# Randomization and Causality

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# References


- R.A. Fisher (1935). The Design of Experiments. Edinburgh: Oliver and Boyd.
- J. Pearl & D. Mackenzie (2018). The Book of Why. New York: Basic Books. [BoW]
- U. Saint-Mont (2015). Randomization Does Not Help Much, Comparability Does.

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# Ideal Experiment

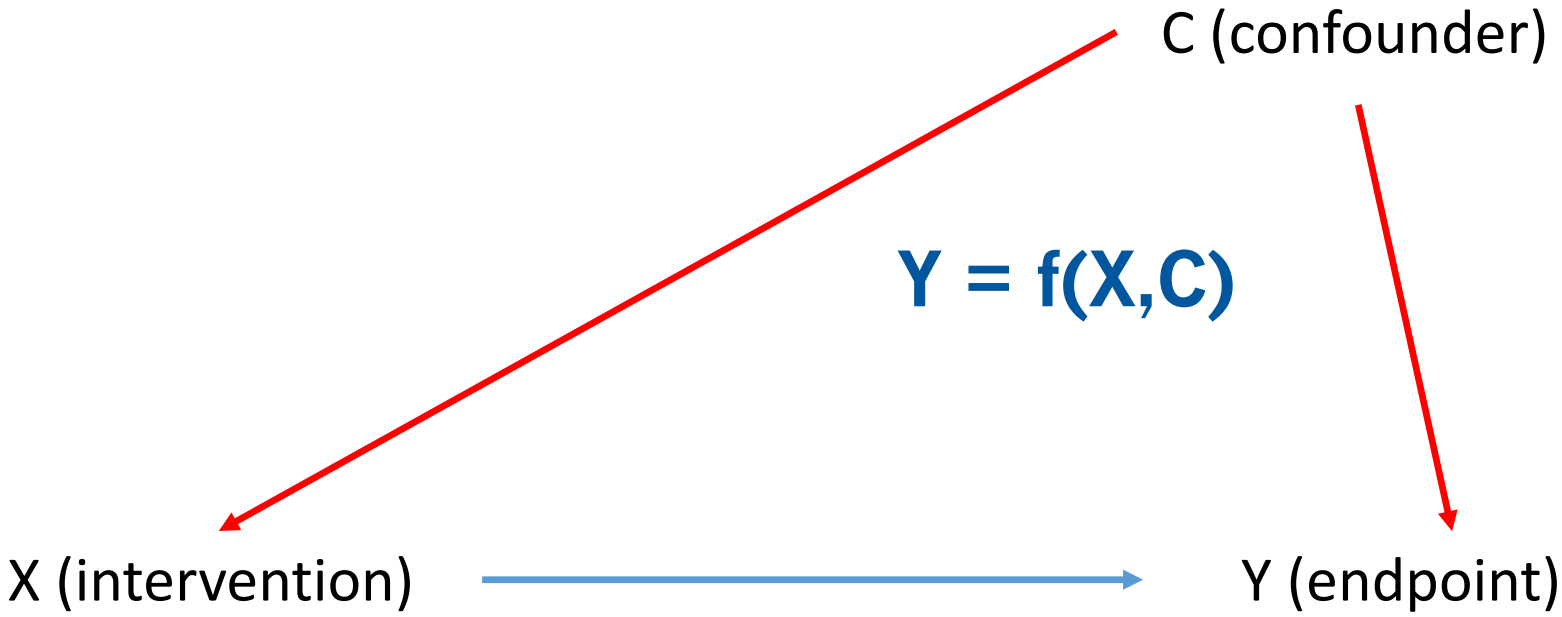
$$Y = f(X)$$

X (intervention)  Y (endpoint)

