

# Models, Medicine, and Our Future.

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If you read anything about general science in your spare time, you know that physicists are presenting a variety of models as they try to explain our world in terms of the quantum reality that is the ground of our existence, and it's not easy. Most of their models are mathematical and based on a number of dimensions going far beyond the three we take as given and even the four we can grasp. But this use of models needs to be understood in its larger frame: we all use models to explain the things we work with in the world; they frame the type of questions we ask in research and define appropriate actions. And sometimes they are grounded in ideas and concepts far less tested than quantum physics.

There is little question that we have learned a lot with the classical analytical model we have used for most of the past eight Centuries to dissect out the organs, functions, and reactions of the human body. With this understanding we have developed drugs to modify the body's reactions that are predictable in their effects, as is mandated by the FDA. But as the number of drug recalls suggests that is getting harder to do and medical researchers frustrated with the lack of workable understanding coming from the human genome project argue that we are likely at the limits of analysis. Like the physicists we need a different model.

Pharmaceutical analysis dissects out reactions of interest and focuses on them, ignoring the complex matrix of reactions from which they were isolated. Most of the recalls come when the effect of the drug on these ignored connections later bites us in the rear with unintended consequences. Also typical of such thinking was the old one gene coding for one protein idea from the early days of genetics. Now we know that there are only 20 to 25,000 genes coding for the estimated 2 million proteins in the human body. Despite the successes we have seen with the analytical model the body is obviously not a linear system. Such systems are mechanical, they have clear cause and effect relationships in their elements; they are predictable. That's why we like them so much; we want to know that what we do will bring a desirable result. But the only way to do this is with large studies that find a statistical norm, which both robs us of our individuality and totally discounts human diversity, the diversity that is the *sine qua non* of a healthy system.

Biologists have switched to an evolutionary model that is nicer to the individual agent because it allows for their adaptation and honors their diversity. Most apparent in this model is the co-adaptation of the agent trying to survive in its environment of microscopic agents trying to recycle them; and both sides in this battle adapt in ways that help them better survive—that's what natural selection is all about. So rather than asking how a particular symptom works and finding ways to balance that process as current medical research continues to do, biologists are asking why the symptoms are expressed in the first place. Natural selection underlies all our symptoms. Some of them are expressed because they give us a survival benefit. George Williams and Randy Nesse in their book, *Why We Get Sick: the new Science of Darwinian Medicine*, call these *defenses*.<sup>(1)</sup> In this view one asks why a symptom is present before jumping to treat. Many of the common and uncomfortable symptoms we all see and treat every day, when viewed in this light, turn out to be defenses that are better off honored and supported. A fever, for example, is a defense. Cold blooded animals that are artificially infected will move into the sunlight to raise their temperatures and will die more often if prevented from doing so. Warm blooded rabbits, experimentally infected and given the antipyretics commonly used on humans, will similarly die more often.

Diarrhea and rhinorrhea are two washing defenses that are commonly treated with drugs, but blocking diarrhea is associated with more irritable and inflammatory bowel conditions, and there is a direct correlation between our use of antihistamines and decongestants, which hobble our nasal defense, and the increases we have experienced in upper respiratory allergies and infections since the early 1970s when these drugs were released for over-the-counter sales.(2) If we were to hobble the defense of our favorite football team they would lose the game; unfortunately it's the same with us. If we find ways to help our defenses, as we do with oral rehydration that keeps the tank full so the GI defenses can do their work, we need less in terms of offenses.

The recyclers are not standing idle either. Microbes are the unquestioned champions of adaptation because of their numbers, their ability to speed up mutation, and their sharing of their successes by horizontal gene transfer with what ever other bacteria may have an interest;(3) and they do this with no hesitation or any indication of desire for the intellectual property rights that hamstrings our side of this arms race. So far our attempts to kill them and increase our survival have only made them more resistant; our tactics are not in our strategic interest. If we want to survive longer in this co-evolution it would behoove us to find a way to negotiate with the recyclers rather than focusing on building bigger bombs.

