PH 458/PH231: Evidence and Policy

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Evidence and Policy??

- Suppose you were Secretary of State for Health in the UK in 2006 and were wondering whether to bring in a policy that banned smoking in public places....
- All sorts of evaluative/normative considerations but a crucial thing you would like to know is whether, *as a matter of fact,* passive smoking causes lung cancer and other diseases. [And also about the extent to which it does so.]
- And you would surely, if rational, want to base your opinion on that factual (theoretical) matter on EVIDENCE.

Evidence based everything!

- "A wise man proportions his belief to the evidence." David Hume *Enquiry* ***Concerning Human Understanding***

Evidence and Policy??

- Or remember the MMR scare back in 2002

MMR

- **BLAIR ATTACKS MMR 'SCAREMONGERS'**
- ***Guardian*** **(Wednesday February 6, 2002)**

- **TORY CALL FOR SINGLE JABS**
- ***Guardian*** **(Wednesday February 6, 2002)**

- **POLL FINDS DISAPPROVAL OF BLAIR'S STANCE OVER MMR VACCINE**
- ***Guardian*** **(Monday February 4, 2002)**

MMR

- **THREE OUT OF FOUR PARENTS FAVOUR SINGLE JABS FOR MMR** ***Guardian*** **(Wednesday February 20, 2002)**

- **AN EPIDEMIC OF FEAR**
- Whoever is proved right, the row over vaccination has highlighted the public's lack of trust in science
- *Observer* (Sunday February 10, 2002)

MMR

- **DEFIANT PARENTS STAND BY DECISION**
- No regrets from sceptics despite their children catching measles ***Guardian*** (**Thursday February 7, 2002)**

- **BLAIR WARNING AS MEASLES PANIC GROWS**
- ***Guardian*** (**Thursday February 7, 2002)**

MMR

- Suppose you were EITHER
- (a) a parent trying to decide what was best for your child OR
- (b) Tony Blair trying to decide whether to change policies on what was and was not available on the NHS
- Amongst all the normative issues, centrally you would want to know what's the EVIDENCE against MMR
- That is, the evidence for a causal link between MMR and autism.

Class size and educational achievement

- Finally suppose you were an official in the State of California in the 1990s worried about falling educational standards
- Considering adopting a policy of reducing class sizes across the board
- Lots of economic issues about what the policy would cost
- And economic/evaluative issues about opportunity costs
- But clearly a crucial consideration is
- *What's the evidence that reducing class sizes will raise educational standards?*

Evidence

- So this is a course about EVIDENCE (and its relationship to policy)
- What you might think ...
- But in fact you can become ‘evidence savvy’ – i.e. ask the right questions about evidence – without being an expert in the science.

Today's lecture

- Some preliminary considerations about evidence
- Some questions that are easy to learn and imperative to ask
- AND (relatedly) how easy it is to make mistakes when assessing evidence
- ESPECIALLY when stochastic or probabilistic claims/theories are involved.

Post hoc ergo propter hoc

- 1. Question 1: There is evidence of a connection between two variables but *is the connection causal*?
- (Easy mistake 1: the post hoc ergo propter hoc fallacy)

- MMR again
- Need to ask counterfactual question
- My favourite example of a 'single case' pheph fallacy
- Lots of statistical ones
- E.g. Probability (dying tomorrow/admitted to hospital today) > Probability(dying tomorrow)
- Doesn't entail that admission to hospital is a causal factor in death
- Need to ask what was the probability of your dying *if you had not been* admitted to hospital

Genetic Fingerprinting

- **THE APPLIANCE OF SCIENCE TO CRIME CONTROL**
- ***Guardian*, Wednesday January 10, 2001**

- **DNA PINCHES POACHERS**
- Genetic fingerprinting is being used to protect rare animals.
  Guardian (**Thursday October 5, 2000)**

- **BEAUTY IN THE BATH MURDERER GETS LIFE**
- Killer caught after 16 years by DNA clue and ex-wife who helped police
  Guardian (**Thursday November 25, 1999)**

Genetic Fingerprinting

- A match probability of 1 in 5 million means that the probability that someone randomly selected from the population will have DNA that matches the sample is 1 in 5 million
- [Already a bit worrying: "As more and more loci are employed, so the standard calculation produces numbers that are further and further beyond the realms that can be investigated by statistical methods. The tiny numbers, although not necessarily "wrong" are without real meaning" (UK Forensic Science Service, 2000)]
- Suppose you are on a jury and the only evidence that Joe Bloggs committed the crime at issue was that
- (i) there had clearly been a struggle but only two different blood samples were found at the crime scene – (a) the victim's blood and (b) someone else's
- (ii) a sample of Joe Bloggs' blood was taken
- (iii) an expert geneticist testifies that the DNA in the (non-victim) blood from the scene matched the DNA in Joe's blood and, in this case, there was a 1 in 5 million match probability
- What's the probability that Joe is innocent?
- There is evidence that jurors (and lawyers!) think that the answer is 1 in 5 milion.

