MED 515 B : Lecture 2

The Architecture of Epidemiological Study Designs

From passive observation to active experimentation.

$$RR = \frac{[a/(a+b)]}{[c/(c+d)]}$$



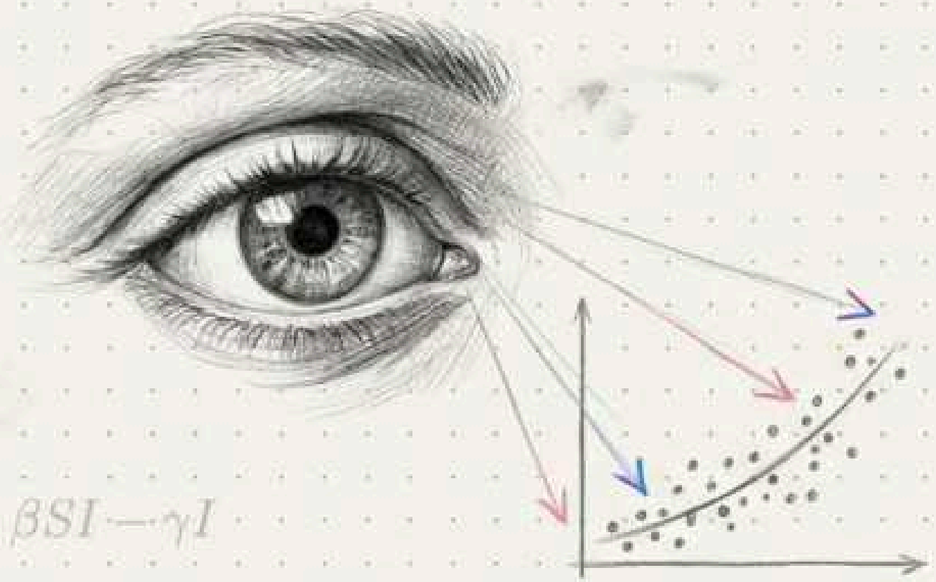
Epidemiological Studies Fall Into Two Broad Families

¶ 2.1

Observational Studies

Researchers watch what happens without intervening. ✓

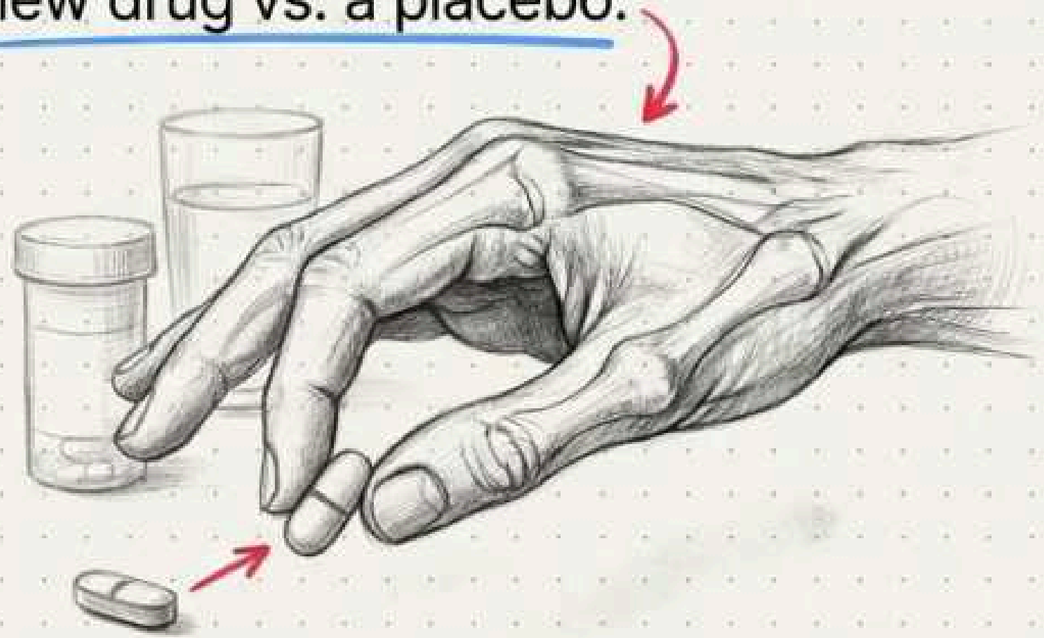
Example: People choose whether to smoke; researchers record health.



