Center for Health Decision Science
CHDS
Harvard T.H. Chan School of Public Health

Sample Solution

Teaching Pack: Building Decision Trees

Citation: Solution. Teaching Pack: Building Decision Trees. Center for Health Decision Science, Harvard T.H. Chan School of Public Health. https://repository.chds.hsph.harvard.edu/repository/collection/teaching-pack-building-decision-trees

CHILD SURGERY IN WAR TORN REGION

Note: This is a hypothetical clinical example created for pedagogical reasons and not based on data.

For children in an unstable war-torn region, there is limited medical and surgical care available and antibiotics are scarce. You have been asked to advise MSF on guidelines to manage a child presenting with a severe large complicated peritonsillar abscess in an unstable region. Based on the information provided, the probability of mortality with immediate surgery in this region (e.g., poorly equipped center, no blood bank, few supplies, and limited access to a trained surgeon) is 10%. Delaying surgery with temporizing oral antibiotics and drainage is the other option. There is a 30% chance this will fail, the child will decompensate and become even more critically ill, and urgent surgery will then be even riskier with a 15% mortality rate. There is a 70% chance, however, that delaying surgery will buy time and stabilize the child. Of the children who are stabilized, about 25% will recover with no sequelae. The other 75% will not completely recover, but you will have adequate time to evacuate the child to a safe zone, so that they can undergo surgery in better conditions. The child in this latter scenario could then undergo a surgical procedure with a much-reduced mortality rate of 3% due to access to appropriate care. Assume those who survive surgery fully recover.

a. Construct a decision tree and using the information you have been provided, conduct a baseline analysis of the two main alternatives. Calculate the expected value (i.e., probability of survival) for each option. Provided your objective is to maximize survival, which alternative would you choose? Show your work.
b. What do you think the results of your analysis will be most sensitive to? In other words, which variables will have the most influence, if they differ from the baseline assumptions? Provide a general answer without extensive calculations and explain your reasoning. (2-3 sentences).
c. Select two variables you think might be influential based on your reasoning in part b. Explore the influence of varying these to be higher and lower than your baseline value. Have your calculations confirmed the initial thoughts you had for part B? Did anything surprise you? (There are multiple acceptable answers).

SOLUTION. CHILD SURGERY IN WARN TORN REGION

a. Your first step is to organize the information you have been provided.

Recall key steps:

1. Identify key elements of the decision problem
2. Structure problem into a logical framework over time
3. Retrieve, synthesize, integrate information needed
4. Conduct a baseline analysis and evaluate uncertainty

Step 1. Identify key elements of the decision problem

Starting point: Child presenting with a severe large complicated peritonsillar abscess in an unstable region

Objective: Maximize the chance of survival

Alternatives:

Immediate surgery

Delayed surgery with temporizing oral antibiotics and drainage

Chances:

Probability of mortality with immediate surgery is .10

Probability of survival with immediate surgery is .90

Probability of success with delayed surgery is .70

Probability of recovery with no sequelae after delayed surgery is .25
Probability of not recovering after delayed surgery is .75

Probability of mortality with planned surgical procedure in safe zone is .03
Probability of survival with planned surgical procedure in safe zone is .97

Probability of failure (i.e., child decompensates, becomes critically ill) with delayed surgery is .30

