12 – Clinical Decision Making

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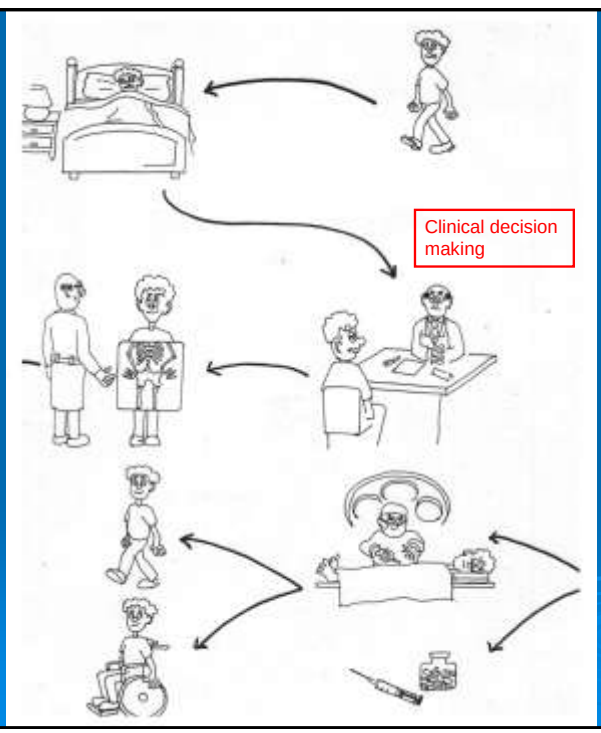


Learning Objectives

- Describe why people are generally very poor at making probability judgments
- Define the most common types of error made in decision making.
- Describe how these errors can affect health-related decisions by both patients and doctors
- Describe “Anchoring”
- Define the “availability”’ and “representativeness” heuristics and be able to give examples of them
- Appreciate that diagnosis and decisions to treat are examples of problem solving and understand how use of heuristics and probability judgments may results in errors being made
- Define “algorithms” and discuss their potential benefits and limitations in clinical situations

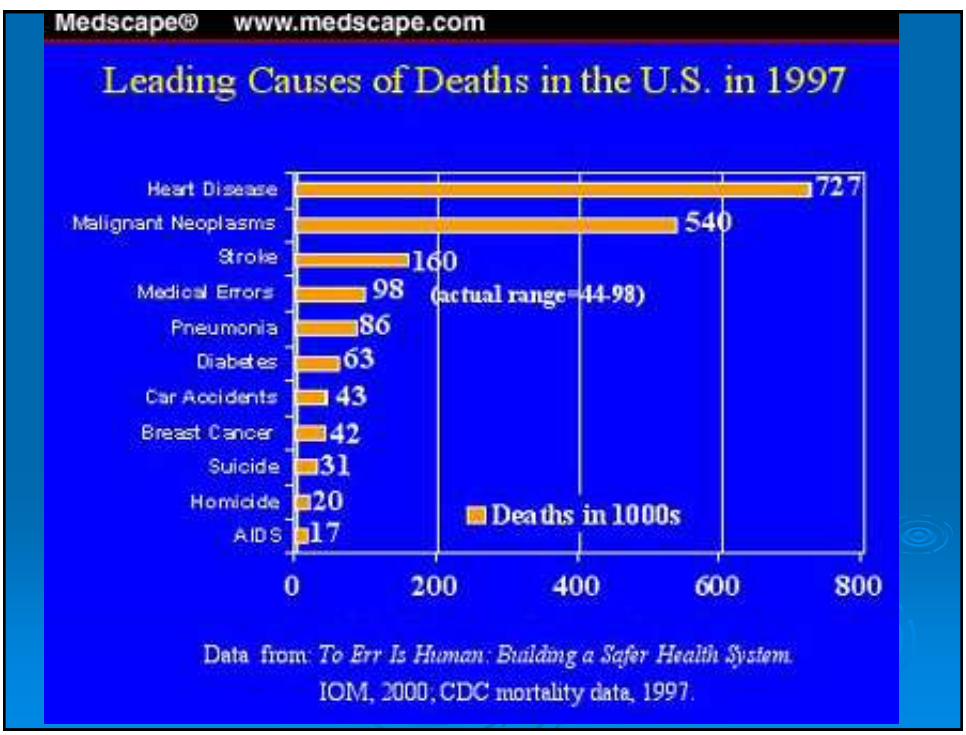
Medical error

- *An error is defined as the failure of a planned action to be completed as intended (i.e., error of execution) or the use of a wrong plan to achieve an aim (i.e., error of planning).*
- E.g. incorrect diagnosis, failure to employ indicated tests error in the performance of an operation, procedure, or test, error in the dose or method of using a drug.

