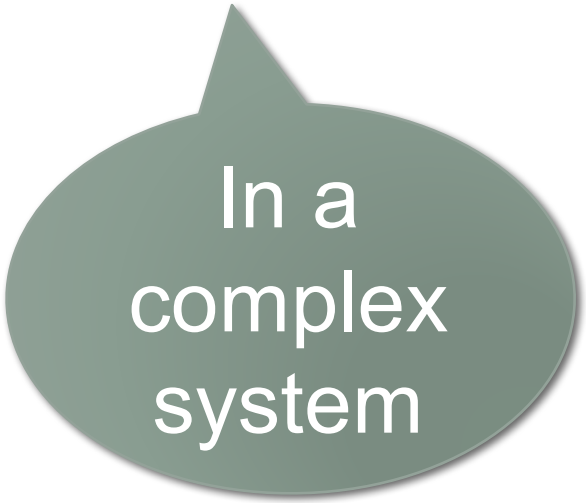
PRINCIPLES OF CAUSATION: HOW DOES CLIMATE CHANGE LINK TO HUMAN HEALTH?

Center for Health, Work & Environment
colorado school of public health

Lee Newman, MD, MA, FACOEM, FCCP
Director, Center for Health, Work and Environment
Professor
Colorado School of Public Health and School of Medicine
University of Colorado, AMC
Lee.newman@ucdenver.edu

How will we establish if climate and climate change are causing (more or different) human disease?

- 'Traditional' Approach
  - Koch's postulates
- Public Health Approaches
  - When a 'bug' is not the exposure
  - Bradford Hill Criteria
- Interventions



Conceptualizing Climate as an environmental hazard

- **Exposure to climate**
  - Direct
  - Indirect

- **Impact on human health**
  - Direct
  - Indirect

Cause of new diseases, effects
Aggravation of existing diseases
Spread of known diseases

Individual level impact
Population level impact

Meeting January 14 1965

President's Address

The Environment and Disease: Association or Causation?

by Sir Austin Bradford Hill CBE DSC FRCP(hon) FRS
(*Professor Emeritus of Medical Statistics, University of London*)

Amongst the objects of this newly-founded Section of Occupational Medicine are firstly 'to provide a means, not readily afforded elsewhere, whereby observed *association* to a verdict of *causation*? Upon what basis should we proceed to do so?

I have no wish, nor the skill, to embark upon a philosophical discussion of the meaning of 'causation'. The 'cause' of illness may be immediate and direct, it may be remote and indirect underlying the observed association. But with the aims of occupational, and almost synonymously preventive, medicine in mind the decisive question is whether the frequency of the un-

Bradford Hill's suggestions for assessing causality

Strength of association

Consistency

Specificity

Temporality

Biological gradient

Plausibility

Coherence

Experiment

Analogy

Bradford Hill Paraphrase

- Strength (effect size)
  - Size doesn't matter, but bigger is better for suggesting causal
- Consistency (reproducibility)
  - Consistent findings observed by different persons in different places with different samples
- Specificity
  - More specific an association is between a factor and an effect the better
  - Causation likely if a very specific population at specific site gets a specific disease with no other likely explanation
- Temporality
  - Effect has to occur after the cause
  - If a delay is expected, effect must occur after the delay

Bradford Hill Paraphrase

- Biological gradient
  - Greater exposure should generally produce greater incidence of effect. (With exceptions)
- Plausibility
  - Mechanism that explains the effect is nice to have
- Coherence
  - Epidemiological and laboratory findings agree
- Experiment
  - “Occasionally it is possible to appeal to experimental evidence”
- Analogy
  - Similar factors produce similar effects to the ones being studied

A core question for the Consortium: How will our research contribute to establishing causality?