Experimental Studies

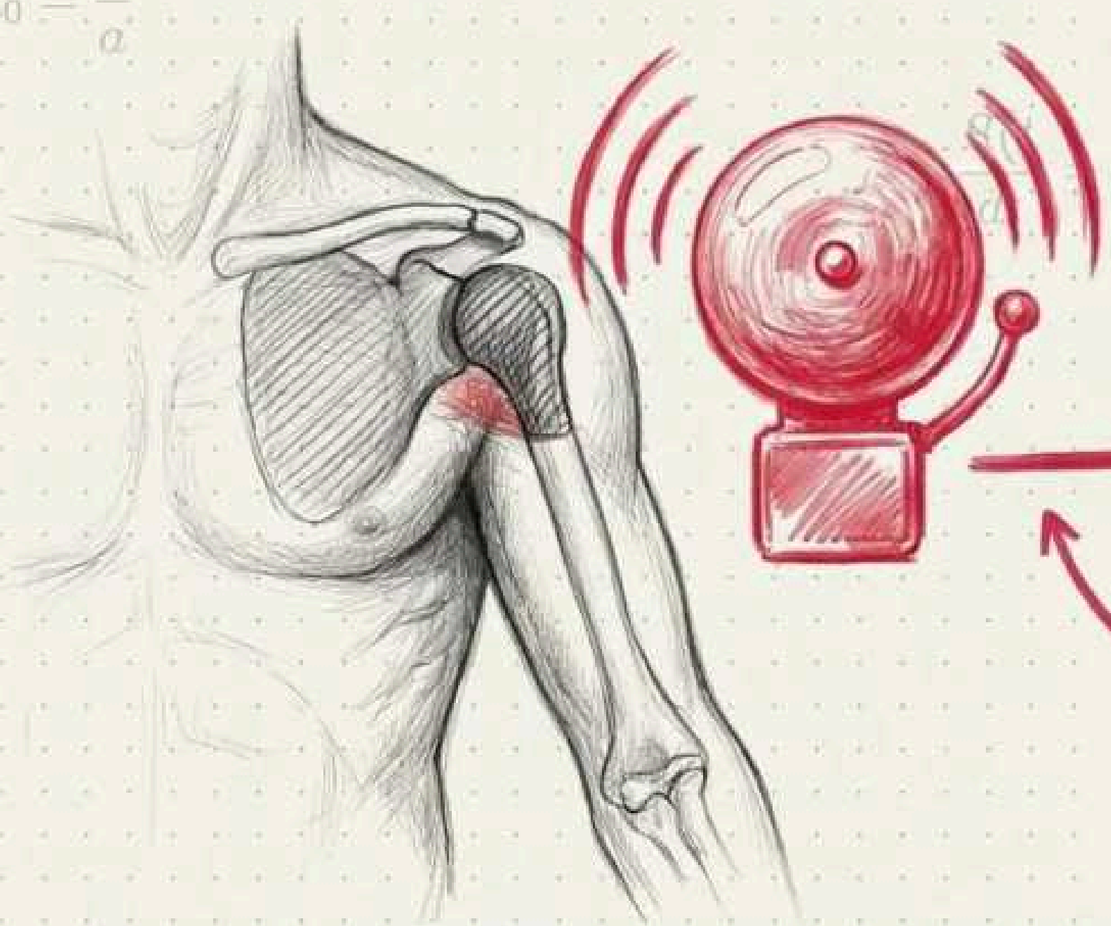
Researchers actively assign the exposure.

Example: A clinical trial assigning a new drug vs. a placebo.



Descriptive Studies Raise the First Alarm

¶ 2.2



Case Report

Describes one unusual patient.

Case Series

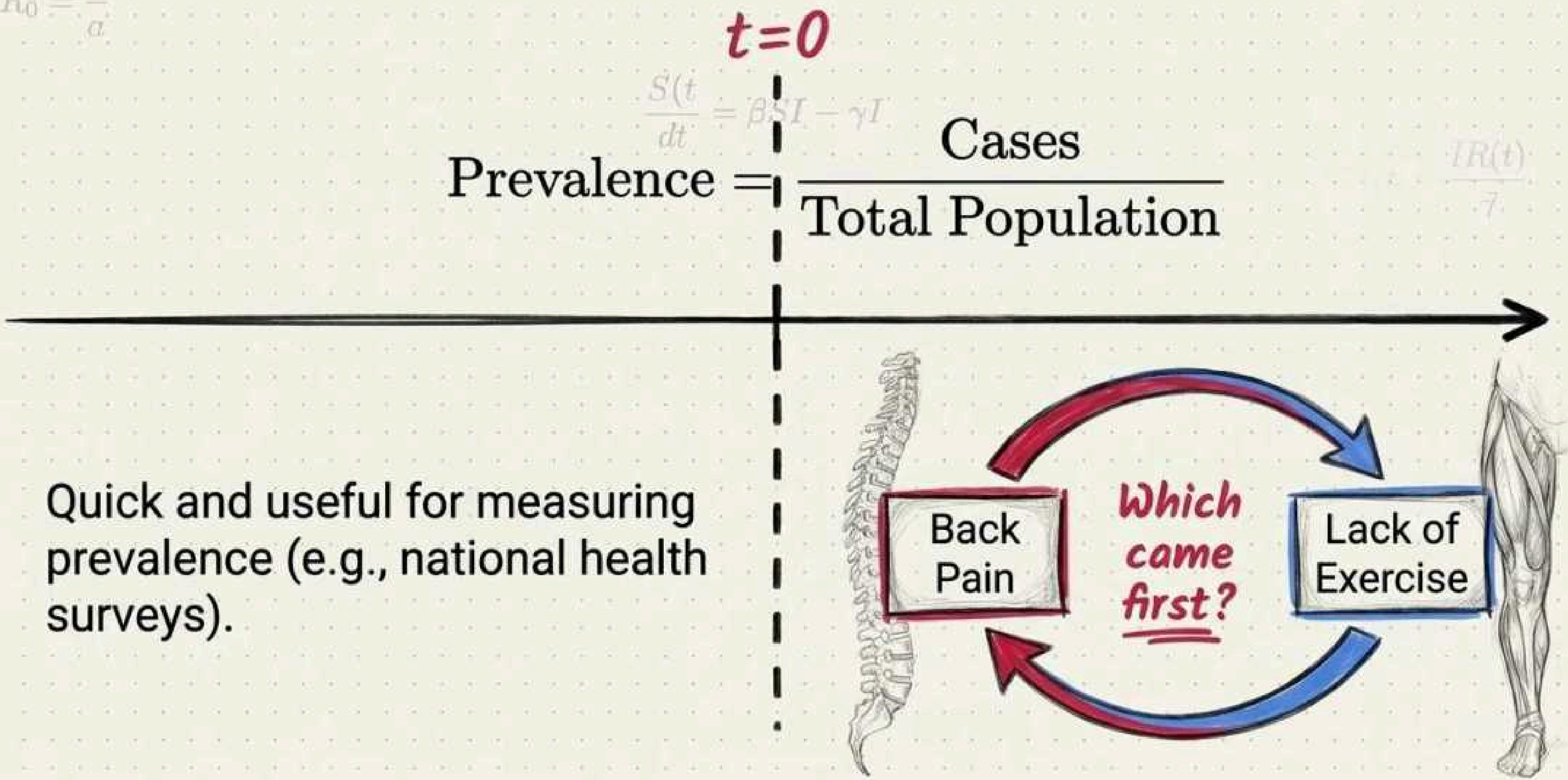
Describes several unusual patients.

