# From EBM to Medical Decision Making: Taking the Next Step

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## Objectives

You will be able to:

- Describe uncertainty in clinical diagnosis and treatment decisions
- Appreciate psychological heuristics and biases that may lead to inferior decision making
- Appreciate the importance of patient utility in medical decision making
- Compare methods of assessing patient utilities for health outcomes
- Explain the concept of expected utility
- Integrate patient values and probability evidence into simple decision trees
- Determine probability thresholds for clinical action

## Elements of a decision

- Decision makers
- Objectives
- Alternatives (choices)
- Outcomes
- Probabilities of outcomes
- Values of outcomes

## Decision Situations

- Certainty – only preferences matter
- Risk – preferences and known probabilities
- Uncertainty – preferences and unknown probabilities
- Conflict – multiple decision makers

## What makes a good decision?

- Process, not product
  - Is the decision process self-consistent?
  - Is the decision robust to irrelevant features?
  - Is the decision consonant with the data?
  - Will the decision process optimize the desired product?
- Good processes are more likely to yield better outcomes, but outcomes are rarely assured

## Case: Kitara

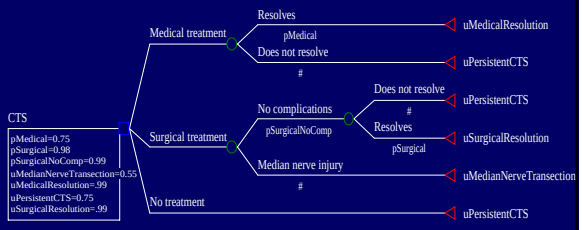
Your group's job, in writing, is to:

- Create a picture or table or tree or other aid to illustrates Kitara's alternatives, probabilities, and outcomes.
- Decide how should she make this decision – or how you would make a recommendation to her.

## Decision Trees

- One useful representation of a decision situation is a decision tree
- Tree contains “nodes” representing:
  - Decision points
  - Points where something is determined by chance
  - Outcomes and their values
- Useful feature #1: Everything is explicit

## A CTS decision tree




Useful feature #2: If you can quantify the outcomes in terms of your objective, you can “solve” a tree and get recommendations

## Utility

- Utility is a measurement of the value that people place on health states
- Conventionally, utility is measured on a scale from


- Utility is important because some treatments impact quality of life, rather than length of life (or chance of death)

## Measuring utility: 3 ways

- Visual analogue scale


80% of the length of the scale,

So the utility is 0.80

## Measuring utility: 3 ways

Standard gamble

- Would you prefer:
  - CTS for sure, or
  - A gamble with a 90% chance of perfect health and a 10% chance of instant death
- Modify the probability of perfect health until subject likes either option equally
- The final probability is the utility of the state being assessed

## Measuring utility: 3 ways

Time Tradeoff

- Would you prefer:
  - CTS for 40 years, followed by death
  - Perfect health for 36 years, followed by death
- Modify the length of life in perfect health until subject likes either option equally
- The ratio of years (e.g. 36/40 = 0.90) is the utility of the state being assessed

## What's your utility?

In groups, assess your utilities for two health states, using VAS and TTO methods:

1. Persistent carpal tunnel symptoms
2. Median nerve injury

| Age: | *20* | *25* | *30* | *35* | *40* | *45* | *50* | *55* | *60* |
|---|---|---|---|---|---|---|---|---|---|
| ♀ | 61 | 56 | 51 | 46 | 41 | 37 | 32 | 28 | 23 |
| ♂ | 56 | 51 | 46 | 42 | 37 | 33 | 28 | 24 | 20 |

## Using utility in decision trees

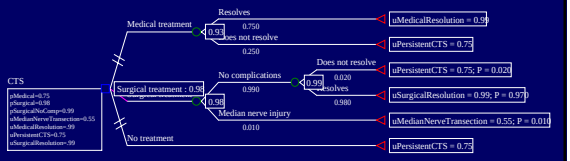
- When dealing with permanent, unchanging health states that affect only quality of life, utilities can be used as outcomes
- Objective is to maximize expected utility

## Using utility in decision trees

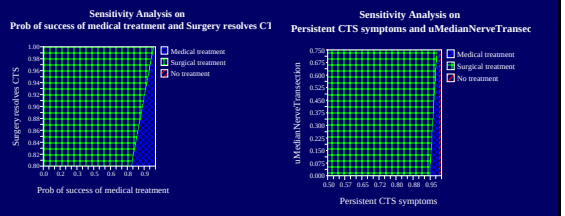
- When outcomes affect quality and length of life, use quality-adjusted life years:
  - QALYs = years in state * utility of state
  - For example, a life of 36 years with:
    - 20 years with utility 0.95 (20*.95 = 19)
    - 10 years with utility 0.90 (10*.90 = 9)
    - 6 years with utility 0.50 (6*.50 = 3)

  Would be a life of 19+9+3 = 31 QALYs
- Objective is to maximize QALYs

## Decision tree solved




## Sensitivity analyses




## Whose utilities?

- The decision maker?
- Patients with the condition?
- People who may one day get the condition?
- Community in general?
- Taxpayers only?

