

Causation in Medicine: Postulates and Pluralism?

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UCL

1880	1890	1900	1910	1920	1930	1940	1950	1960	1970	1980	1990	2000
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Epidemiological Causation

1880	1890	1900	1910	1920	1930	1940	1950	1960	1970	1980	1990	2000
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ANOVA

Counterfactuals
Sufficient-
Component Cause
DAG / SEM
Bayesian
Networks

Epidemiological Causation

1880	1890	1900	1910	1920	1930	1940	1950	1960	1970	1980	1990	2000
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Infectious Disease Causation

1880	1890	1900	1910	1920	1930	1940	1950	1960	1970	1980	1990	2000
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Infectious Disease Causation

Koch,
1882, 1890

Rivers,
1937

Huebner,
1957

Koch's Postulates – A Modern Formulation

(Grimes, D.J. 2006. “Koch's Postulates—Then and Now,” *Microbe*. 1: 233—8.)

- The same organism must be present in every case of the disease
- The organism must be isolated from the diseased host and grown in pure culture
- The isolate must cause the disease when inoculated into a healthy, susceptible animal
- The organism must be re-isolated from the inoculated, diseased animal

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Infectious Disease Causation

Koch,
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Huebner,
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Rivers' Scheme

(Rivers, T.M. 1937. "Viruses and Koch's Postulates," *Journal of Bacteriology*. **33**: 1—12.)

- A specific virus must be found associated with a disease with a degree of regularity
- The virus must be shown to occur in the sick individual not as an incidental or accidental finding but as the cause of the disease under investigation.
- If the animals display symptoms or pathological features which are related in a plausible fashion to the clinical manifestations of the pathogen in humans then the researcher should be encouraged

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Infectious Disease Causation

Chronic
Disease
Causation

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Chronic
Disease
Causation

Cassel, 1976

Wynder, 1966

Hill, 1965

Surgeon General, 1964

Yerushalmy and Palmer, 1959

Hammond, 1955

- Causality
- Bradford-Hill criteria ..
- strength (eg RR)
 - consistency, specificity
 - Temporal sequence
 - Biological gradient (\uparrow skin \rightarrow \uparrow effect)
 - Coherence / plausibility
 - interventional evidence (reversibility)

Hill Criteria

(Hill, A.B. 1965. “The Environment and Disease: Association or Causation?”
Proceedings of the Royal Society of Medicine. **58**: 295—300.)

- Strength
- Consistency
- Specificity
- Temporality
- Biological gradient (dose-response)
- Plausibility
- Coherence
- Experiment
- Analogy

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Infectious Disease Causation

Chronic
Disease
Causation

'Grand Unified' Causation

1880	1890	1900	1910	1920	1930	1940	1950	1960	1970	1980	1990	2000
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MacMahon and Pugh, 1967

Evans, 1976

Doll and Peto, 1981

Elwood, 1988

'Grand Unified' Causation

Susser,
1988, 1991

Evans' Criteria 1

(Evans, A.S. 1976. "Causation and Disease: The Henle-Koch Postulates Revisited," *Yale Journal of Biology and Medicine*. **49**: 175—95.)

- Disease should follow exposure to the putative agent
- Exposure increases disease incidence prospectively
- Exposure increases disease prevalence
- Exposure to the cause more common in those with the disease than those without *ceteris paribus*
- Dose-response relationship

Evans' Criteria 2

(Evans, A.S. 1976. "Causation and Disease: The Henle-Koch Postulates Revisited," *Yale Journal of Biology and Medicine*. **49**: 175—95.)

- Experimental reproduction of the disease possible
- Measurable host response following exposure to the cause
- Elimination of putative cause reduces incidence
- Prevention of the host's response eliminates the disease
- The whole thing should make biologic and epidemiologic sense.

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Infectious Disease Causation

Chronic
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'Grand Unified' Causation

Epidemiological Causation

Conclusions

- These causal schemes may appear convincing, but there are many difficulties with their use...
 - Terminology
 - Specificity versus strength
 - Counterexamples
- But yet they are highly successful...
- How might we regard their relationship to ‘philosophical’ causation?

Three possible scenarios

- Causal schemes do not refer
 - Schemes used to justify intuition. No relationship between causation and causal evidence
- Causal schemes refer
 - Evidential and causal pluralism
 - Evidential pluralism and causal monism

References

- Evans, A.S. 1976. “Causation and Disease: The Henle-Koch Postulates Revisited,” *Yale Journal of Biology and Medicine*. **49**: 175—95.
- Grimes, D.J. 2006. “Koch’s Postulates—Then and Now,” *Microbe*. **1**: 233—8.
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