Raises the first alarm about a new disease or side effect.

⚠ **Cannot test causes:** No comparison group exists.

Cross-Sectional Surveys Measure a Single Point in Time

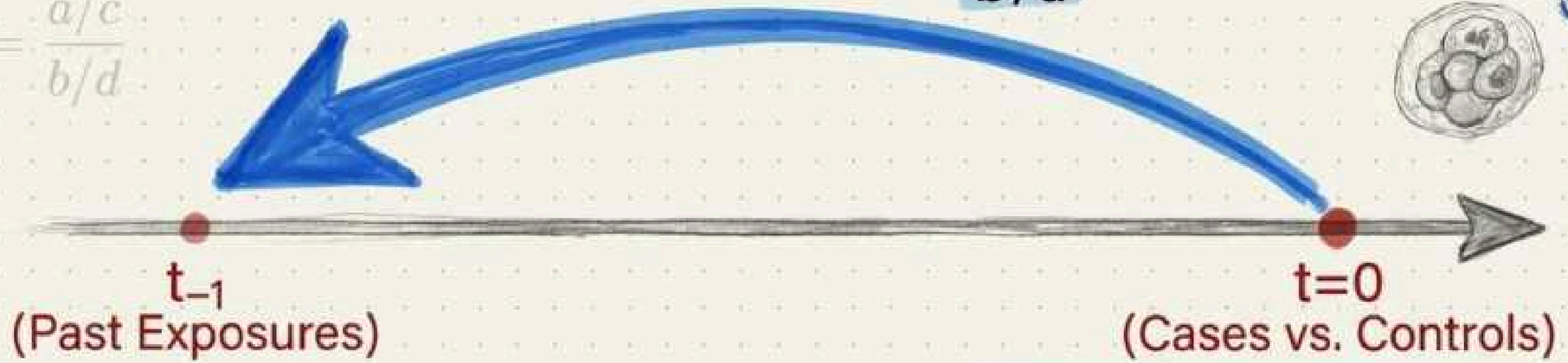
¶ 2.3

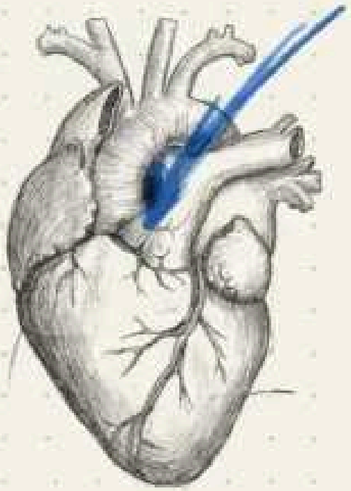


Case-Control Studies Look Backward from the Outcome

¶ 2.4

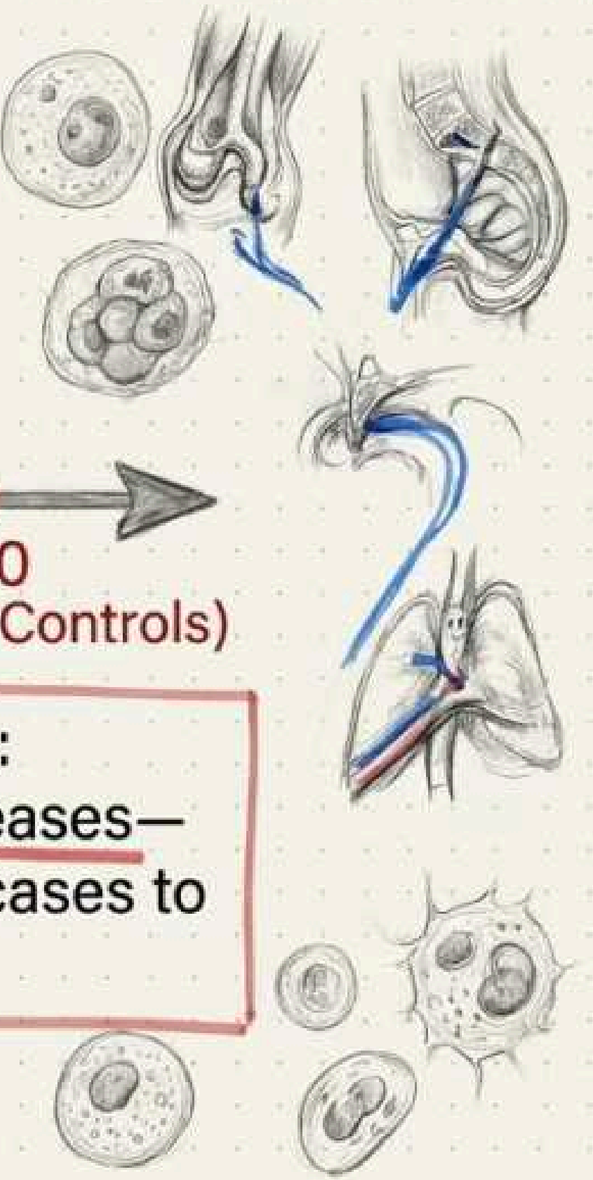
$$\text{Odds Ratio (OR)} = \frac{a/c}{b/d}$$





