



EVOLUTION,
MEDICINE, &
PUBLIC HEALTH

Evolution, medicine and public health

Embracing the future

We are approaching three decades since publication of 'The Dawn of Darwinian Medicine' [1], the inspiration for the International Society for Evolution, Medicine and Public Health (ISEMPH). Much has changed since then. The year 1991 was 1 year after the Human Genome Project was initiated, also a year after the mathematics for BLAST were developed. Yet to come were Next Generation Sequencing and the explosion of population genetics and phylogenetics methods to analyze sequence data. Microbiomes were unheard of. iGEM—the international genetic engineering club initiated at MIT—was more than a decade from its inception, and long stretches of arbitrarily specified DNA sequences could not yet be made to order.

With the ensuing major increases in biological technologies, the potential for and role of evolutionary biology in addressing socially relevant problems has changed rapidly and dramatically. Genetic engineering now promises huge changes in the way humans interact with their environment, and this engineering will radically affect the evolution of species around us, important especially in agriculture, infectious disease and possibly conservation. Drug development itself now sometimes involves evolution in microcosms. Phylogenetic and population

genetic analysis of pathogens to understand their evolution and transmission has become routine in tracking infectious disease and has precedents in criminal forensics. Perhaps equally important is that evolutionary biology is now integrated with most of biology, a far cry from the state of the discipline four decades ago. This integration means that evolution has indirect ties to human health, even for work that does not fall in the traditionally perceived realm of evolutionary biology.

We are thus witnessing a profound expansion in the relevance of evolutionary biology to human health and society. The heir apparent for this new generation of evolutionary applications is ISEMPH. No other society has regarded its mission to be that of social benefits from evolutionary biology. Embracing this expansion will be exciting and rewarding. At present, some new (and speculative) applications of findings in evolutionary biology with a high potential for human benefit include:

- gene drive interventions in wildlife and disease vectors
- insect symbionts (e.g. *Wolbachia* and the suppression of insect vectors and viral transmission)
- genetically modified crops and their impact on pest evolution

- genetically modified microorganisms for the production of pharmaceuticals, food additives and other products
- genetically modified organisms for capture of greenhouse gases
- genetically modified organisms for food production and food security
- disease dynamics and epidemiology, extended to agriculture
- vaccine design
- cancer therapeutics
- evolutionary risk prediction and next-generation resistance mitigation in herbicides, insecticides and antimicrobials
- evolutionarily robust microbiomes for health, food and carbon capture
- forensics

This list is not intended to be exhaustive; rather, it inspires the imagination for much of what is starting to happen and what may come. These examples have in common a high potential for rapid growth and rigorous experimental foundations of a type that will be needed for industrial investment and regulatory approval—and for widespread acceptance.

ISEMPH was founded around a specific concept of Darwinian Medicine. Yet the science behind and the issues confronting these new applications are fundamentally overlapping with evolutionary medicine—and certainly kindred in spirit. Education about evolutionary concepts, rigorous evolutionary science, rational discussion about ethics/implications will be relevant to all these applications within and beyond medicine and public health.

ISEMPH therefore has much more to contribute than its current focus in shepherding this new era of applications. Our personal view is that ISEMPH and its journal, *Evolution, Medicine and Public Health* (EMPH), will be greatly enriched by embracing this broader role of evolution in public health and medicine, expanding the topics encouraged in EMPH and presented at the annual meeting, and offered in public outreach.

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1. Williams GC, Nesse RM. The Dawn of Darwinian Medicine. *Quart Rev Biol* 1991;**66**:1–22.