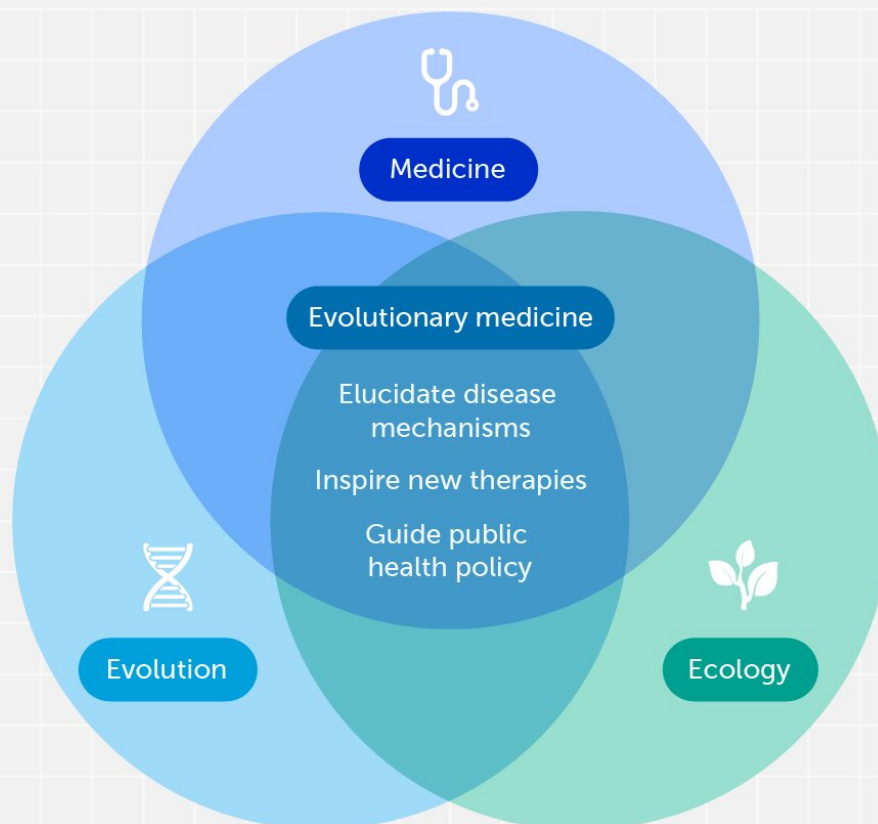


From anti-antibiotics to extinction therapy: How evolutionary thinking can transform medicine

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Evolutionary medicine can transform
biomedicine and public health



Natterson-Horowitz B et al. (2023) The future of evolutionary medicine: sparking innovation in biomedicine and public health. *Front. Sci.* 1:997136. doi: 10.3389/fsci.2022.997136

Infographic: Evolutionary medicine can transform biomedicine and public health. Credit: Natterson-Horowitz et al.

The word 'evolution' may bring to mind dusty dinosaur bones, but it impacts our health every day. For example, even though antibiotics were invented only a century ago, the evolution of antibiotic resistance is already a major concern. The rise in modern health problems such as obesity can also be traced back to evolutionary principles.

An article published in *Frontiers in Science* demonstrates how applying an [evolutionary perspective](#) to medicine can inspire new ways of preventing and treating disease.

"Evolutionary medicine holds promise to transform our understanding of why we get sick and strengthen our ability to protect [human health](#)," said Dr. Barbara Natterson-Horowitz, a cardiologist and [evolutionary biologist](#) on the faculty of Harvard University and the University of California, Los Angeles. "We came together with experts across many fields to create an overarching research agenda for extending the field."

"Our aim is to drive new biomedical innovations and effective [public health measures](#), for everything from infectious disease and pandemics to cancer, diabetes, and [cardiovascular disease](#)," said Prof Daniel Blumstein of the University of California, Los Angeles.

Overcoming chemotherapy and antibiotic resistance

Drug resistance is a global health threat in urgent need of solutions. Since bacteria and cancer cells naturally adapt to survive medications,

new drug-resistant variants emerge constantly. This problem is currently addressed by continuously producing new antibiotics and cancer chemotherapies—a temporary and costly solution.