Starts with the outcome. Researchers gather people with a disease (**cases**) and **similar people without it (controls)**, then **look back.**

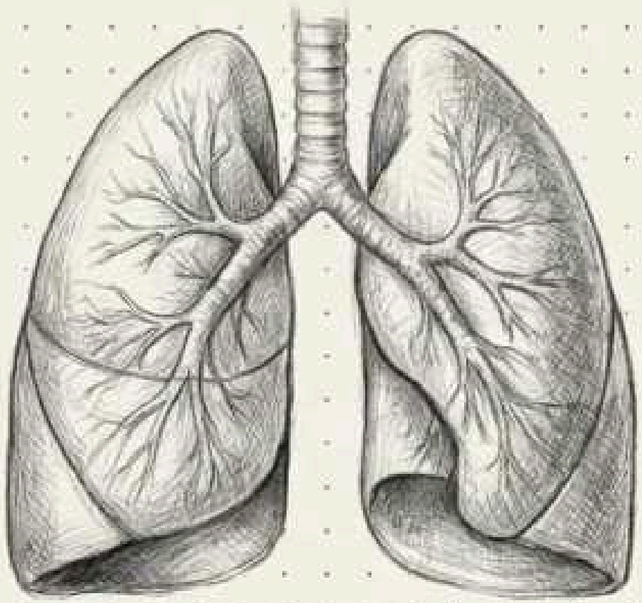
Strategic Advantage: Efficient for rare diseases—**no need** to wait for cases to arise.



The 1950 Doll & Hill Study and the Threat of Recall Bias

¶2.5

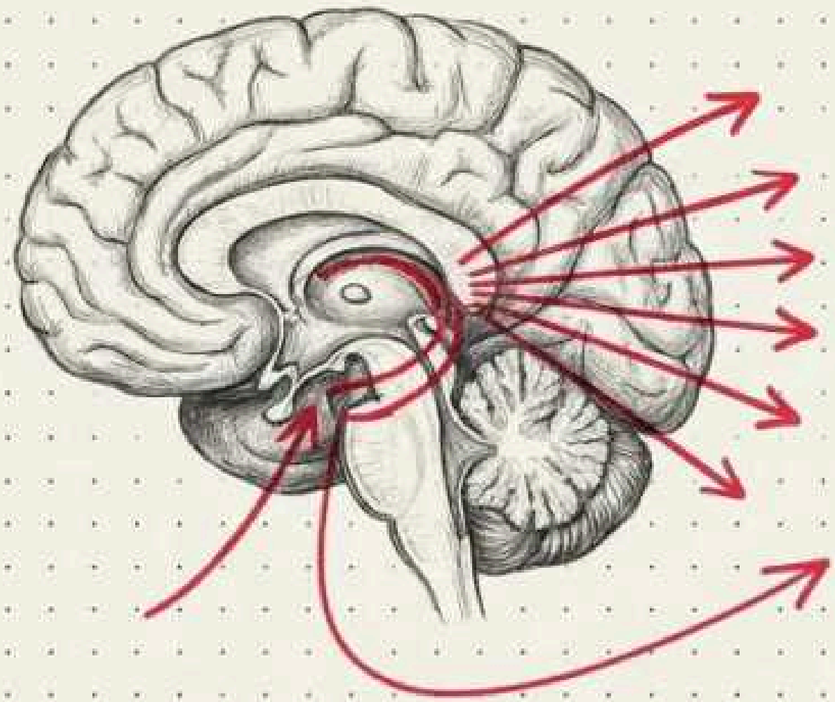
The Finding



1950: Doll & Hill compare lung cancer patients to other hospital patients in London.

Finding: Cancer patients were far more likely to be heavy smokers.