Medical error

- 1999 report from Institute of Medicine in USA estimated that between 44,000 and 98,000 patients die in hospitals in the USA each year because of medical error.

http://www.nap.edu/catalog.php?record_id=9728



Wayne Jowett

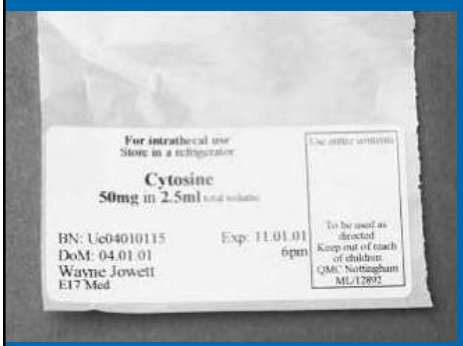
- Wayne Jowett was diagnosed with acute
- Lymphoblastic leukaemia in 1999 aged 15.
- By June 2000 Wayne was in remission, but still needed three-monthly injections of two chemotherapy drugs - Vincristine (IV) and Cytosine (IT).
- On 4th January 2001 Wayne was mistakenly given Vincristine intrathecally. He became slowly paralysed and almost a month later his parents agreed to turn off his life support machine.
- Similar errors involving Vincristine had been made **14 times** in Britain since 1985, 11 resulted in death the other 3 in paralysis. The Specialist Registrar Dr Feda Mulhem was convicted of manslaughter and sentenced to 8 months imprisonment.

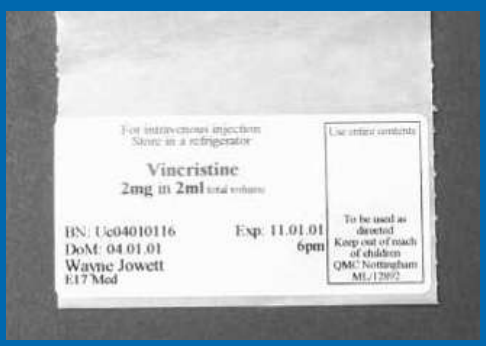
Sun

NEWS

Death jab doc behind bars

By JOHN ASKILL

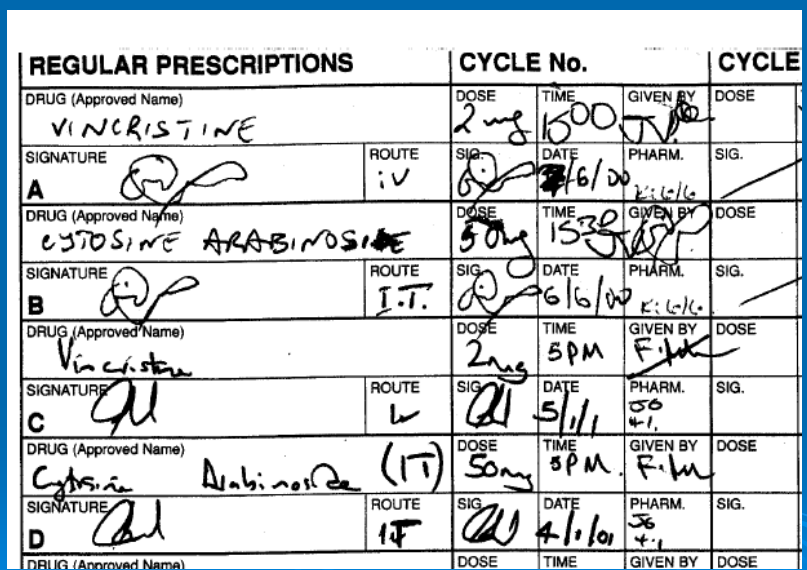




The drugs were in similar syringes and both clear liquids and although clearly labelled they were stored together on the ward's fridge.

Extract from external enquiry report Dr Mulhem, Specialist Registrar

- "The system for the administration of chemotherapy at Leicester was that drugs for administration intrathecally were never available on the ward at the same time as drugs for administration by another route. When I administered chemotherapy, only intrathecal drugs were in the chemotherapy box."
- "At LRI, the custom was to transport drugs for intrathecal administration to patients in a yellow box. Thus displaying to the doctor receiving it a clear and unambiguous visual cue as to what the syringe or syringes in the box should contain."