**Given an ideal experiment, the endpoint is a function of the intervention only.**

# Real Situation

**Without further measures, however, some endpoint is a function of the intervention and potential confounders:**



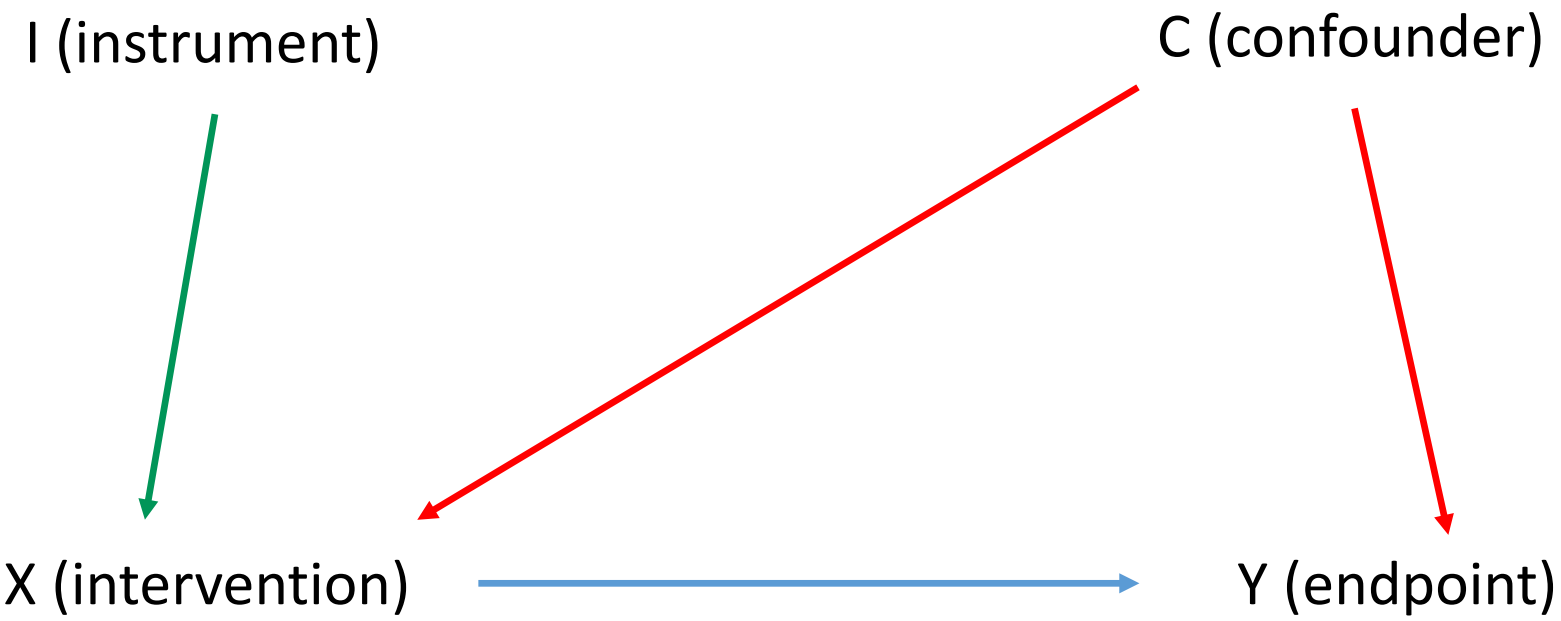
# Accessing a causal effect

There are several strategies to achieve this:

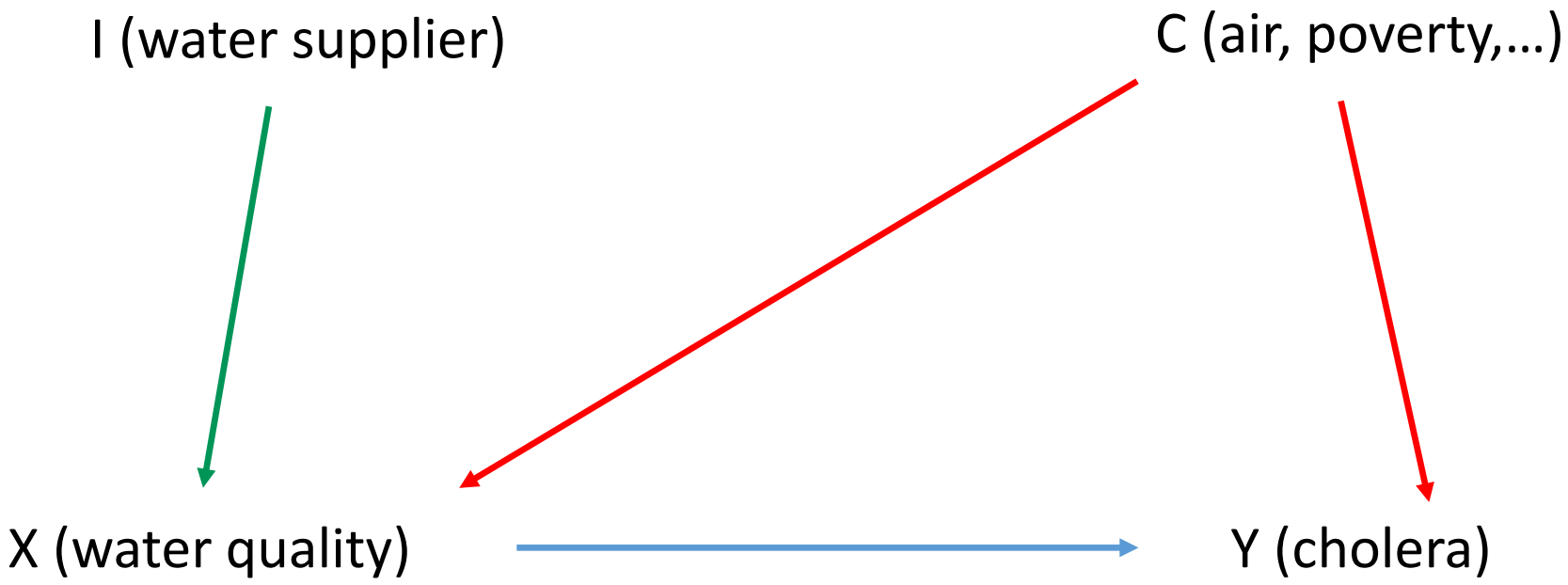
1. Pearl‘s „front door“ criterion.