The Threat

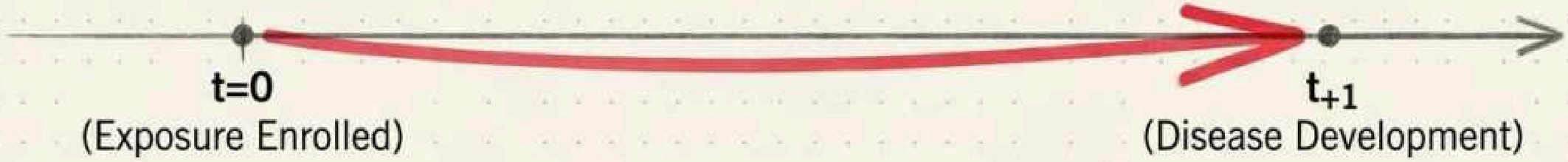


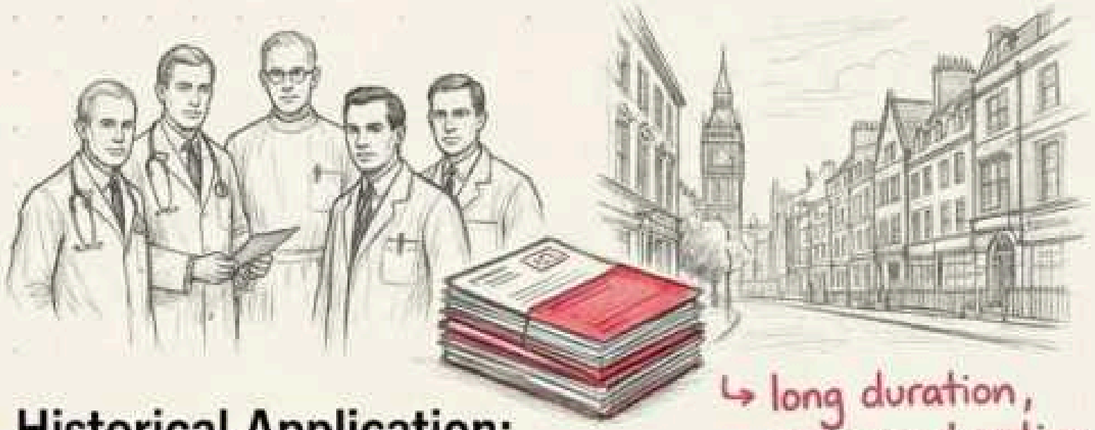
Vulnerable to Recall Bias: Diseased patients remember past exposures differently than healthy controls.

Cohort Studies Start with Exposure and Follow Forward

¶ 2.6

$$\text{Incidence} = \frac{\text{New Cases}}{\text{Population at Risk} \times \text{Time}}$$



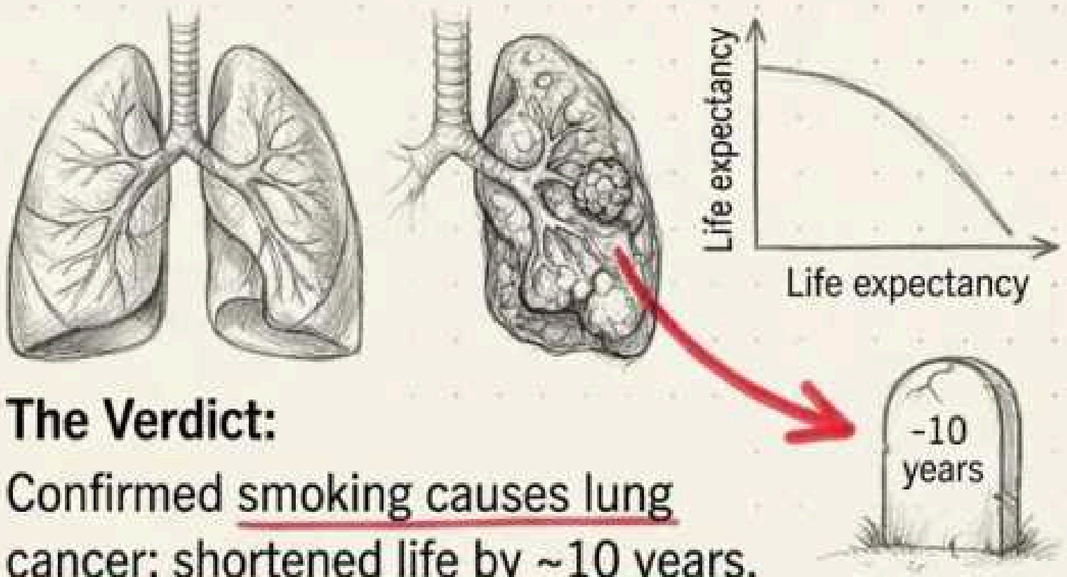


↳ long duration, and lone duration

Historical Application:

Doll & Hill (1951). Followed >30,000 British doctors for 50 years.

↳ large sample size

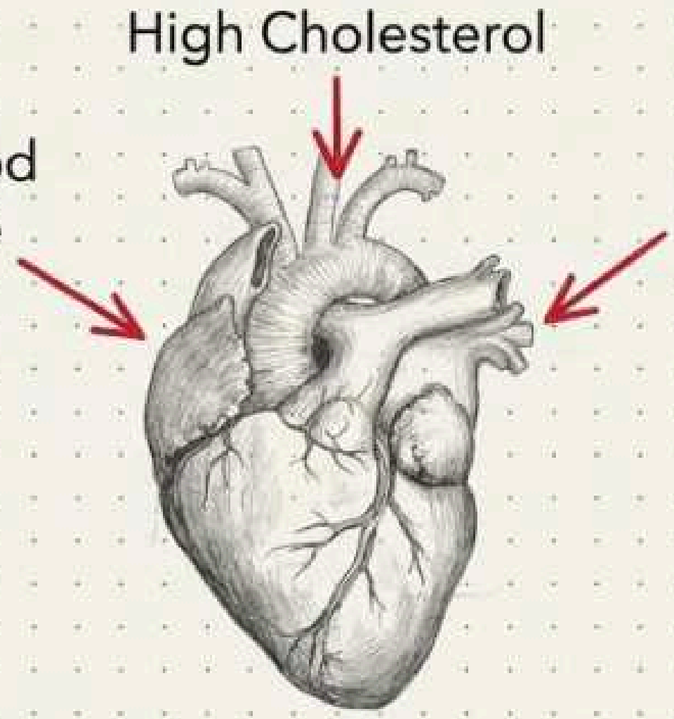


The Verdict:

Confirmed smoking causes lung cancer; shortened life by ~10 years.

Cohorts Measure Risk Directly but Require Massive Resources

¶ 2.7

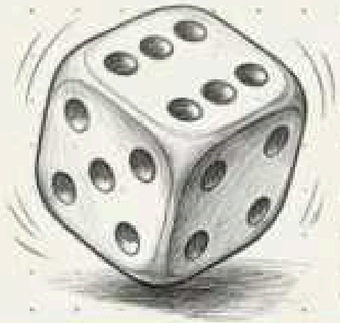


The Framingham Heart Study (Massachusetts, 1948).

