

## ABSTRACTS

# Implications of Anthropogeny for Medicine and Health

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### ***Zoobiquity and "One Medicine"***

**Barbara Natterson-Horowitz, UCLA**

Getting a bad diagnosis is about more than just having a disease. Merely hearing words like breast cancer, melanoma, stroke, septic shock, depression, and eating disorders activates high anxiety triggering an often painful and unsatisfactory search for an explanation. Self-recriminations, finger pointing, blame and shame contribute to patient suffering. Moreover, our culture's preoccupation with disease prevention has led to a widespread and dangerous fallacy: that "good" behavior in the form of eating and other health habits can prevent diseases. The implication is clear: getting sick points to "bad" choices. Increasing awareness of the occurrence of all of these "diseases of civilization" and more in wild animal species offers a path towards a more empathic and more accurate understanding of the nature of health and disease.

### ***Are There Human-Specific Diseases?***

**Ajit Varki, UC San Diego**

Comparative medicine has a long and strong tradition, in which studies of naturally occurring diseases in other animals has shed much light on the origins and pathophysiology of human ailments. Less attention has been paid to the flip side of the coin, i.e., are there diseases that are preferentially or uniquely human? In our studies of the comparative biology of humans and other hominids (the so-called "great apes"), we have encountered several surprising examples in which common human diseases appear to be either absent in these closest living evolutionary cousins, or manifest in a rather modified form. Conversely, examples exist of diseases apparently not common in humans but prominent in other hominids. Given the close genetic similarity of all these species, it is worth investigating these differences, with the goal of better understanding the pathological processes involved, for the benefit of both humans and "great apes." This talk will present a summary of available information on this topic, mentioning genetic and molecular explanations to date and related aspects of sialic acid biology differences between humans and other hominids.

### ***Evolving Milk***

**Katie Hinde, Arizona State University**

Unlike WEIRD adults- Westernized, Educated, Industrial, Rich, Democratic- far removed from the ancestral conditions that shaped our bodies and behavior, the breastfed infant develops within an "adaptively relevant environment." As an integrated food, medicine, and signal, milk nourishes, protects, and informs the developing neonate through nutrients, immunofactors, and hormones. Importantly, milk varies across species, populations, individuals, and across time. Although breast milk is described as liquid gold, and breastfeeding as the gold standard of early life nutrition, scientists have yet to identify "liquid gold standards." Decoding mother's milk is necessary to enhance precision medicine for the most fragile infants and children in neonatal and pediatric intensive care units.

### ***Heart Disease in Hunter-Gatherers?***

**Michael Gurven, UC Santa Barbara**

Atherosclerosis and other chronic non-communicable diseases are commonly believed to have been rare among ancestral humans. Instead, they are often seen as recent consequences of modern environments and lifestyles. One important lens for viewing health and disease in evolutionary context is the biomedical study of subsistence-level societies living under relatively traditional conditions without modern amenities. In order to help understand whether heart disease is an ancient stalker or a modern scourge, I will first assess the demography of

preindustrial human life span and show that long lifespan is an evolved human trait. I then discuss recent attempts to evaluate cardiac and arterial health in preindustrial humans. While evidence of atherosclerosis in both ancient and contemporary preindustrial humans exists, there is less evidence that such pathology is clinically relevant. While there may not be a single smoking gun that explains a human heart-friendly lifestyle, the importance of a well-regulated immune system may be central.

***Homeostasis, Inflammation and Disease***  
**Ruslan Medzhitov, Yale School of Medicine**

Homeostasis is a property of biological systems to maintain key parameters at the desired level, close to the set-point value in the face of external and internal perturbations. Homeostatic systems can have either fixed, or adjustable set points. The latter provide the benefit of flexibility but have a vulnerability of dysregulation, resulting in chronic diseases. The diseases of homeostasis are invariably associated with inflammation. Inflammation is a protective response against infection, injury and other environmental challenges and internal perturbations of homeostasis. While providing life saving defense, inflammation operates at a cost to homeostasis. The intricate connection between homeostasis and inflammation is rooted in underlying principles of control circuits. These principles, and their implications for human diseases, will be the focus of this presentation.