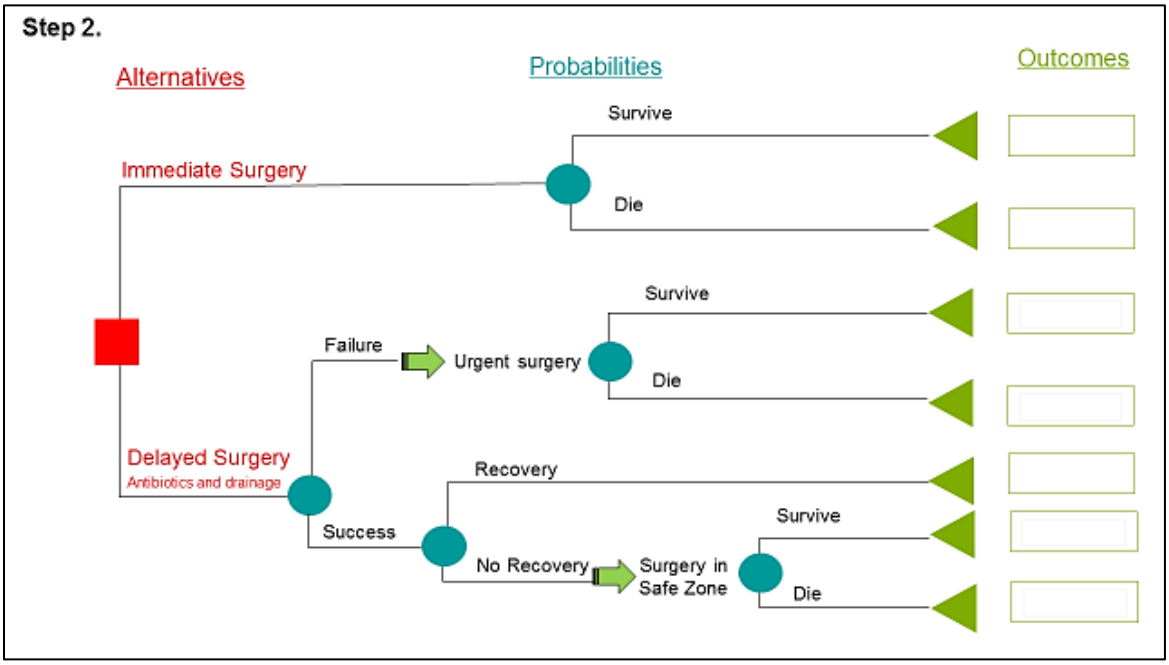
Probability of mortality with urgent surgery is .15
Probability of survival with urgent surgery is .85

Outcomes:

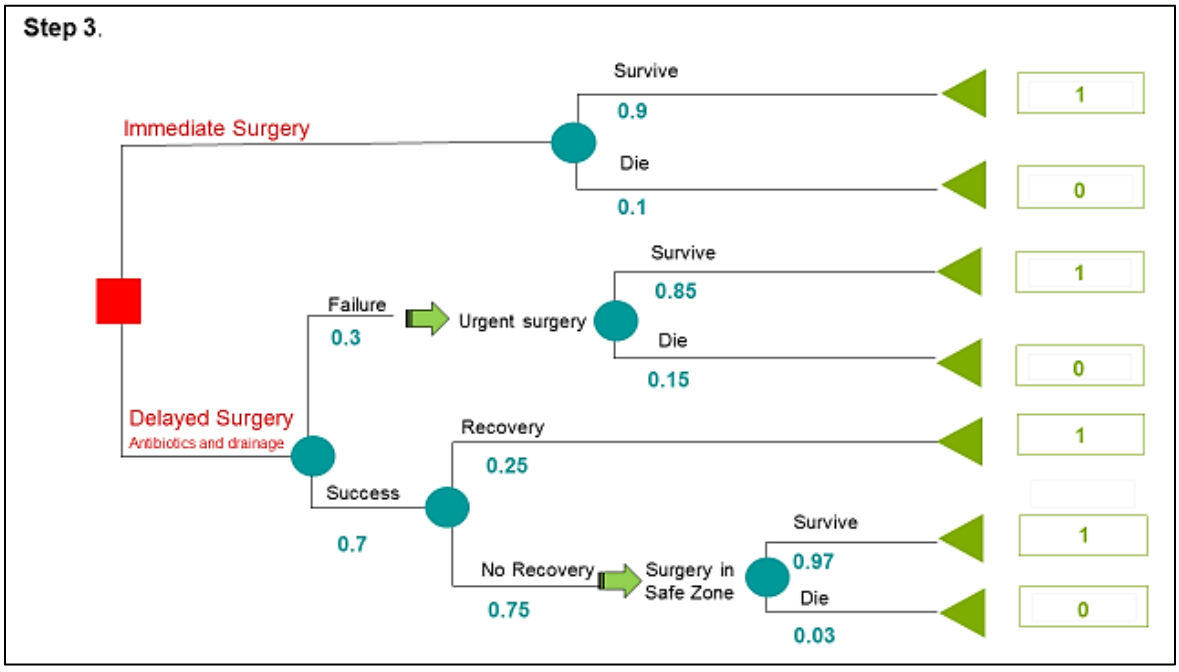
Probability of survival

Probability of death

Step 2. **Structure problem into a logical framework over time -** integrate the core elements (alternatives, chances, outcomes) into a decision tree. Build your decision tree from left to right.