Strengths	Weaknesses
• Shows which came first; measures incidence and risk directly.	• Slow, expensive, entirely impractical for rare diseases.

The Randomized Controlled Trial (RCT): Testing by Chance

¶ 2.8



Participants are assigned strictly by chance.

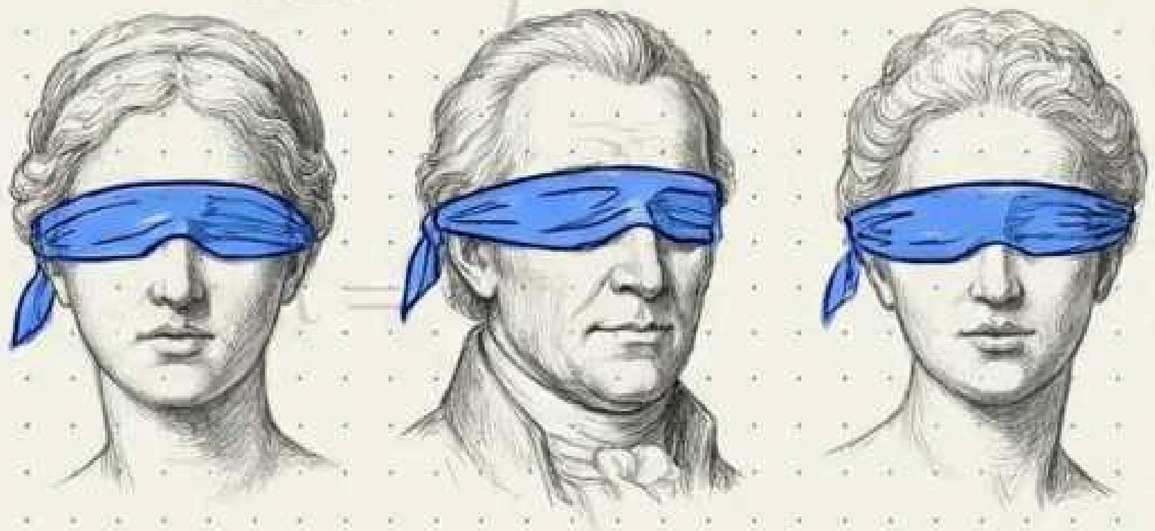
Path A (Treatment)

Path B (Comparison: Placebo or Standard)

Balances both known AND unknown factors—differences in outcome can be attributed purely to the treatment.

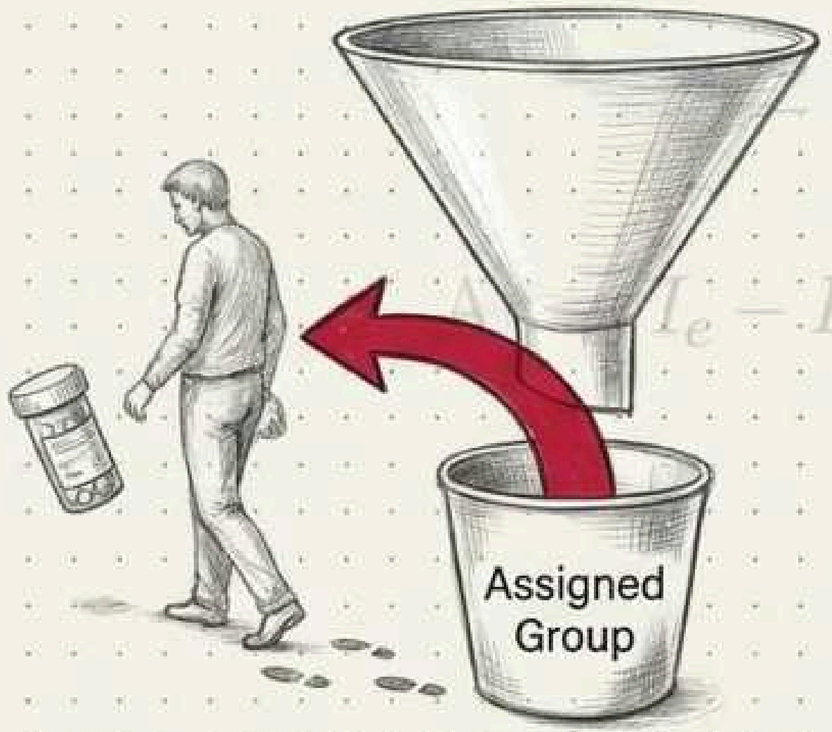
Trials Add Protections: Blinding and Intention-to-Treat