Genetic Fingerprinting

- What the match probability tells you is that the probability that there would be a match with the sample from the scene if Joe were innocent is very low.
- But you don't want to know Prob(match/innocent) you want to know Prob(innocent/match)!
- Here's the easiest way to think about it:
- You don't have anything else to go on so the crime could have been committed by anyone in the country at the time
- But say the crime required some degree of strength so we can rule out small children
- Assume that the matching is flawless in that the guilty person's DNA will definitely match that at the scene
- But then there are around 50 million other people who are in fact innocent

Genetic Fingerprinting

- A 1 in 5 million match probability means that we would expect that of those 50 million innocent people the blood DNA from 10 of them, would match that found at the scene just “by chance”
- So on average there will be 11 people in the whole population whose blood DNA matches, one of whom is guilty and 10 innocent
- So the probability you want, Prob(innocent/match), is not 1 in 5 million
- BUT 10 in 11!
- [Of course in practice it is very unlikely that this will be the only evidence – though there have definitely been miscarriages of justice (including cases where the rest of the evidence pointed in favour of innocence!) based entirely on misunderstanding of the probabilities.]

Getting probabilities ‘the wrong way round’

- Question 2: do I have the probabilities relevant for my decision straight?
- (Easy mistake 2: getting probabilities the wrong way round)
- Suppose you know that John Smith is *either* a Professor of Philosophy *or* an Office Worker.
- You are told: he is very absent-minded, spends all his time reading books, is completely impractical, and never wears a tie at work.
- Which is he more likely to be?

Understanding what the evidence really tells us about risk

- Suppose you are told
- Prophylactic mastectomy reduces the risk of dying from breast cancer in those at high risk of contracting the disease by 80%.
- And reduces the risk of dying from breast cancer in those at moderate risk of contracting the disease by 100%.

Understanding what the evidence really tells us about risk

- WOW!
- Suppose instead you are told that the risk reduction in the high risk group is 4%
- And in the moderate risk group is 2.4%
- You might be less impressed!
- Similarly if you were told that
- The number of women who would have to be given a prophylactic mastectomy in order to save one life is 25 (high risk group)
- NNT (number needed to treat) in moderate risk group to save one life is 42.
- And therefore on my recommended measure, the NNIs (numbers treated ineffectively) are 24 and 41

Understanding what the evidence really tells us about risk

- Difficult to believe that these different claims about risk can be consistent
- Yet they are
- Here are the “bald facts” - the trial results on which the above claims about risk were based

Understanding what the evidence really tells us about risk

N = 639	Deaths (per	100 women)
Treatment	High Risk group	Moderate risk group
Prophylactic Mastectomy	**1**	**0**
Control (no mastectomy)	**5**	**2.4**

Understanding what the evidence really tells us about risk

- No question of one way of presenting the facts being right and the others wrong
- The different presentations are consistent
- Nonetheless the different presentations are likely to evoke quite different reactions

Understanding what the evidence really tells us about risk

- You might be surprised to know that a 1998 survey of 58 leaflets on mammography screening issued by Australian health authorities found that the number of leaflets mentioning the absolute risk reduction of death from breast cancer was
- **0**
- And the number of leaflets mentioning the NNT – i.e. the number of women who would have to be screened to avert one death from breast cancer was
- **0**
- And they all emphasise relative risk

Understanding what the evidence tells us about risk

- Question 3: don’t try to fob me off with just the relative risk, what was the absolute risk?
- (Easy mistake 3: letting the high numbers associated with relative risk reductions/increases give you a greatly exaggerated view of the impact of the intervention at issue.)

What about the downside?

- Question 3 is closely related to another important and simple lesson
- Once the real (absolute) benefit of the treatment is understood, the issue of the “downside” really shouts out.
- Question 4: you’ve told me about the evidence for the benefits what about the evidence for the costs?
- (Easy mistake 4: getting so starry-eyed about the evidence for the exaggerated relative risk reduction that you forget about the possible downside of the intervention)
- Widespread in modern medicine with its relentless pursuit of small effects
- Cp statins
- Also ‘The Great Daylight Robbery’

Surrogate outcomes

- “In the early 1980s, people started dying in unexpected ways. At first only a few doctors noticed anything, but soon people all around the world were dying en masse. Faced with such dire circumstances, Ronald Reagan’s NIH stepped in and orchestrated a multicenter trial employing thousands of medical professionals in 26 cities across the world. The randomized clinical trial, begun in 1987, became a flash point as ethicists debated the acceptability of giving half of the patients placebo in lieu of treatment. By the late eighties tens of thousands of people were dying every year; estimates of the death toll for the decade range from 240,000 to 700,000 in the United States alone. It was loss of life on the order of American casualties in World War II.”

- ??
- 40,000 deaths from HIV/Aids in that decade

Surrogate outcomes

- Real story these deaths were iatrogenic: caused by antiarrythmic drugs.
- The story of ventricular ectopic beats
- You DON'T want not to have your VEBs suppressed
- You DO want to avoid cardiac arrest.
- Question 5: Is there evidence that there is a connection between the intervention and the outcome I really care about?
- (Easy mistake: settle for connections between the evidence and *surrogate* outcomes –
- Invariably because you feel it's plausible that there is a causal link between the surrogate and the real
- But you need EVIDENCE for that!)
- Cp statins and reduction in cholesterol.

External Validity

- STAR project in Tennessee (1985-), RCT study ("gold standard of evidence")
- Result: reducing class sizes in Tennessee High Schools produced notable increases in educational performance
- (minority and inner city children benefitting 2 or 3 times as much as their white and nonurban peers)
- Formed an important basis for the decision by the California State to agree to spend $1bn p.a. (rising to $1.6bn) on reducing class sizes
- Result: no effect
- No suggestion that STAR produced the wrong result in Tennessee
- Question 6: Does the evidence generalise?
- (Easy mistake 6 assuming that because there is evidence that a policy worked 'there', it will also work 'here')