



***Africa Impact Evaluation Program on AIDS
(AIM-AIDS)
Cape Town, South Africa
March 8 – 13, 2009***



Causal Inference

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March 9, 2009



Motivation



- Causal inference: Does a relation from cause to effect exist?
- In the health sciences, many of the critical questions are causal in nature
- For example:
 - What is the efficacy of a given drug on a target population?
 - What fraction of HIV infections could have been prevented by a given treatment or policy?



Motivation



The most challenging empirical questions for our health programs also involve cause-effect relationships:

- Does the decentralization of health facilities **improve** the quality of service provision?
- Does HIV testing **cause** behavioral change amongst high-risk populations?
- **Policy perspective: What works? What are the benefits per unit costs of alternative interventions?**



Identifying causal impact



- Evaluate the impact/effect of a program or an intervention on some outcomes of interest
 - By how much did X (intervention) change Y (outcome)?
- **Not the same as correlation!**
 - X and Y are related, move together in some way
 - Holding an umbrella & having wet shoes
 - Does the umbrella cause wet shoes?



Evaluation Question



- What is the effect of an intervention/treatment P on outcome Y ?
- Example: What is the effect of an Information campaign (P) on VCT-uptake among the youth (Y)?

Impact of P =

VCT uptake (Y) for a youth participating in the information campaign

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VCT uptake (Y) for the same youth in the absence of the information campaign
(at the same point in time)



Attributing Causality: Problems

We observe VCT uptake (Y) for a youth participating in the information campaign

But we do not observe VCT uptake (Y) for the same youth in the absence of the information campaign

Fundamental problem: We never observe the same individual with and without program at the same point in time

Attributing Causality: Solution

Estimate/ mimic/find a good proxy for what would have happened to outcome Y in the absence of program P

- Compare the youth with someone who ‘looks’ exactly like him/her who was not exposed to the intervention P at the same point of time
- In other words, we must find a valid Counterfactual or Control group

Finding a Valid Counterfactual

- Understand the process by which program participation (treatment) is determined:
 - How are benefits assigned? What are the eligibility rules?
 - The counterfactual must be similar in terms of the likelihood of treatment/program participation
 - The treated observation and the counterfactual should have identical characteristics, except for benefiting from the intervention
- **only reason** for different outcomes between treatment and counterfactual is the **intervention (P)**

“Counterfeit” Counterfactual #1

Before and After

- Same individual before and after treatment
- Example: Food aid program to subsistence farmers in a drought-prone area
- Compare incomes before and after
- Findings: Income after food aid is lower than income before food aid
- Did the program fail?

What else is happening over time?

- Beneficiaries received aid because of their characteristics
- Cannot separate effect of food aid from the shock that led to needing it (worsening drought situation)
- Effect of treatment and time-varying variables on outcome cannot be separated

“Counterfeit” Counterfactual #2

Compare participants to non-participants at the same time

- Non-participants:
 - Those who choose not to enroll in program
 - or
 - Those who were not offered the program, ineligible

Problem:

- We cannot determine why some participate in the program and others do not, existing differences in behavior could affect outcomes
- Cannot compare eligible to ineligible, differ in characteristics that also affect outcomes

Why might participants and non-participants differ? An example



Government program offers VCT:

What is the effect of VCT on risk behaviors?

- Who signs up?
 - What if those getting treatment decide to get tested because they know they know they engage in high-risk behaviors or think they might be HIV positive?
- Participants have lower health status and/or engage in riskier behaviors relative to those who do not sign up— differing (pre-existing) characteristics that also affect outcomes of interest
- Non-participants → a poor counterfactual for the treatment group

Possible Solutions...

- Guarantee comparability of treatment and control groups
- ONLY remaining difference is intervention
- How?
 - Experimental design
 - Non-experimental/ Quasi-experimental design

These solutions all involve...

- EITHER Randomization
 - Give everyone an equal chance of being in control or treatment groups
 - Ensures that participants and non-participants will be similar on most characteristics
 - Only difference is the intervention
- OR Transparent & observable (quantifiable) criteria for assignment into the program
 - Separate effects

Conclusions



- Seek to measure the causal effect of a program on some outcome
- Need a valid counterfactual, find a good control group
 - Behave the same as treated group in the absence of the intervention
- Invalid counterfactuals:
 - Before and after: time-varying variables
 - Participants vs. non-participants: characteristics
- Options (Tomorrow!)
 - Randomize
 - Quasi-experimental methods: More assumptions



Thank You

