groups in order to maintain internal validity. This was not our question, and we did not think this step was necessary.

We agree with Ms Cameron that careful experimental design is required when doing clinical research on living subjects. In addition to being important to clinical research, it also is required when doing experimental pain research such as ours. We, like Ms Cameron, also look forward to seeing in the Journal a clinical study regarding the different effects of TENS applied to various sets of acupuncture points.

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References


Decision Tree Structure

To the Editor:

We were delighted to see Watts's recent paper on decision analysis (Physical Therapy, July 1989, pages 569-576) because we agree with Watts that this procedure is a useful one for difficult decisions. It requires practitioners to examine their beliefs and experiences and the research literature in a systematic way. Thus, it can be useful to clarify thinking and promote scientific practice.

The way Watts has presented decision analysis, however, includes some errors that we feel should be corrected. The first error relates to the general structure of a tree. Watts states that “choice points and chance points alternate with each other as time progresses...” (page 571). Alternation is not necessarily the case, as can easily be seen in postsurgical situations. If a patient opts for surgery (as opposed to some other treatment), he can survive or die (chance). If he survives, he can have an uneventful recovery or complications (chance). In this case, a decision node is followed in time by three chance nodes. The structure of the tree must follow the actual events as they occur over time, whether these events are chance occurrences or decisions.

The second error also relates to the structure of a tree. Branches of a decision tree should terminate with outcomes for each of the final options or chance occurrences. Their probabilities of occurrence should be included in the same way they are included in the earlier portions of the tree. Watts has made her terminal nodes decisions rather than outcomes. By ending on a decision, outcomes are ignored. In addition, by terminating each branch on a decision, the decision problem has not been solved; rather, more decisions have been added.

Last, one of the advantages of decision analysis is that a value for outcomes is incorporated into the model, whether that value represents patient preference, costs, or years of healthy life. This value is included at the terminal node of any path. One of the “rules” of decision analysis is that the probability of an outcome and its value must be independent.1,2 When the tree is averaged out and folded back, the value for each outcome is multiplied by the probability of the outcome. The products are summed at each chance node, and the process continues back to a decision node. In Watts's description, rather than terminating each path with an outcome with its attendant value, she has estimated a path probability. Because path probabilities include the probabilities at the chance nodes, when the tree is folded back, the probabilities are used at least twice, once at the terminal node and again at the chance nodes. More importantly, the value of the outcome is not included. Rather than performing a separate cost analysis as she has done,
Watts could include cost as one measure of the value of the outcomes.

Decision analysis is not a simple procedure. As anyone who has studied it will attest, there are many areas in which error can be introduced, most notably in the assignment of values of the outcomes. We would hope that the reader of Watts’s fine article will not attempt to perform a decision analysis based on that article alone. Further study is necessary under the guidance of skilled analysts. However, all physical therapists should be aware of the process and its advantages and disadvantages, and Watts is to be commended for her efforts to bring this technique to the attention of physical therapists.

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References


Author Response:

Karen Hayes and Becky Wojcik raise several important questions about decision analysis format. I agree that analyses need to reflect actual events and that sometimes this calls for decision trees that show several consecutive chance points instead of following the general convention of alternating chance and chance nodes. This lets us emphasize the different ways in which a patient’s response may evolve, and provides detail that may be essential for making a wise decision. The same sort of variation in general format may be equally valuable when we want to emphasize differences in action choices that involve a progressive series of procedures rather than simple, one-time actions. However, including this additional detail in decision-tree diagrams can confuse our clinical thinking rather than clarify it if the diagrams become so large and complex that they are difficult to follow.

Decision trees are similar in many ways to road maps. They guide our planning by making it easy to see the key choices we must make and the consequences that might accompany different actions. Detail that may be of critical importance in making one decision may be irrelevant and distracting for another. For example, if I am planning to drive from Boston to Chicago and want to select the overall route I will take, a large-scale map that shows only major towns and roads probably will be most useful. However, if I already know I want to cross New York on the major east-west toll road, but want to break my trip with a short visit to my niece in Rochester, I will need to consult a local map that shows even very small streets in that area before I can decide on the best route from the toll-road exit to her house. The important rule to follow in drawing decision trees is to include all events that are essential to consider in making the decision at hand, but to avoid true but unimportant details if they threaten to obscure our view of key relationships between choices and chances.

Hayes and Wojcik are correct in emphasizing that all paths on a completed decision-tree diagram should terminate with outcomes. The only completed tree presented in my paper is in Figure 3, and there all paths do lead to an outcome. This is shown by giving the number of successful outcomes expected among every 1,000 patients whose treatment and responses follow each path. Instead of showing just the successful outcome rate, the diagram could have two branches at the end of each path, one for a satisfactory and the other for an unsatisfactory end result. However, this would greatly increase the visual complexity of the diagram and simply state the obvious, because we know, for example, that a satisfactory rate of 600 per 1,000 must be accompanied by an unsatisfactory rate of 400. When useful analysis calls for a more complex set of outcome categories, this simplification in tree format becomes impossible. Figures 1, 2, and 4 in my paper show only parts of incomplete trees because their purpose is to illustrate specific components of format. However, in Figures 2 and 4 a few of the paths have been carried out all the way to outcomes. These show five different outcome categories, each represented by a different number or number-letter symbol. I apologize for not explaining in the figure legends that these are the same categories suggested in paragraph 3 on page 570 of my paper (1 = dead, 2A = surviving but severely impaired and with comfort or care problems, 2B = surviving and severely impaired but without comfort or care problems, and so on).

I am not sure I understand Hayes and Wojcik’s comments on assigning values to outcomes. They seem to suggest that
such valuation should be substituted in some way for cost analyses and combined from the very beginning with calculations of probabilities. This seems very unwise. The probability that a particular course of action will achieve a specific outcome, the value of that outcome to the patient if it is achieved, and the resources (costs) required to carry out the actions involved are three very different things. Each should be assessed with a different procedure, and each contributes in a different way to the final selection of a preferred strategy.

Because it was intended only as a brief introduction to a complex method, my paper described only the main features of the procedures for analyzing probabilities and costs. It did not attempt to deal at all with the demanding processes that may be needed to determine individual patients’ concerns and preferences in order to assess the personal utility or value of outcomes. Clearly, as Hayes and Wojcik point out, clinicians cannot expect to learn all they need to know about decision analysis from my short article. Fortunately, however, the references listed at the conclusion of my article provide clear and helpful guidance for the reader who wants to learn more. Of course it would be helpful to take a formal course on the method and to have advice from expert analysts as you begin trying to do analyses of your own. However, such courses and advisors are not yet readily available to many clinicians. Although the method is fairly complex, it is not mysterious. Particularly when several clinicians work together on a decision analysis, I believe it can help them exchange ideas, clarify their thinking, and improve their clinical judgement—even if the format used to summarize this work includes some technical errors. I hope then that readers who find this introduction to decision analysis interesting will try to learn more about it and that they will begin soon to attempt analyses of their own. Decision analysis is a useful, flexible, and forgiving tool for thinking about patient care, and it can be valuable in the hands of the novice as well as those of the expert.

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