¶2.9



Patient Doctor Assessor

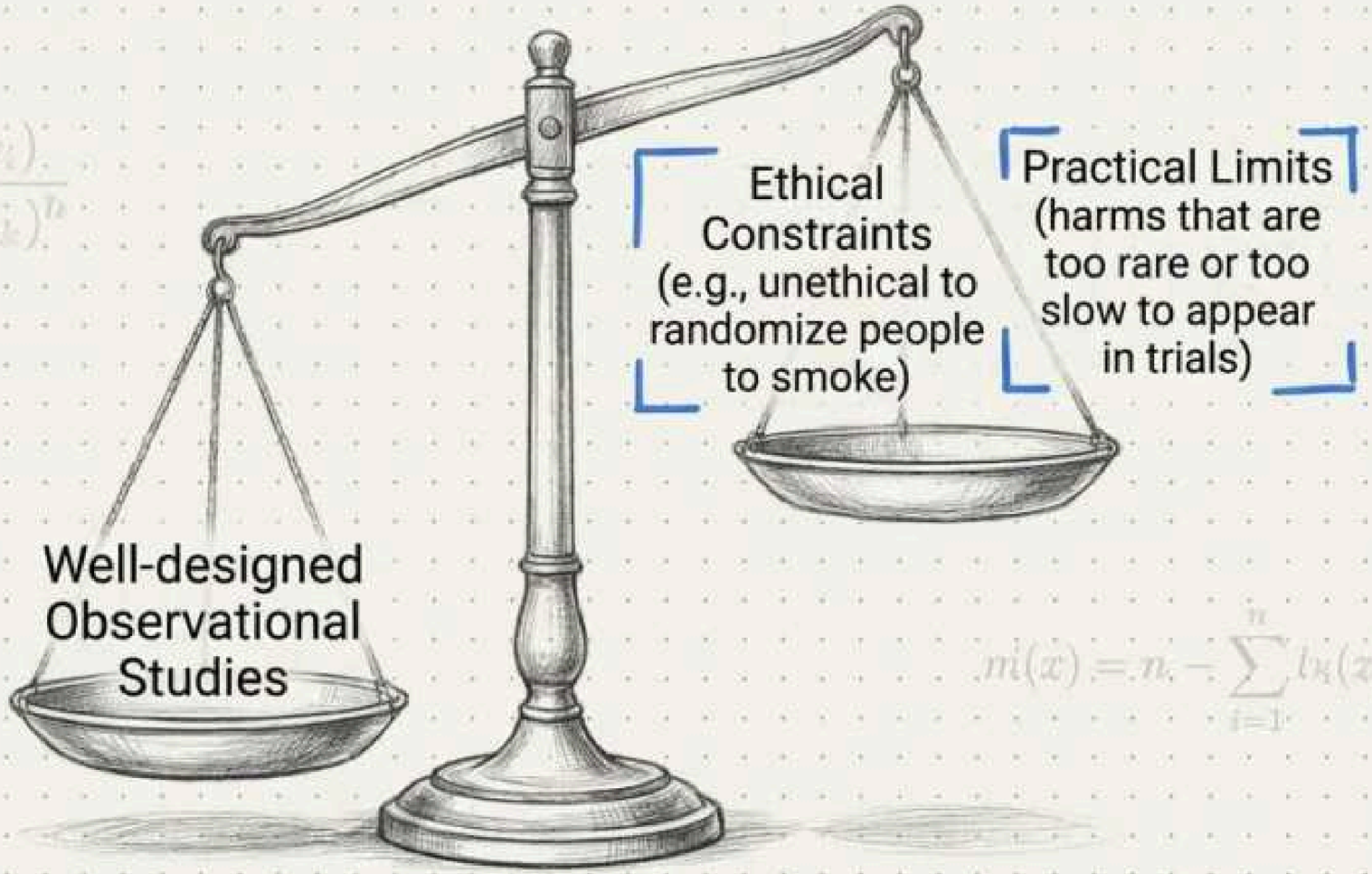
Expectations cannot distort results.



Analyzes every participant in their assigned group, even if they stop treatment, preserving randomization benefits.