Evolutionary diversity can inspire **biomedical innovation**

Animals resistant to high-impact human diseases

Hypertension



Giraffe

Cancer



Elephant

Aging



Naked mole rat

Type 2 diabetes



Hummingbird

Exploring biodiversity could uncover new disease-resistance mechanisms and therapeutic strategies

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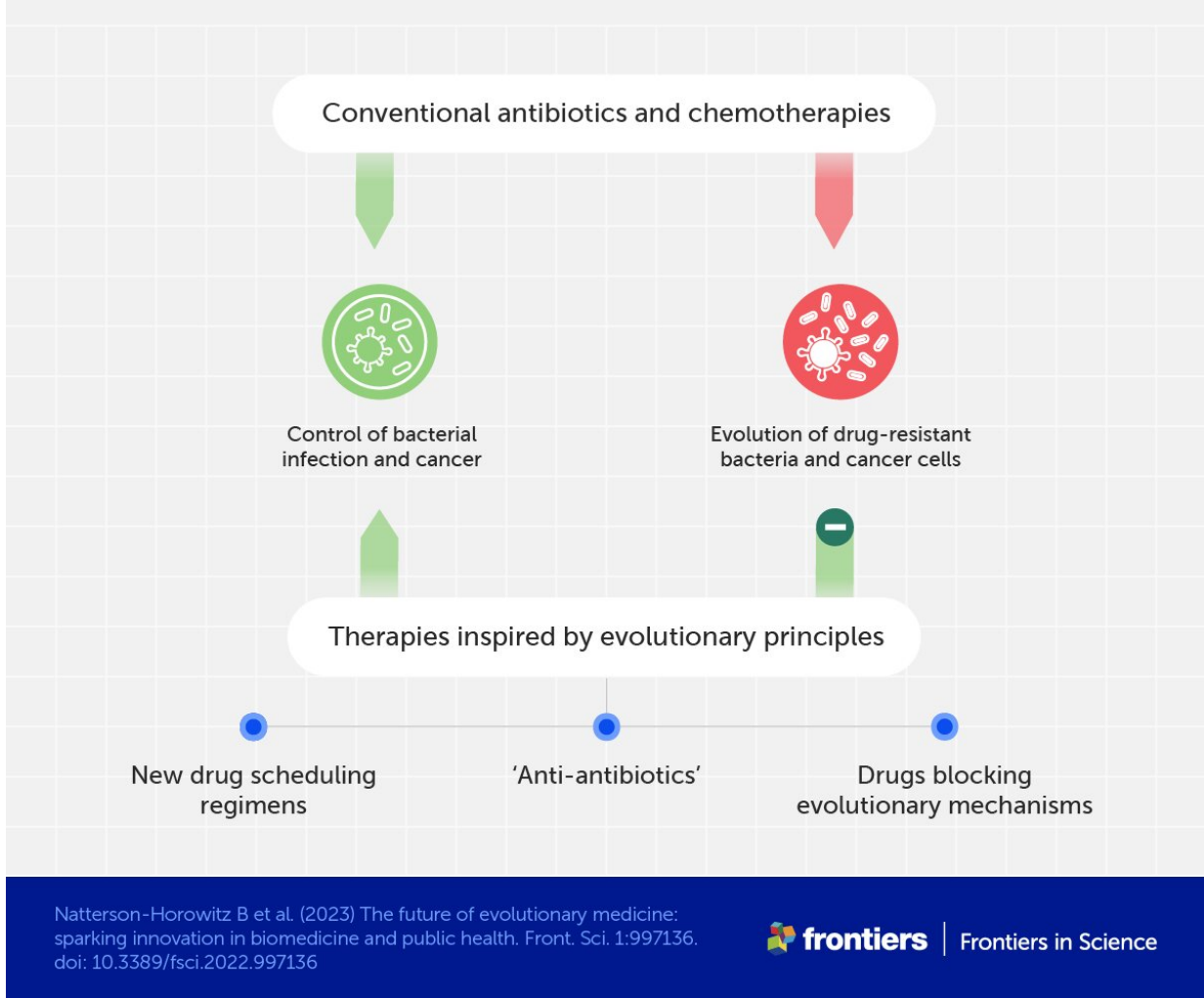
Infographic: Evolutionary diversity can inspire biomedical innovation. Credit: Natterson-Horowitz et al.

Evolutionary-inspired strategies could break this cycle. For example, 'anti-evolution' drugs could stop bacteria from sharing resistance genes with each other. 'Anti-antibiotics' are another innovative strategy that could stave off many hospital-acquired antibiotic-resistant infections. These infections often occur when antibiotics administered to the bloodstream reach harmless bacteria in the gut, causing antibiotic-resistant strains to evolve and spread. Oral anti-antibiotics that block these drugs in the gut could prevent this.

In the case of cancer, a branch of evolution called extinction biology could help tackle chemotherapy resistance. "The idea is that an effective way to eradicate a population is to first critically reduce its size with an ecological catastrophe—like the meteor strike for the dinosaurs," explained Blumstein. "And then kill remaining individuals with a second disaster—like the famine that followed the meteor."

Extinction therapy translates these principles into a clinical strategy. Patients would receive a high dose of one cancer drug to reduce the tumor size, as in current protocols. But before drug resistance has a chance to arise, the first treatment would be replaced by another to kill off the remaining [cancer cells](#).