***Why Genes that Harm Health Persist***  
**Randolph Nesse, Arizona State University**

Why hasn't natural selection eliminated genetic variations that harm health? The question is central to our ability to use new genetic technologies to improve health, but there are strong tendencies to provide simplistic single answers. The old answer has been that mutations happen and natural selection is not all-powerful. This is correct and important but only part of a full explanation. The idea that genes that cause disease also may have benefits is popular but not as widely applicable as many would wish. Many variations that cause disease are not abnormal at all; they cause problems only in modern environments. Others increase Darwinian fitness at the cost of personal health. Some benefit one sex at the expense of the other. The framework of evolutionary medicine offers a taxonomy of explanations for genetic variations that harm health.

***The Divided Child***  
**David Haig, Harvard University**

My mother's kin are not my father's kin. This asymmetry results in conflicting selective forces acting on genes of maternal and paternal origin revealed in the phenomenon of genomic imprinting. Genes of paternal origin in a child are predicted to favor benefits to the child but reproductive costs to the child's mother (or other matrilineal kin) whereas genes of maternal origin are predicted to favor benefits to the child's mother. These intragenomic conflicts will be illustrated with disorders of imprinted gene expression. Beckwith-Wiedemann and Silver-Russell syndromes provide evidence that genes of paternal origin promote, and genes of maternal origin restrain, fetal growth. Prader-Willi syndrome provides evidence of evolutionary conflicts associated with breastfeeding and infant sleep.

***Adaptations to High Altitude***  
**Cynthia Beall, Case Western Reserve University**

The two major human populations that have adapted well to high altitude, the Tibetans and Andeans, have strikingly different phenotypes" (West, 2012 p. 1229). The founders of contemporary indigenous highland populations moved into their stressful environment with an ancient oxygen homeostasis toolkit that we share with all multicellular animals. Our oldest single-celled ancestors evolved in the hypoxic conditions of the early oceans, our vertebrate and mammalian ancestors evolved in atmospheres with as little as 12% atmospheric oxygen at some times – compared with 21% today. Individuals experience hypoxia during normal intrauterine life, sleep, and wound healing. Our oxygen homeostasis genetic and molecular toolkit consists of ancient elements that have functioned for hundreds of millions of years. These considerations could reasonably lead to a hypothesis that human biology retains ample capacity to adapt to chronic, lifelong high-altitude hypoxia. Indeed, an estimated 90 million or more residents at 2500m or higher demonstrate such a capacity. However, populations in different geographic areas appear to have undergone further evolution and adaptation during the past 5 – 35,000 years (depending on location) with the result that they have somewhat different biological characteristics. This talk covers different patterns of adaptive biological characteristics among high-altitude native populations and the accumulating evidence explaining why and how those different responses came about.

***Shining Evolutionary Light on Human Sleep and Health***  
**Charles Nunn, Duke University**

Scientists have made substantial progress in understanding the evolution of sleep across the Tree of Life, including in primates. Remarkably, evolutionary changes in sleep along the human lineage have been largely ignored. This omission is surprising given the extraordinary mental capacity and behavioral flexibility of humans, and the importance of sleep for cognitive performance. Based on new evolutionary analyses and studies of sleep in traditional human populations, I propose that human sleep is highly derived relative to other primates. Specifically, humans are more flexible in their sleep patterns than other great apes, and human sleep is shorter and exhibits a higher proportion of REM than expected, compared to other primates. While many sleep scientists lament the continued erosion of sleep in modern life, our new findings suggest that natural selection has been hard at work for millions of years to shorten human sleep. I will identify selective pressures that may play a role in favoring shorter sleep in humans, and I will consider the consequences of these evolutionary changes for understanding human sleep disorders, health across the lifespan, and health disparities.