As well as antibiotic resistance they developed manipulations that help them recycle us faster than we wish. While diarrhea is fundamentally a defense it is also manipulated by a toxin elaborated by the bacteria causing cholera to be excessive to the point that we die of dehydration trying to wash it out. The defense of a fever is similarly high-jacked in malaria to be so high the exhausted patient becomes an unresisting meal for hungry mosquitoes. In both cases our defenses are tricked into helping the infecting agent spread.

Others, most notably Paul Ewald in his book, *The Evolution of Infectious Disease*, show that the most effective way of countering these manipulations is using commonly available means to make it harder for the infecting agent to get around.(4) Clean water (for cholera), bed nets (for malaria), condoms (for STDs), hand washing (for communicable diseases), and improved nasal hygiene (for URIs, allergies, and asthma) either block the transmission of infectious agents or help our bodies wash them out prior to any defensive signaling; and, as Ewald points out with numerous examples, assisting defenses in this way applies pressure on the the infecting agents to adapt toward commensalism, to living with us in helpful rather than recycling ways. Ewald is optimistic that this approach can end our losing battle with the microbes that actually are the Titans of life on this Earth.

Williams and Nesse introduced these ideas, already firm in the biological world, into the medical world in 1994 but there has been little interest there in seeing differently. Because of our need for predictability research in the medical world is still, and will likely remain, stuck in linear thinking and the analytical cause and effect model.

We need to see differently; we need a new model. The biological model encourages to ask why a particular symptom is expressed; it's always a good idea before jumping to treat it, no matter how bothersome it may be. And finding ways to optimize, not just our structure, but all of our other defenses is a challenge that is not too difficult to surmount; in my own practice I helped to develop a nasal spray that optimizes our defenses there.(5) As in physics where the ground of quantum mechanics has replaced the analytical, mechanical Newtonian model, our outdated mechanical model in medicine needs a radical updating.

Systems theory provides some information on how different elements work together and provides a framework for the models. There is a scale of systems that extends from a simple mechanical interaction, which is easily understood and totally predictable, to the adaptation of living systems that creates a completely unpredictable novelty very much in line with Nancy Pelosi's comment about the Health Reform Bill: "We have to pass it so

that we can see what it does.” Fundamental to this scale are the number of elements in the system and their arrangement. Simple mechanical systems are arranged linearly and are easily understood and totally predictable, even with numerous elements. When the elements start interacting with each other to form networks, however, it gets harder. The three-body problem in physics is where one needs precise information for a moon landing and must consider the forces of the earth as well as the sun as they affect the moon. Solutions to this kind of problem are best and easiest obtained with simulation programs and their accuracy and reliability depends on the how well we understand the interacting elements and how many of them we overlook. As with predicting the weather we get mostly percentages and probabilities for results.

Living systems are a step further. Not only are they complex and highly networked but they can read and adapt to their own environments; they are called complex *adaptive* systems. Even bacteria, the simplest of life forms, can respond to threatening environments, like antibiotics, by ramping up their mutation rate and developing resistance. All life forms adapt in this way by natural selection but the process takes a long time, except for the bacteria which are able to counter the time by their numbers.

On a different level that is yet higher and faster are children who are able over a few years to adapt their brains and behaviors to fit into the variety of human cultures into which they are born. Most rapid of adaptations is our conscious gaming of the various economic, social, and political environments with which we are all surrounded for our own benefit. It is the realization of the importance and the prevalence of this adaptive gaming that made Pelosi’s often denigrated comment so appropriate.

Just one example of the shift that would occur if we switched our model from the analytical mechanical one we now use, to one that recognizes that we humans are adaptive is our use of placebos. We are not sure exactly what level placebos work on, but there is little question that they do. They are now used in placebo controlled trials to control for our ability to adapt. But if we recognize and acknowledge that adaptation is a characteristic of living agents and something we all do, this new view allows us to see the placebo, not as an unethical treatment, but as an agent with very powerful drug effects that can improve our health at little expense and a great deal more safety.

## References

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