REGULAR PRESCRIPTIONS		CYCLE No.			CYCLE
DRUG (Approved Name) VINCRISTINE		DOSE 2 mg	TIME 1500	GIVEN BY	DOSE
SIGNATURE A	ROUTE IV	SIG	DATE 4/6/01	PHARM.	SIG.
DRUG (Approved Name) CYTOSINE ARABINOSIDE		DOSE 50mg	TIME 1530	GIVEN BY	DOSE
SIGNATURE B	ROUTE I.T.	SIG	DATE 6/6/01	PHARM.	SIG.
DRUG (Approved Name) Vincristine		DOSE 2mg	TIME 5PM	GIVEN BY	DOSE
SIGNATURE C	ROUTE IV	SIG	DATE 5/1/1	PHARM.	SIG.
DRUG (Approved Name) Cytosine Arabinoside (IT)		DOSE 50mg	TIME 5PM	GIVEN BY	DOSE
SIGNATURE D	ROUTE IT	SIG	DATE 4/1/01	PHARM.	SIG.
DRUG (Approved Name)		DOSE	TIME	GIVEN BY	DOSE

http://www.guardian.co.uk/society/2001/apr/19/health1

- Dr Morton "...said to Dr Mulhem "Vincristine?" Dr Mulhem replied in the affirmative. Dr Morton then said "intrathecal Vincristine?" Dr Mulhem again replied in the affirmative.
- Dr Mulhem couldn't recall if the SHO "...actually said the word 'Vincristine'" but stated "once again I had clearly fixed in my mind that the drug was Methotrexate and not a drug for administration other than IT. "

Can you identify the presence of any of the psychological factors we have come across?

- Packaging not designed to attract attention
- Top-down processing (expectations affect perception)
- Obedience

Decision making

Two systems of decision making

17 x 24

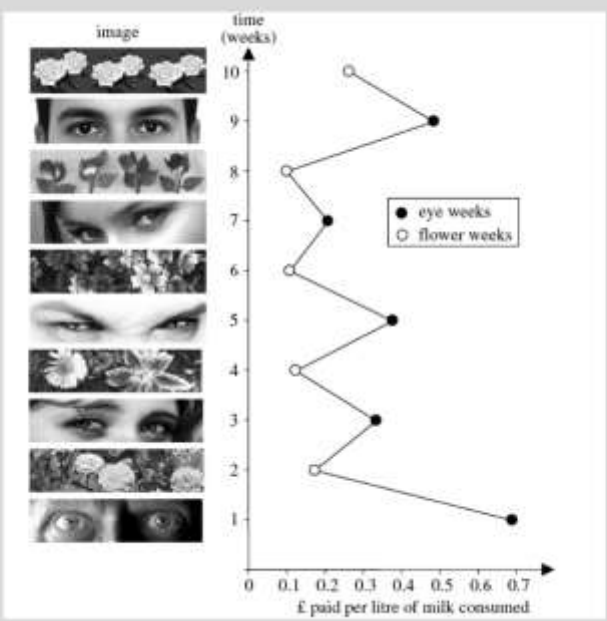
Two systems of decision making

- System 1 (Hot)
  - Answer “2+2=”
  - Drive a car on an empty road
  - Detect hostility in a voice
  - Complete the phrase “Bread and ……”
- System 2 (Cold)
  - Tell someone your phone number
  - Compare two washing machines for overall value
  - Complete a tax form

Two systems for decision making

(Metcalfe and Mischel 1999)

Hot system	Cold system
Emotional	Cognitive
"Go"	"Know"
Simple	Complex
Reflexive	Reflective
Fast	Slow
Develops early	Develops late
Accentuated by stress	Attenuated by stress
Stimulus control	Self control



Nisbett & Wilson (1977)

- An experimenter conducted a “consumer study” in a shopping mall. He laid out four pairs of tights in a row and asked consumers to pick out the pair they liked the best. In reality all four were identical. However, consumers were significantly more likely to select the far right most pair (even though they were switched around randomly each time).
- Moreover when asked about their selection the consumers were able to provide justifications for their choice e.g. sheerness, strength etc. None mentioned the position, indeed when the experimenter suggested that position may have influenced their choice they looked at him as if he was mad!
- System 1 (Hot) often controls our actions automatically but system 2 (Cold) is blisfully unaware believing himself to be in charge!