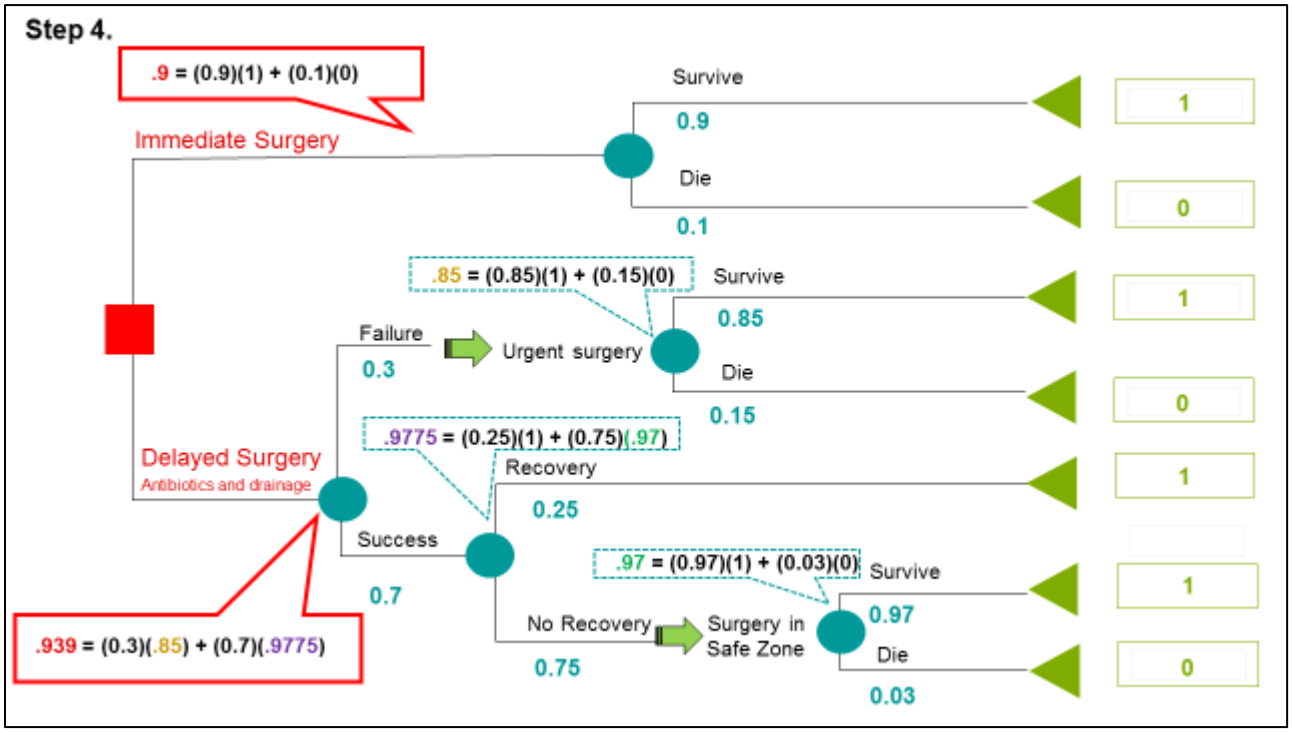
Step 3. **Retrieve, synthesize, and integrate information needed.** Populate the decision tree with the probabilities provided in the problem statement. Be sure to express outcomes consistently. Check to be sure you know what you are trying to maximize or minimize!



Note: The key here is that the outcome at the end of the tree will be expressed as a probability, and in this case, the probability of surviving. So if traveling down the branch of your tree results in survival at the

terminal node, then your terminal node would have a probability of 1 as the outcome, because you survived. If traveling down a branch of your tree results in death at the terminal node, then your terminal node would have a probability of 0 as the outcome, because you did not survive. In other words, the probability of survival would be 0 if you went down the branch where you suffered a fatal event.

Step 4. Conduct a baseline analysis (and evaluate uncertainty). Let's first complete this part of the problem and calculate the expected value of our two alternatives for our baseline analysis.



Below, we provide the abbreviated math calculations. See next page for decision tree and complete calculations by branch!

EV(immediate surgery) = 0.1*0 + 0.9*1 = **0.9**

EV(delay surgery) = 0.7*(0.25*1+0.75*(0.03*0+0.97*1)) + 0.3*(0.15*0+0.85*1) = **0.939**

So now we can interpret our baseline results. Recall, our objective is to maximize survival. So which alternative would you choose? **In order to maximize survival, you would want to delay surgery.**

b. **What do you think the results of your analysis will be most sensitive to?** In other words, which variables will have the most influence, if they differ from the baseline assumptions? Provide a general answer without extensive calculations and explain your reasoning. (2-3 sentences).