

Counterfactual Medicine: Can Comparative Physiology Test Our Causal Models?

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Abstract

This concept paper examines counterfactual medicine: can comparative physiology test our causal models?. It develops an argument drawn from Terrain Medicine for Dinosaurs, identifies the relevant biological or clinical mechanisms, and considers where that argument may fail. This is a narrative perspective, not a systematic review or an original clinical study.

The central problem

Counterfactual biological reasoning asks what would be expected if a known physiological process operated under different size, environment, anatomy or evolutionary history. The dinosaur book proposes using extreme cases to test whether medical models are genuinely mechanistic or merely fitted to familiar human baselines. The useful insight is that physical constraints can generate bounded predictions, even when direct clinical trials are impossible.

Mechanisms and causal architecture

An animal with exceptional body mass changes surface-area-to-volume relationships, load-bearing demands and the geometry of circulation. Air-sac respiration in avian lineages introduces different ventilation considerations from mammalian lungs. A fossilized bone lesion can be compared with known tissue responses across living archosaurs, but preserved morphology does not by itself reveal the organism's symptoms, immune history or clinical prognosis. Counterfactual modeling can expose hidden assumptions in human-centered physiology: for instance, whether an explanation depends on body size, posture, metabolism or a specifically mammalian organ system.

A discriminating example

A giant sauropod and a modern bird differ in size, ecology and often anatomy, yet both exist under fundamental physical constraints. A comparative model may use those constraints to narrow possibilities without pretending to observe extinct physiology directly. This is useful reasoning, but it cannot be elevated to a treatment manual in the absence of living reference populations.

Competing explanations and limitations

The main danger is analogical overreach. Modern birds and crocodilians are not interchangeable representatives of extinct lineages; dinosaurs varied enormously over time. A model may fit a vivid story while remaining underdetermined by sparse fossils. Claims about psychological distress, gallbladder physiology, therapeutic dose or detailed infection timelines in extinct species would usually exceed the available evidence.

What evidence would change the interpretation?

A credible counterfactual paper states which parameters are known from fossils, which are borrowed from living taxa, what mathematical or mechanical assumptions are used, and how predictions change across plausible parameter ranges. Competing reconstructions should be carried through the analysis rather than suppressed. The method is weakened when it generates no observation capable of distinguishing alternatives.

Implications for medical interpretation

For Absurd Health Institute, the broader lesson is transferable: explanatory models earn credibility by surviving difficult cases, including cases unlike those from which they were first developed. That is an argument for disciplined inference, not certainty beyond evidence.

Selected scientific reading

Kitano (2002), Systems biology: a brief overview, Science.
<https://doi.org/10.1126/science.1069492>

Barabási, Gulbahce & Loscalzo (2011), Network medicine: a network-based approach to human disease, Nature Reviews Genetics.
<https://doi.org/10.1038/nrg2918>

Bailleul et al. (2019), Dinosaur paleohistology: review, trends and new avenues, PeerJ.
<https://doi.org/10.7717/peerj.7764>

Original source: Terrain Medicine for Dinosaurs. All source books supplied by the author.

Conceptual research commentary. Not a peer-reviewed clinical study, original trial, systematic review, validated diagnostic instrument or treatment protocol. Consult qualified care for medical decisions.