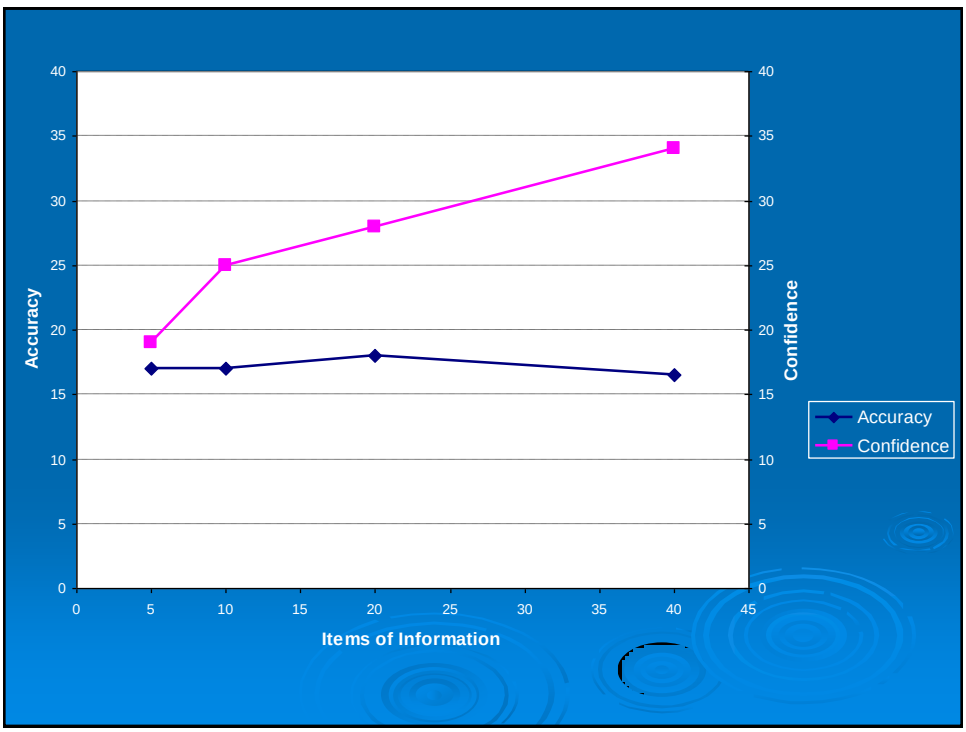
The two systems operate as an elephant and the rider – Jonathan Haidt (2006)

Decision making error

Confirmatory bias and over-confidence

Slovic (1973)

- Experienced horserace handicappers given a list of 88 variables relating to past performance of horses and riders.
- Asked to predict outcome of a race based on five most important items, then 10, 20 and 40 most important variables.



Sunk Cost Fallacy

- Arkes & Blumer (1985) Arranged to have season tickets sold to visitors to the ticket booth randomly at full price ($15) or at a discount ($13 or $8)
- Then observed frequency of attendance at plays over the season.
- Rationally, the price paid for ticket should not influence how often it is used
- However, they found that the people who paid a higher price used the ticket more then those who paid the discounted price.

Sunk Cost Fallacy

- Sunk costs are any costs that have been spent on a project that are irretrievable ranging including anything from money spent building a house to expensive drugs used to treat a patient with a rare disease.
- Rationally the only factor affecting future action should be the future costs/benefit ratio **but** humans do not always act rationally and often the more we have invested in the past the more we are prepared to invest in a problem in the future, this is known as the Sunk Cost Fallacy or the “Concorde Effect”.

Making estimates

Split group into two halves before next slide

Q) What is the percentage of people living in London who were born in Poland?

- Is it higher or lower than 10%?
- Estimate the exact percentage
- Now look away for the next slide

Q) What is the percentage of people living in London who were born in Poland?

- Is it higher or lower than 0.1%?
- Estimate the exact percentage

Results

- Is it higher than 3%?

