

Study designs for environmental and policy research

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- Different types of evidence (“evidence typology rather than hierarchy”)
- Study design is not the only predictor of the quality or relevance of the evidence
- External validity as important as internal validity

Study Designs for Environmental /Policy Research

- Randomized trials
- Observational studies
- Natural experiments
- Modeling/simulation approaches

Randomized trials

- Confounder control (“selection effects”)
- Avoid extrapolations (“non exchangeability”)
- What should we randomize to?
- Feasibility (randomization, diffusion, sample size)
- Generalizability

Observational studies

- Maximum flexibility / exploratory
- Most appropriate in initial phases of research
- Causal inference sometimes questionable
- Focus on characteristics rather than policies or interventions
- Need for rigorous analytical approaches and sensitivity analyses to methodologic problems
 - Multilevel and spatial analyses
 - Propensity score matching
 - MSMs
 - IV approaches
 - Sensitivity analyses to exposure definition

Simplifications and assumptions are sometimes OK.....

Natural Experiments

- Improved causal inference, sometimes
- Real world policy/intervention (high relevance)
- Timing and partnerships: how??
- Sometimes, natural experiments may not exist...

Modeling/Simulation approaches

- Understanding of processes can lead to identification of more effective interventions
- Systems approaches:
 - Agent-based models
 - Systems dynamics modeling

Neighborhood (spatial) patterning of health emerges from the functioning of a system:

- individuals interact with their environment
- individuals interact with each other
- individuals and environments adapt and change over time.

General Process	Example neighborhood differences in physical activity
I. Health is affected by features of neighborhood	Availability of places to be physically active and promotes physical activity
II. Persons are sorted into neighborhoods based on individual attributes	Persons of lower income and minorities live in neighborhoods with less resources

General process	Example neighborhood differences in physical activity
III. Persons select neighborhoods based on preferences for certain attributes	Physically active persons choose to live in neighborhoods with more PA resources
IV. People change their behavior in response to the behavior of others around them	Seeing more people walk in the neighborhood stimulates individuals to walk
V. Neighborhoods change in response to the behavior of residents	The presence of more physically active residents increases the availability of recreational resources

The focus of regression approaches.....

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An example: Agent-based models

- Computer representations of systems: “agents” that interact in space and time
- “Agents” defined at multiple levels (persons, businesses, governments etc.)
- Agents change or take actions in response to:
 - their own attributes
 - interaction with other agents
 - the environment
 - prior experience
- Use simulation to observe how system dynamics emerge from agent interactions and adaptations
- Use summaries of simulations to draw conclusions regarding outcomes of the modeled processes and how interventions on a given parameter may affect them

Modeling/simulation approaches

- From describing associations to modeling the processes that generate them
- Prediction of effects
 - Under conditions different from those observed
 - Accounting for feed back loops and adaptation of people and environments over time
- Conclusions contingent on validity of the model
- Process of building these models can highlight policy-relevant areas where we need more data!

Auchincloss A, Diez Roux AV. A new tool for epidemiology? The usefulness of dynamic agent models in understanding place effects on health. AJE in press

In summary.....

- Complementarity of evidence
- Sometimes we need to act in the presence of incomplete evidence (in fact we are already acting.....)
- Experimental evidence is not always necessary for action
- Key is that we learn from the results of these actions

Five recommendations...

- Draw on (and synthesize) multiple sources of evidence
 - “Match the question with the design”
 - e.g. observational studies and identification of potentially relevant “exposures”
- Develop systematic ways to capitalize on natural experiments
- Emphasize both external and internal validity
- Act on incomplete evidence but evaluate those actions rigorously
 - “policy surveillance”
 - “practice-driven evidence”
- Explore utility of systems/simulation approaches