## The Preference Prediction Problem

- People are not always good at knowing what life in a new state will be like
- People adapt and don't always anticipate their adaptation
  - (cf. Brickman, Philip; Coates, Dan; Janoff-Bulman, Ronnie. **Lottery winners** and accident victims: Is happiness relative? *Journal of Personality & Social Psychology. Vol 36(8) Aug 1978, 917-927.)*
- There's a difference between prospective valuation of an experience and how we'll remember it

## Duration Neglect

(Redelmeier & Kahneman, 1996; Redelmeier, Katz, & Kahneman, 2003)

- In 1996, patients undergoing diagnostic colonoscopy rated their discomfort every 60 seconds.
- Immediately afterward and 1 month later, they retrospectively evaluated the procedure.
- Retrospective evaluations depended on worst and last moments of discomfort; they did not depend on length of the procedure (which varied from 4-69 minutes)
- In 2003, effect verified in an RCT: patients with artificially extended procedures (with less uncomfortable ends) reported significantly better experiences, and had higher rates of repeat colonoscopy.

## When do doctors use decision analysis?

- When a decision is:
  - New, uncertain
  - High stakes, resource intensive
  - Amenable to study
- (At UIC, faculty in Medicine, Pediatrics, and Pharmacy have been involved in published decision analyses)

## What else do people do?

- When a situation is routine (matches a known pattern), we rely on scripts
- When a situation is less routine but not high-stakes enough for decision analysis, we rely on judgment
- Judgment is often based on heuristics (rules of thumb) that are usually good, but …

## "Asian disease problem"

(Kahneman & Tversky, 1984)

- Imagine that you're preparing for an outbreak of a disease expected to kill 600 people, and you have two options available:

72% Program A: 200 people will be saved

28% Program B: 1/3 probability that 600 will be saved and 2/3 probability that nobody will be saved.

## "Asian disease problem"

(Kahneman & Tversky, 1984)

- Imagine that you're preparing for an outbreak of a disease expected to kill 600 people, and you have two options available:

22% Program C: 400 people will die

78% Program D: 1/3 probability nobody will die and 2/3 probability that 600 people will die

- But Programs A and C are identical, as are Programs B and D!

## Honoring Sunk Costs

(Arkes & Blumer, 1985)

85% As president of a large drug company, you've invested $10M of company money into researching an HIV vaccine. The project is 90% complete, but another firm has begun marketing a vaccine that is more effective and less expensive than yours. Should you invest the last $1M of your research funds to completely finish your vaccine?

17% As president of a large drug company, an employee has suggested you use the last $1M of your research funds to completely develop an HIV vaccine. However, another firm has begun marketing a vaccine that is more effective and less expensive that you could make. Should you invest?

## Adding Alternatives

(Redelmeier & Shafir, 1995)

- 67-year-old with chronic right hip pain due to osteoarthritis. NSAIDs have failed. You have decided to refer to an orthopedic consultant. The patient agrees.
  - First, however, you check the formulary and find the patient hasn't tried ibuprofen. Do you:
    - refer to orthopedics and also start ibuprofen
    - refer to orthopedics and do not start new medication 53%
  - First, however, you check the formulary and find the patient hasn't tried ibuprofen or piroxicam. Do you:
    - refer to orthopedics and also start ibuprofen
    - refer to orthopedics and also start piroxicam
    - refer to orthopedics and do not start new medication 72%

## Omission Bias

(Ritov & Baron, 1990)

- There have been several epidemics of flu, which can be fatal to young children. 10 out of 10,000 children will die from the flu.
- A vaccine eliminates the probability of getting the flu, but can have fatal side effects. The children who die from the side effects aren't necessarily the ones who would die from the flu.
- You are married and have one child, a one-year old. Your child will have a 10 in 10,000 chance of dying from the flu without vaccination. What overall death rate for vaccinated children would be low enough for you to vaccinate?
- (57% would not vaccinate if the vaccine had a 9 in 10,000 death rate)

## Intransitivity

(adapted from Tversky, 1969)

| | A | B | C |
|---|---|---|---|
| Personality | Good | Fair | Poor |
| Appearance | Fair | Poor | Good |
| Wealth | Poor | Good | Fair |

- Many people:
  - Prefer A to B (better on personality, appearance)
  - Prefer B to C (better on personality, wealth)
  - Prefer C to A! (better on appearance, wealth)

## Summary of Day 1

- Aspects of clinical uncertainty can be quantified, illustrated, and analyzed
  - Risk (outcome probability, evidence-based)
  - Utility (outcome value, preference-based)
- Decision analysis suggests choices to maximize expected utility when it counts
- In more casual decision-making, we live and die by judgment (and support systems)
- Copy of lecture notes available at: http://araw.mede.uic.edu/~alansz/courses/ecpp