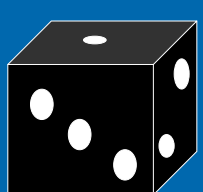
- Actually ~ 1.6%

http://www.guardian.co.uk/news/datablog/2011/may/26/foreign-born-uk-population#

Anchoring

- Individuals poor at adjusting estimates from a given starting point (probs. & values)
- Adjustments crude & imprecise
- Anchored by starting point

Probability



Many clinical situations involve making decisions on the basis of probabilities e.g. two or more competing diagnoses, alternative treatments which may be effective etc.

Predictions

- I toss a coin and it comes down heads, I toss it again and it comes down heads, I toss it twice more; each time it comes down heads.
- If I toss the coin again what are the odds of it coming down heads? (nb it's not a trick coin)

- The chances of a coin landing on heads on 5 consecutive tosses are 1 in 32 (0.5 x 0.5 x 0.5 x 0.5 x 0.5)
- However, the chances that the coin will land on heads on the fifth toss are 50%.
- If you said there is a greater than 50% chance of it landing on heads you have falllen prey to "Gambler's Fallacy"

Gambler's fallacy

- The **gambler's fallacy** is a logical fallacy involving the mistaken belief that past events will affect future events when dealing with independent events.
- In clinical situations it could encompass a belief that if one patient in a clinic presents with a rare condition it would be impossible for the next patient to present with the very same condition.
- Or alternatively that if not a single patient out of several seen in a speciality clinic then the next patient is more likely to be a true case.

- You are invited by a a fellow Imperial College Student to a party at which there are about 30 medical students, 70 students studying other subjects at Imperial. You end up speaking to a guy named James who tells you that he has already had 12 pints before getting to the party, he says he shouldn't really be at the party because he has an exam the next day.
- Rate the probability that James is a medical student

Base rates

- In this example the probability that James is a medical student is 30% (30/30+70) but in similar vignettes participants frequently rate probabilities based more on extraneous information than on the base rate.
- People show susceptibility to favouring extraneous information over base rates even when they are specifically told that the information is not relevant.

Assessing conditional probabilities

- A woman presents to you with a lump in her breast. From your examination, her age and your previous records of similar cases, you estimate that the chance of cancer is low, about 1% (p=.01).
- You send her to the radiologist for a mammogram and the radiologist says the mammogram is positive, indicating cancer.

Conditional Probabilities

- *Baseline risk of cancer=1%*

Mammogram Result	Cancer	No Cancer
Positive	0.8 (sensitivity)	0.1 (false positive)
Negative	0.2 (false negative)	0.9 (specificity)

Given the positive mammogram, what is the probability that your patient has cancer?

Baye's Theorem

$$P(A/B) = \frac{p(B/A).p(A)}{p(B/A).p(A)+p(B/\underline{A}).p(\underline{A})}$$

where

p(A)=probability of having cancer (=0.01)
p(A)=probability of not having cancer (=0.99)
p(B/A)=probability of positive mammogram given cancer (=0.8)
p(B/A)= probability of positive mammogram given no cancer (=0.1)

$$P(A/B) = \frac{0.8 \times 0.01}{0.8 \times 0.01 + 0.10 \times 0.99} = 0.08$$

- Physicians asked this question typically estimated the risk to be 70-80%

Heuristics

- Heurisitcs are simple "rules of thumb" which are built on experience and are applied to simplify decision making in an ambiguous situation.

Representativeness

(How to win big on the lottery)

- Which number is more likely to come up in lottery:
- 7, 12, 25, 37, 49 - bonus ball 19
- 1, 2, 3, 4, 5 - bonus ball 6
- Odds of correctly picking all 6 numbers = 1: 13,983,816
- On average if you spend £1 a week on the Lottery, you may just win the jackpot in 270,000 years time

Representativeness heuristic

- Subjective probability that a stimulus belongs to a particular class based on how 'typical' of that class it appears to be (regardless of base rate probability)
- While often very useful in everyday life, it can also result in neglect of relevant base rates and other errors. The representative heuristic was first identified by Amos Tversky and Daniel Kahneman.

