

Evolutionary Medicine: An Academic Elective

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ABSTRACT

This article includes an argument for the importance of academic electives in undergraduate medical education, along with a description of an academic elective that I took during the summer of 2012. The elective was a one-week course in evolutionary medicine, which is a growing field that is guiding exciting new medical advances. The key theme of the elective was the application of evolutionary theory to research and clinical practice in the fields of infectious disease and oncology. The elective took place in the beautiful setting of Mount Desert Island, in Maine, with a small group of learners of various ages and academic backgrounds. Leaders in the field were present to discuss the bright future of this young discipline. Through this elective I was able to develop new perspectives on my approach to medicine, which I will carry throughout my career. Academic electives of all types are an effective way for medical students to widen their knowledge base, which helps in both understanding disease and in patient communication.

KEYWORDS: *evolutionary medicine, evolution, academic elective, paradigm shift, medical research, cancer, infectious disease, public health*

In most medical schools, the first two years of study traditionally consist of classroom learning while the last two years involve hands-on clinical work. Current changes in medical school curricula allow for earlier clinical exposure in years one and two at the expense of time spent in lecture and group discussion. This encroachment may be of concern, because in-depth study of the core sciences of medicine, through lecture and group discussion, lays a foundation of knowledge for students to build upon with clinical experience. Doctors must be fluent in the language of science beyond a superficial level in order to be confident in today's science-heavy, evidence-based clinical world. A greater understanding of the language of science not only helps students fully grasp the complex intricacies of patient management, but also aids in the acts of explanation to and communication with patients, which are powerful healing tools in themselves. Keeping up with the science is an ever-growing task for medical students, as the frontiers of research and knowledge continue to spread rapidly. Therefore, opting to take an academic elective is one way that medical students can expand and solidify their pre-clinical scientific knowledge base and begin their journey as life-long learners. This article is an account of the experiences that I had during a fully academic elective in evolutionary medicine.

The original article that jump-started the field of evolutionary, or Darwinian, medicine was written in 1991 by psychiatrist Randolph Nesse and biologist George C. Williams.¹ They described evolutionary medicine as the application of the theory of natural selection to medicine as a means to enhance our understanding of human biology and to improve our ability

to treat and predict the course of disease.¹ The authors gave four examples of areas in medicine in which evolutionary theory can be applied: infection (host-parasite interaction), injury and toxins, genetics, and host-environment interactions.¹ One example they explored in detail is the role of iron sequestration and fever during bacterial infection.¹ Research has shown that treating fevers in certain situations with antipyretics, as well as supplementing iron deficiency during infection, can actually worsen an infectious course.¹ Humans have evolved mechanisms to make their bodies less hospitable to pathogenic bacteria during infection, including increasing their body temperature and decreasing circulating substrates available for bacterial use.¹ Appreciation of these evolutionary explanations for the adaptive roles of fever and iron sequestration in the setting of bacterial infection informs physicians that minimal treatment may be the best treatment in this setting.¹ This is just one example of many of the uses of evolutionary medicine in everyday clinical practice. Overall, the main message that proponents of evolutionary medicine are trying to share is: we are human animals with a biological history understood best through the theory of natural selection, so why not use this truth to maximize self-knowledge, as a species, and promote human health and well-being?

I set forth to explore the field of evolutionary medicine through a one-week course that took place during the summer of 2012. The elective consisted of an engaging and dynamic combination of lecture, small group discussion, and workshops. It was bracketed by inspiring talks from leaders of the field, including Dr. Nesse, in which current advances in the application of evolutionary thought to the study of infectious disease and cancer were presented; hence the title: Evolutionary Foundations of Medicine and Public Health: Focus on Infection

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and Cancer. Two leaders in these academic niches presented their research. Dr. Carlo Maley explained how his expertise in computer programming was essential for the development of a mathematical model for clonal selection in cancers. He used Barrett's esophagus as the basis of his model.² Dr. Andrew Read, a researcher in infectious disease, argued that the conventional wisdom of treating infections with antibiotics over-aggressively is shortsighted; a more conservative approach with less selection pressure on resistant strains could increase the lifespan of our current antibiotic arsenal. He used a model of malarial infection in mice for his experiments.³ Both professors used fundamental tenets of evolutionary theory to guide their research designs and to interpret their results. Learning about this exciting research first-hand from these researchers was an experience that only an academic elective could provide.

While the majority of my time was spent learning new and interesting facts and concepts in organized lectures and discussions, the time spent outside structured events rounded my experience. There were only around 40 participants, which created a very intimate environment and facilitated engaging and insightful conversation at meals or during hikes of the local Acadia National Park. Everyone was so excited about the future of the field and their role in it; the energy and optimism was contagious. Teenage undergraduate students, middle-aged practicing doctors, and retired professors all came together through this shared academic interest. It was refreshing to learn alongside a heterogeneous and enthusiastic group of people that were present to share and create new perspectives on approaches to medicine. Clinical electives cannot provide such a diverse group of learners to interact with.

During a lecture on infectious disease and antibiotic resistance one of the older participants, philosopher of science Michael Ruse, brought up an interesting point. The lecturer was describing the historical origins of the commonly known medical truth that patients should finish their entire prescription of antibiotics, even if they feel better, during an infectious course. An old American advertisement from the early 20th century with a phrase that described this point was displayed on the screen. Michael conjectured in his inquisitive British accent: based on the wording and considering the time of its posting, the ad seemed to be hinged on the Neo-Lamarckian view of inheritance of acquired traits, and not on the Darwinian view of natural selection. Was antibiotic treatment of bacterial infection once scientifically backed by the old abandoned science of Lamarckian evolution (i.e. the evolutionary theory of inheritance of acquired traits hypothesized in the early 1800's⁴)? There was no clear-cut answer to this question, but it sparked an interesting discussion

that was a highlight of the elective and an experience that only this type of environment could foster. It turns out that the point Michael made is a highly relevant one to today, as some research in prokaryotic gene biology is starting to be viewed once again through the lens of Lamarckian evolution.⁴

The elective took place at the Mount Desert Island Research Laboratory in Bar Harbor, Maine, which is an idyllic place to study biology and ecology, and a refreshing change of pace from the busy hospital environment. The research center has a rich history and is set up as a group of cabins and tiny marine laboratories sprawled across rocky beaches on the Eastern coast of Mount Desert Island. Many researchers have gone there to study marine life during the summer months over the past century. Today, the labs are used for research in a wide range of topics within biology and ecology. Regenerative biology is one example, which is the study of cellular regeneration of constituent parts of non-mammals with implications for understanding aging in humans.⁵

To help patients, doctors must be both compassionate and knowledgeable. Academic electives are a great way for physicians-in-training to widen their knowledge base. They encourage medical students to confront ideas and interact with people that are not found in the traditional clinical setting. They also add richness to the study of medicine that will stick with medical students throughout their careers. This kind of elective opportunity is not hard to organize. I found this elective with a ten-minute online Google search. Any medical student can do the same, he/she just has to hone in on what his/her academic passion is and search for the opportunity in order to bridge it into their study. Evolutionary medicine is just one example; there are many other fast-growing, exciting fields in medicine including such disparate areas as mindfulness and meditation, medical robotics, and nanomedicine. These experiences motivate a renewed passion for learning, which will ultimately make us better physicians.

For further reading on evolutionary medicine refer to: <http://evmedreview.com/>.

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