2. Fisher‘s randomization.

# Instrumental Variable

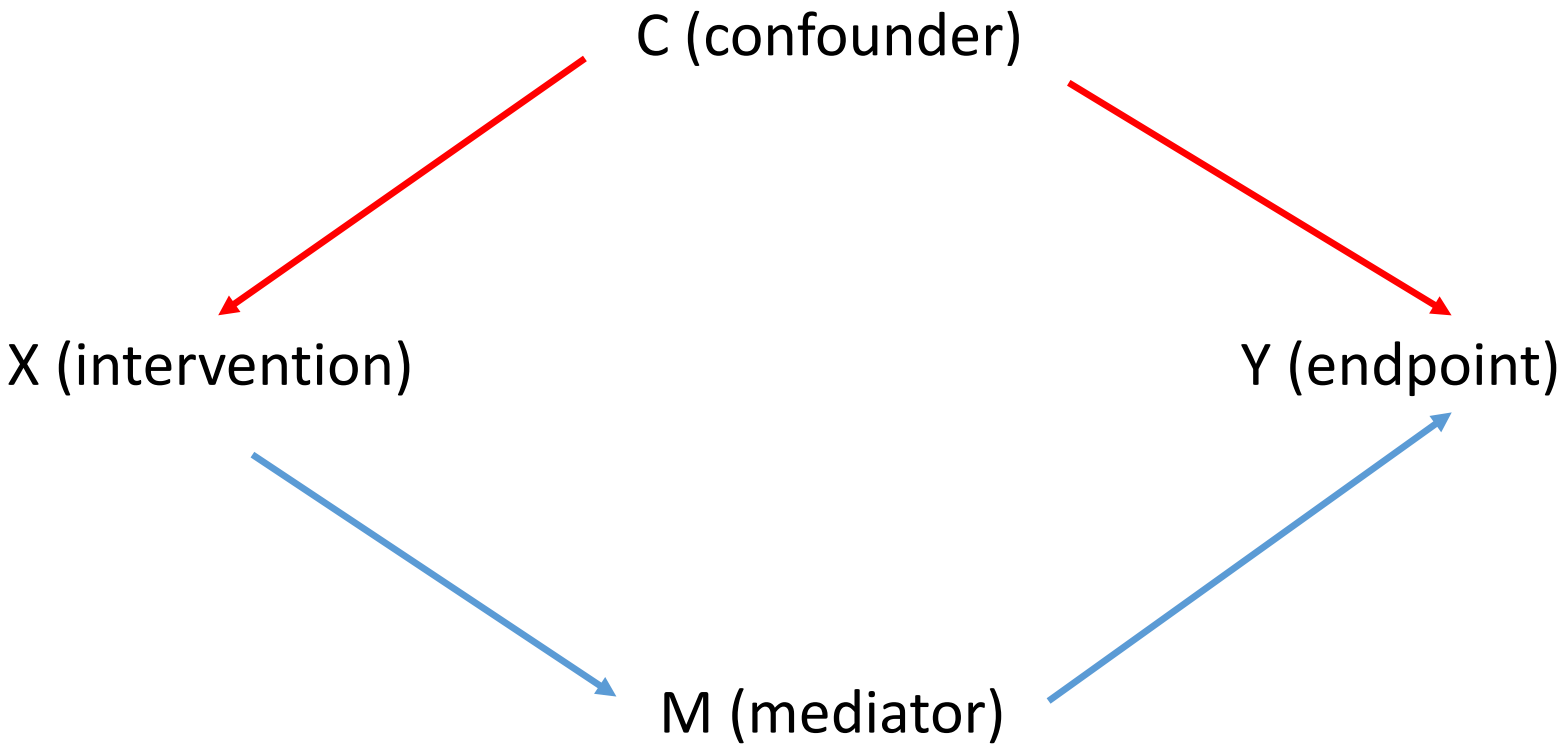


# Example: Snow (1854)




**The Book of Why [BoW], pp. 248-249**

# 1. Front Door Criterion (Pearl)




**BoW, pp. 225, 229**

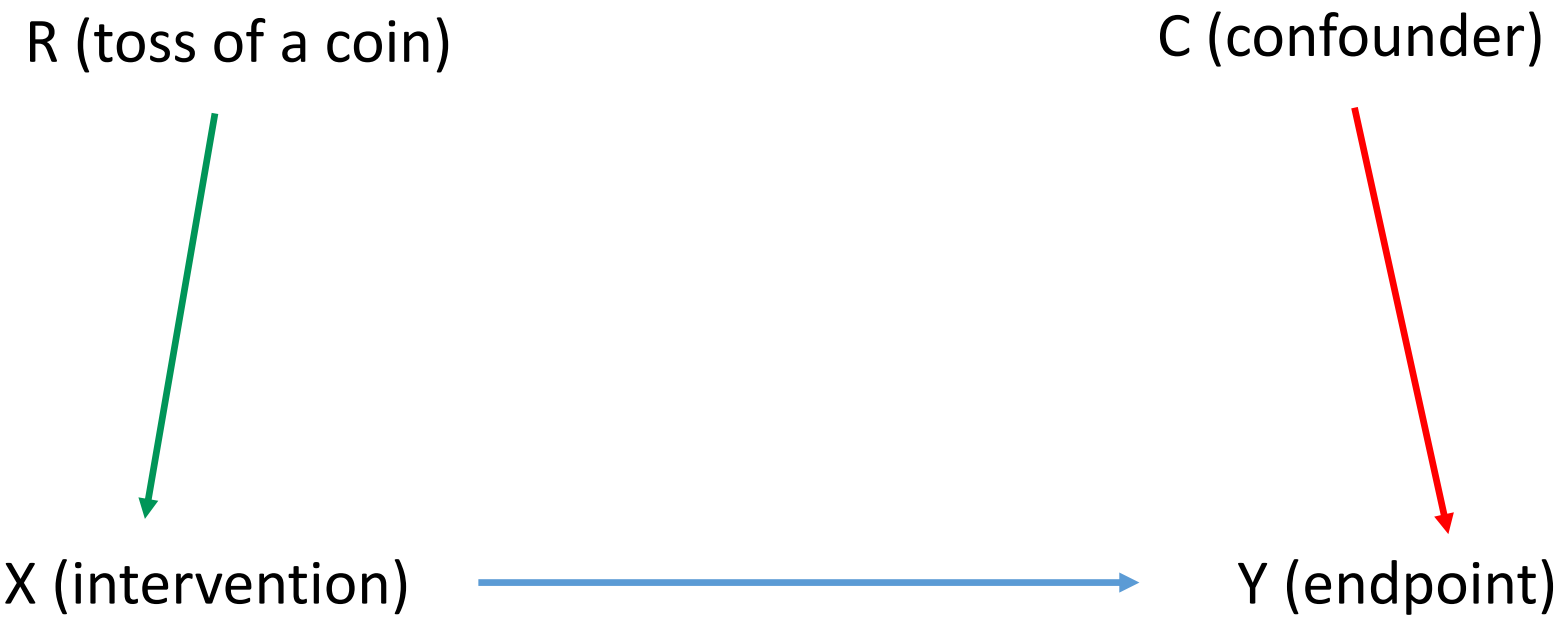
# The book of why

**BoW, p. 231, slightly rephrased:**

**Front-door adjustment is a powerful tool, since it allows us to control for confounders that we cannot observe, including those that we can‘t even name.**

