that the optimal decision can be made at the decision nodes. The decision tree is analysed by folding back the tree or by a process known as calculating the expected utility (EU). Folding back the tree begins with the outcomes and works backward through the tree to the point where a decision must be made.

A decision making analysis was applied to a non-small-cell lung cancer model (mediastinal metastases) by using TreeAge software.

Results

The example: For patients who have a non-small-cell lung cancer, a physician will decide whether to apply mediastinoscopy or not. This decision will be made according to the computed tomography (CT) results. If mediastinoscopy has been performed, then the physician will have to decide in favor of surgery or radiation therapy (Figure 2).

- defining the problem, alternative actions and possible outcomes (3,6,8): (Figure 1)

- determining probabilities (1,3,6):

prior prob. of mediastinal metastases:	0.25
CT sensitivity:	0.60
CT specificity:	0.77

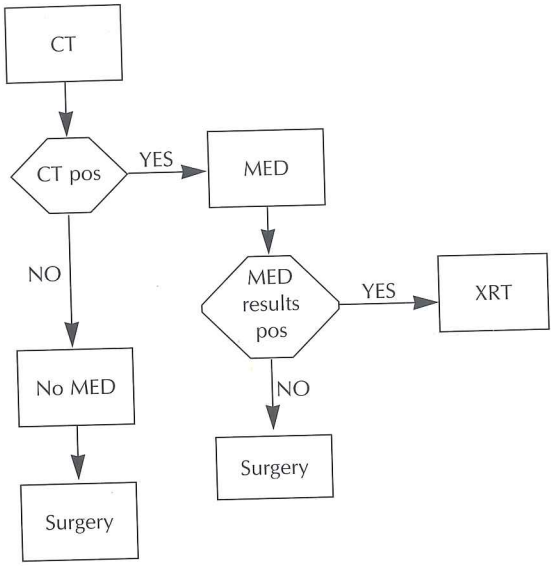

Figure 1. *Defining the problem, alternative actions and possible outcomes.*

Mediastinoscopy sensitivity:	0.85
Mediastinoscopy specificity:	0.995
Mediastinoscopy mortality prob.:	0.0001
Surgery mortality prob.:	0.02
Radiation therapy mortality prob.:	0.01

-deciding on the value of the outcome: See the chart in Figure 2.

Discussion

According to the chart given in Figure 2, the optimal path of the decision tree is; when CT is applied to a patient with non-small-cell lung cancer, there is a 67.7% probability that the CT result will be negative and mediastinoscopy will not be preferred in this case. Surgery is a better choice than radiation therapy with a probability of 67.7% and the cost of this path is approximately ~$1700. (2.750.000.000 TL).

On the other hand, there is a 32.3% probability that the CT result will be positive. In this case mediastinoscopy will be preferred. When the mediastinoscopy result is positive (39.8%) radiation therapy is found as the optimal choice with a probability of 12.8% and a cost of ~$4850 (8.000.000.000 TL). When the mediastinoscopy result is negative (60.2%), surgery is the optimal choice, with a probability of 19.4% and a cost of ~$2100 (3.500.000.000 TL).

Although the results obtained from the analysis of decision tree is very important and helpful for making a clinical decision, the decision tree analysis is often used during preliminary predictive modelling. Other modelling techniques such as neural network, artificial intelligence, memory based rea-

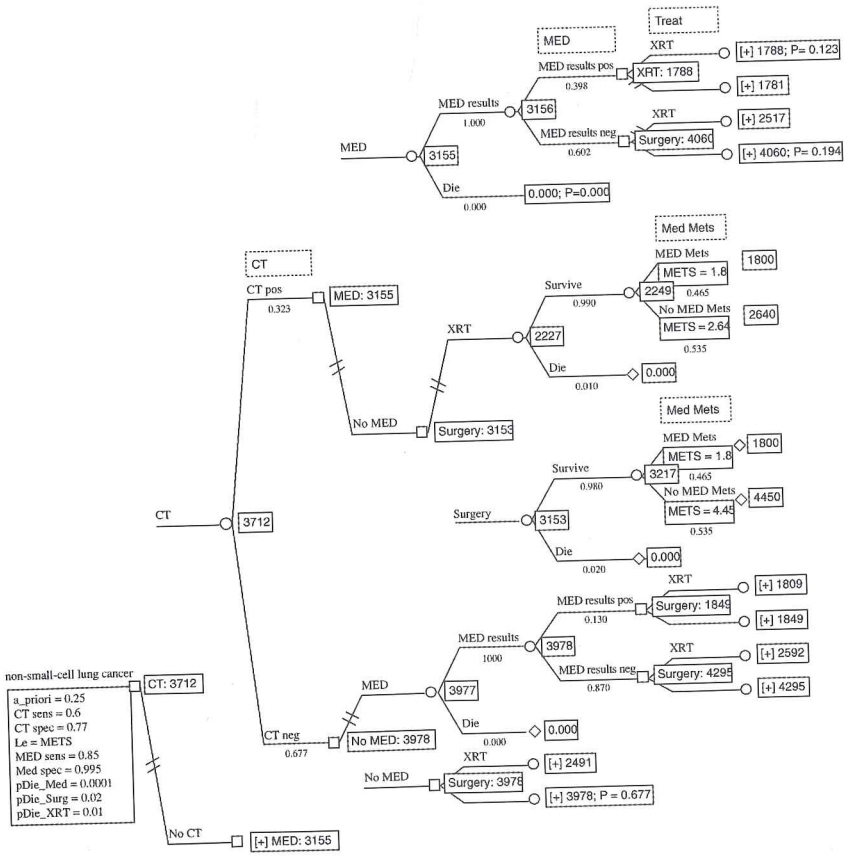

Figure 2. *Decision tree for non-small-cell lung cancer with probabilities and utilities included (6,8).*

soning and regression should also be used in association with decision trees to make more robust clinical decisions for solving more complex problems (2,4).

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