Evolutionary medicine strategies can stem drug resistance



Infographic: Evolutionary medicine strategies can stem drug resistance. Credit: Natterson-Horowitz et al.

Using biodiversity to drive biomedical innovation

The authors highlight that many new therapeutic strategies may be

hidden in plain sight, among the biodiversity of the natural world.

"Giraffes have the highest blood pressure of any animal, and yet they don't suffer from the organ damage that hypertension causes in people. And elephants and Tasmanian devils rarely get cancer," said Natterson-Horowitz. "What is the biology that protects these animals from diseases that kill us? Extraordinarily powerful insights are out there that we haven't tapped into yet."

The authors call for a systematic mapping of disease vulnerability and resistance mechanisms in nature: "Creating this database could, within a decade, help identify unique traits and ultimately lead to novel clinical treatments," said Blumstein.

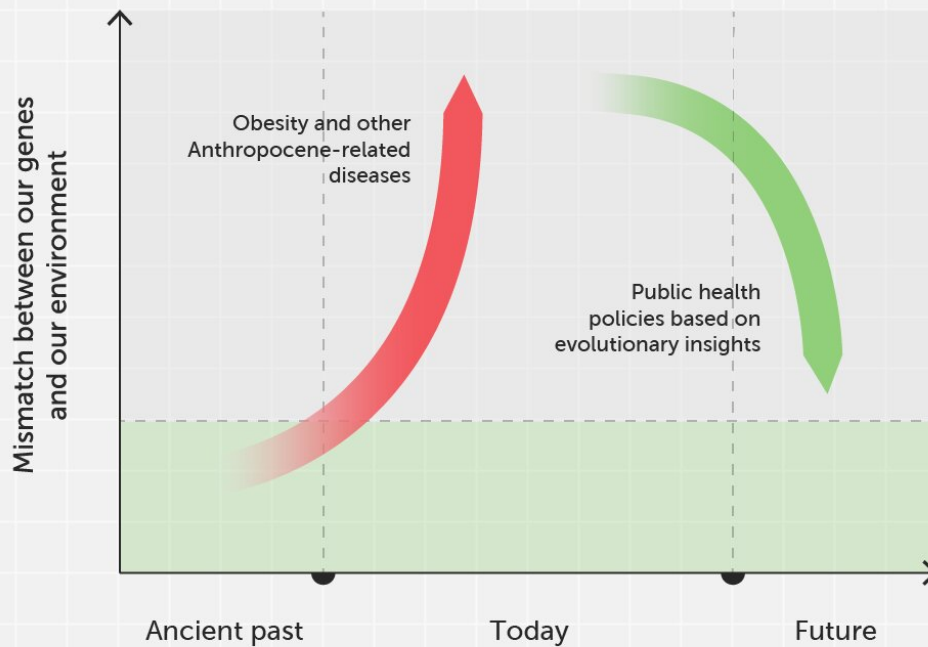
Improving public health measures

Evolutionary principles could also guide more effective public health policies. "Our bodies and minds evolved in one environment but are living in another—and that causes disease," said Natterson-Horowitz. "Cardiovascular disease, low fertility, and other common 'modern' conditions all result from this evolutionary mismatch."

These conditions are often treated as 'lifestyle' diseases with interventions that place the responsibility fully on the individual, such as exercise and dietary changes. However, this approach of changing health behaviors doesn't always work. The authors argue that evolutionary-based public health policies would focus on improving ecological conditions instead.

"It's not about treating diabetes when a person gets it at 40, but about making the investment during childhood. Policies that promote interventions early in life can have an immensely positive effect on future health and welfare," Blumstein added.

Evolutionary medicine can stem the rise in 'modern' health issues



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Infographic: Evolutionary medicine can stem the rise in 'modern' health issues.
Credit: Natterson-Horowitz et al.

An evolutionary-inspired roadmap for better health

Evolutionary perspectives are already making their way into the public and political agenda. Some countries have restricted antibiotics use and introduced taxes on sugar-sweetened beverages. However, the authors emphasize that realizing the full potential of evolutionary medicine requires greater investment and interdisciplinary collaboration.

"Evolutionary insights have tremendous—and as yet unrealized—potential to better understand, prevent, and treat existing and emerging threats to human, animal, and planetary health. Our article provides a roadmap for basic biological and biomedical research as well as the development of innovative biomedicines and more effective public health measures," the authors concluded.

More information: Barbara Natterson-Horowitz et al, The future of evolutionary medicine: sparking innovation in biomedicine and public health, *Frontiers in Science* (2023). DOI: [10.3389/fsci.2023.997136](https://doi.org/10.3389/fsci.2023.997136). www.frontiersin.org/journals/science/articles/10.3389/fsci.2023.997136

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