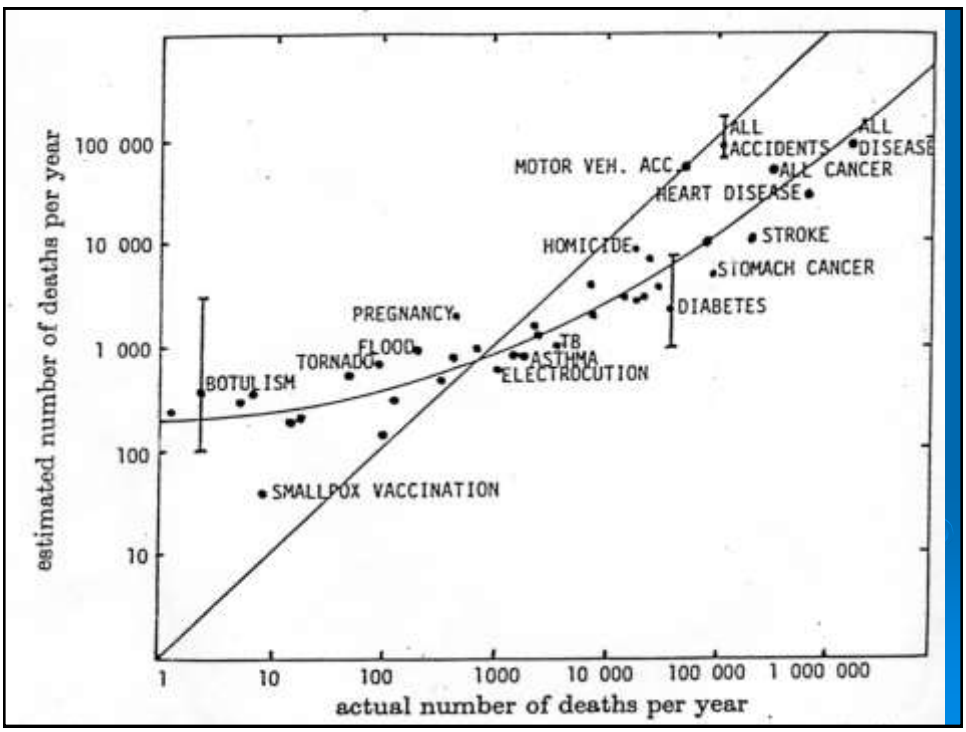
Implications of representativeness heuristic

- Over-reliance on certain evidence; neglect of other information
- Tend to ignore prior probs
- Misconceptions about randomness
- Sample size ignored

(Kahneman & Tversky)

The Availability Heuristic

- Probabilities are estimated on the basis of how easily and/or vividly they can be called to mind.
- Individuals typically overestimate the frequency of occurrence of catastrophic, dramatic events.



Implications of availability heuristic

- Rehearsal of event scenarios increases subjective probability.
- Overestimate the likelihood of catastrophic events
- Causes individuals to view themselves as immune from many more mundane hazards.

(Abelson & Levi)

What can be done about cognitive errors and heuristics?

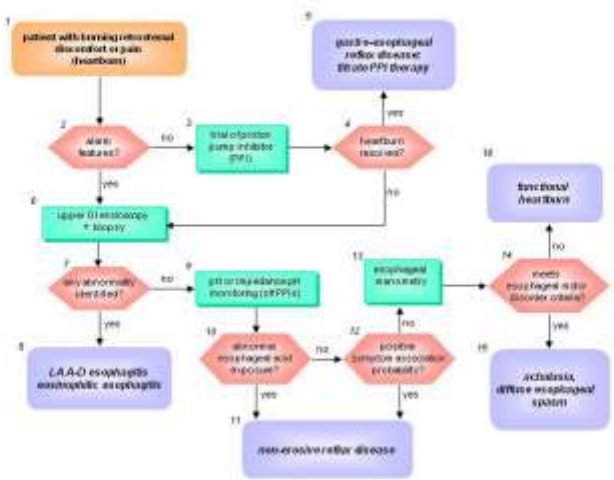
How can decision making be improved?

1) Recognize that heuristics and biases may be affecting our judgement even though we may not be conscious of them
2) When making critical decisions, **slow down** and consciously engage System 2.
3) Counteract the effect of top-down information processing by generating alternative theories and looking for evidence to **support** them rather than just looking for evidence which confirms our preferred theory.
4) Understand and employ statistical principles e.g. Base rates and Bayes Theorem
5) Use of Algorithms

Algorithms

- An algorithm is a procedure which, if followed exactly, will provide the most likely answer based on the evidence.
- The rules of probability are examples of algorithms.
- Algorithms are most useful in situations where the problem is well defined which excludes most everyday decisions
- For the most part, people have to be specially taught how to use them

Figure 1: Recurrent heartburn




I MADE 120
DECISIONS TODAY...
ALL OF THEM WRONG.


"That's all Folks!"