**For exactly the same reason, randomized controlled trials are considered the „gold standard“ of causal effect estimation.**

# 2. Randomized Experiment



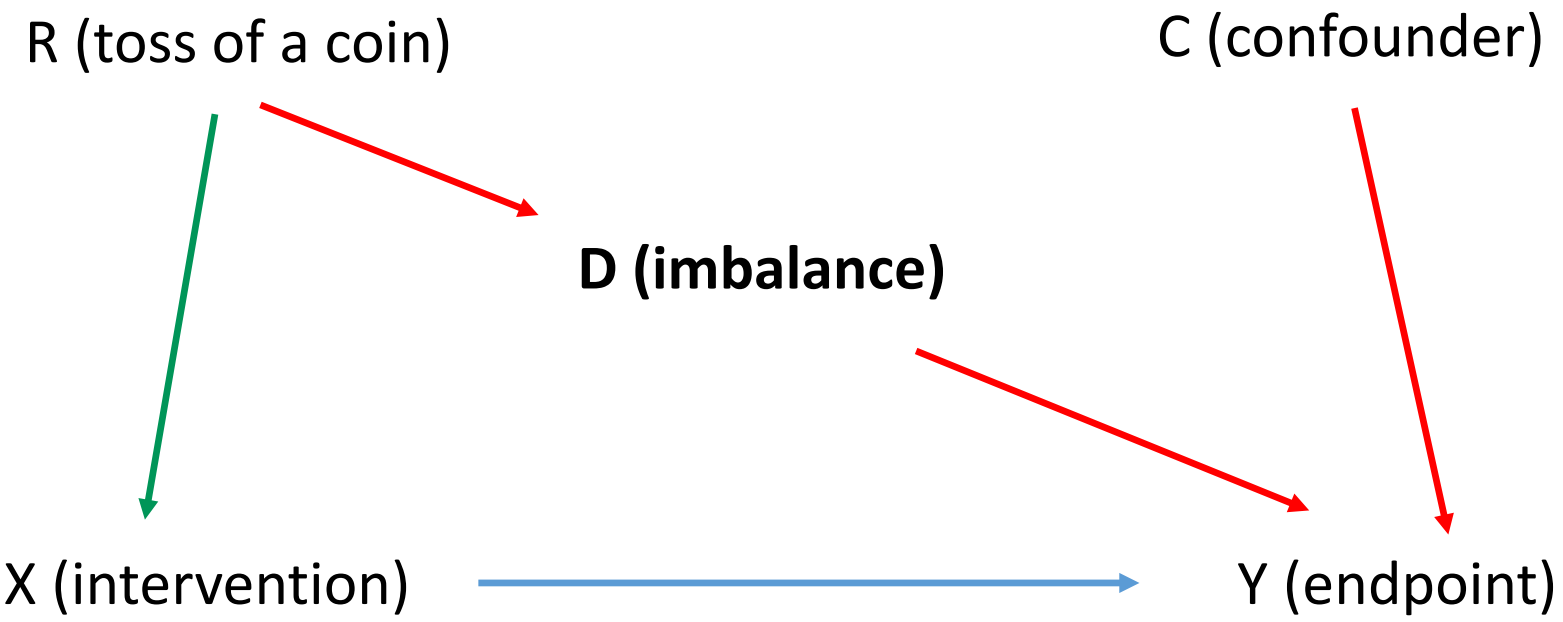

**BoW, p. 149 (simplified)**

# Randomization (Fisher 1935)

**In a randomized experiment, the outcome of some random process triggers the intervention (Treatment vs. Control, in particular).**

**According to the received view, randomization does not threaten the validity of an experiment, since it „disables all the old confounders without introducing any new confouders.“ (BoW, p. 149)**

# Randomization‘s „side effect“




## Main argument in Saint-Mont (2015)

# Tell me Why did … happen

**Alas, randomization may create an imbalance – a new path - and thus an alternative explanation.**

**Thus one cannot say why an endpoint occurred: it may have been caused by the intervention or by the imbalance.**