DAGviromental health: a (re)introduction to causal diagrams and their application in environmental epidemiology research

Causal diagrams are increasingly being used in epidemiologic settings to employ causal knowledge or assumptions in order to address confounding, measurement error and selection bias. Applications of causal diagrams recently have appeared in the environmental epidemiology literature, yet in spite of their usefulness, familiarity with the formal "rules" of causal diagrams is not widespread. Therefore, for the proposed symposium, we aim to provide an introduction to causal diagrams (direct acyclic graphs [DAGs]) and provide detailed examples, relevant to environmental epidemiology, in which DAGs have been applied. In the examples, we will show how DAGs can be used to critically facilitate: the decision to adjust for serum lipids in analyses of lipophilic toxins in serum; decisions not to adjust for particular variables; the assessment of measurement error's impact in analyses of change in an outcome; and the identification and management of selection bias in studies that evaluate the health effects of environmental exposures. The workshop will conclude with the presenters using DAGs to working through selected real-life problems submitted by participants.

Note that this is a reprisal of a similar workshop offered two years ago. Some of the content—particularly the examples and consideration of cases offered by participants—is new, while other content—particularly, the fundamentals of DAGs—remains the same.

causal models, epidemiologic methods, confounding, measurement error, selection bias

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1. Introduction to session and speakers.
Speaker: Jennifer Weuve and Marc Weisskopf (co-chairpersons)
5 minutes

Introduction to causal directed acyclic graphs (DAGs).
Speaker: Marc Weisskopf (co-chairperson) and Jennifer Weuve (co-chairperson)
60 minutes

Bias from overadjustment and unnecessary correction.
Based on: Schisterman EF, Cole SR, Platt RW. Overadjustment bias and unnecessary adjustment in epidemiologic studies. Epidemiology. 2009 Jul;20(4):488-95.
Speaker: Enrique Schisterman, Senior Investigator, National Institute of Child Health and Human Development, National Institutes of Health, Rockville, MD USA.
20 minutes

Example 1: To adjust or not adjust for serum lipids in studies of the health effects of lipophilic environmental contaminants, with an extension to consider "creatinine correction."
Based on: Schisterman EF, Whitcomb BW, Louis GM, Louis TA. Lipid adjustment in the analysis of environmental contaminants and human health risks. Environ Health Perspect. 2005 Jul;113(7):853-7.
Speaker: Enrique Schisterman
30 minutes

Example 2: The impact of measurement error in the analysis of change in an outcome.
Based on: Glymour MM, Weuve J, Berkman LF, Kawachi I, Robins JM. When is baseline adjustment useful in analyses of change? An example with education and cognitive change. Am J Epidemiol 2005;162:267-278.
Speakers: Jennifer Weuve (co-chairperson)
30 minutes

Example 3: Selection bias in the evaluation of environmental exposures on pre-term birth and low birthweight.
Based on: Hernández-Díaz S, Schisterman EF, Hernán MA. The birth weight "paradox" uncovered? Am J Epidemiol. 2006 Dec 1;164(11):1115-20.
Speaker: Enrique Schisterman and Marc Weisskopf
30 minutes

Example 4: Selection bias – the underlying reason for 97-year-olds who still smoke … and why they can wreck havoc on your analytical inferences.
Based on: Weuve J, Tchetgen Tchetgen EJ, Glymour MM, Beck TL, Aggarwal NT, Wilson RS, Evans DA, Mendes de Leon CF. Accounting for bias due to selective attrition in analyses of cognitive decline: the example of smoking and cognitive decline in older adults. (submitted).
Speaker: Jennifer Weuve
30 minutes

Your research in DAGs: requests from the audience and discussion.
Based on: Questions submitted before the workshop.
Speakers: Schisterman, Weisskopf, Weuve
20 minutes