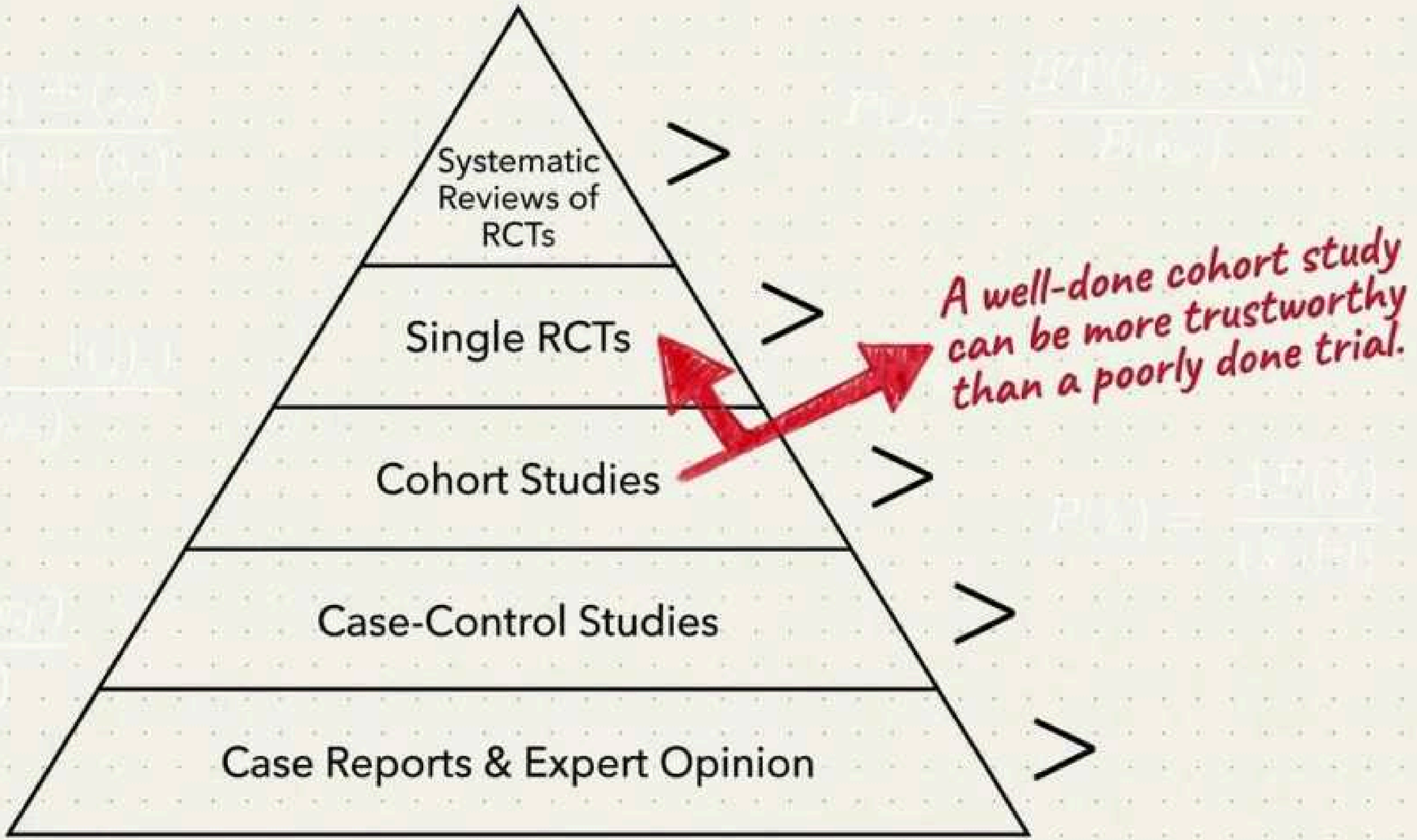
¶ 2.10

Not Every Question Can Be Answered by a Trial

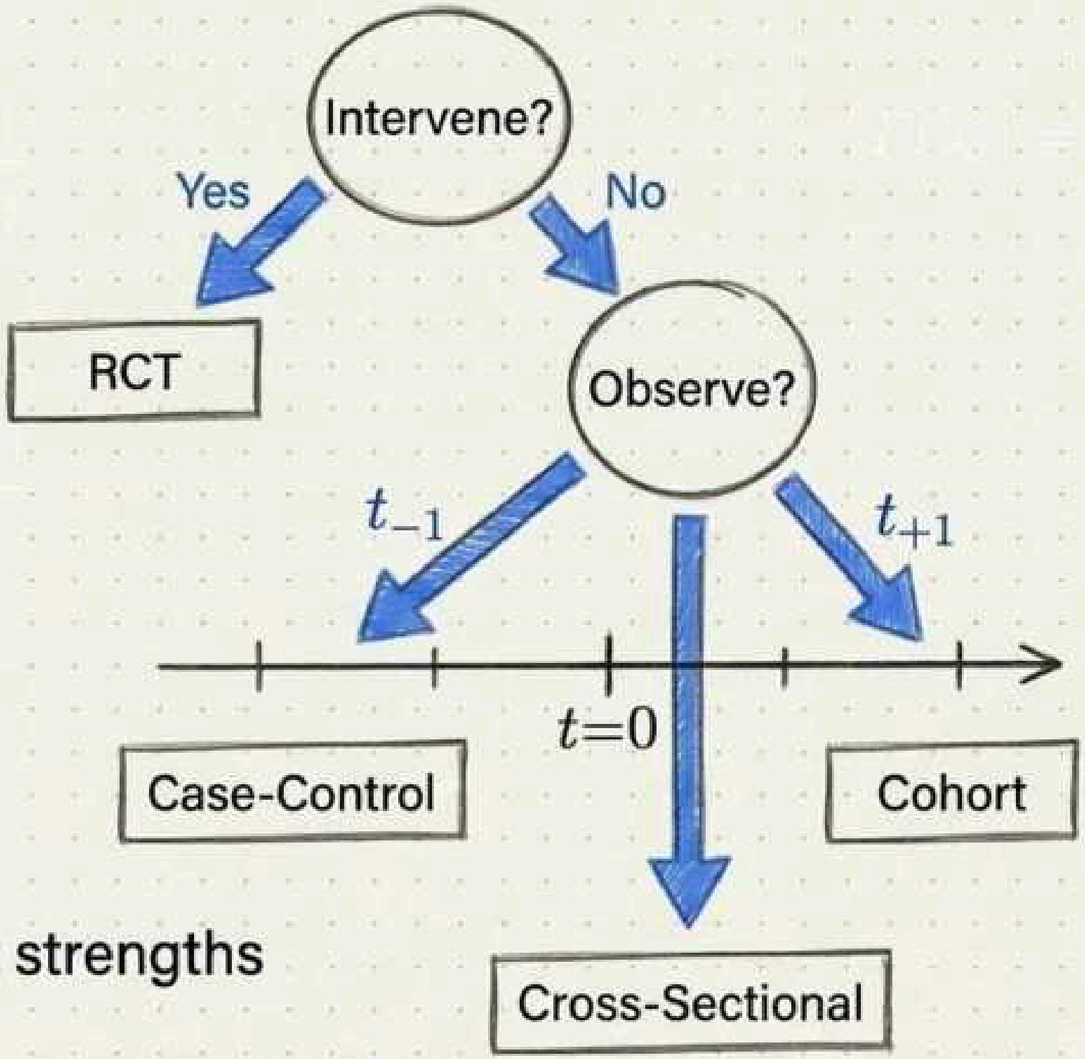


Observational methods remain an essential, irreplaceable tool in epidemiology.

The Hierarchy of Evidence Synthesizes the Designs



The Right Design Depends Strictly on the Question



Every design has distinct strengths and unique weaknesses.

Up Next:
The threats every design must guard against & reasoning about cause and effect.