

## **PERSONALIZED MEDICINE WILL NEVER BE THE SAME DUE TO HELPFUL, TIME SAVING MODERN TOOLS AND INFORMATION TECHNOLOGY**

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Everything evolves. Earth is very different today than it was four and a half billion years ago, when it first formed. Humans, our patients, are very different today than they were six million years ago when we began to walk upright, on two legs. And medicine is a very different proposition today than it was thirty years ago.

Everything evolves, but not at the same rate. Human evolution, measured in thousands, if not millions of years moves forward in fits and starts – a mutation here, and an adaptation there. Human knowledge, and the complexity of society expand relentlessly, often randomly, down one road or another; information accumulates, populations grow and shift, needs change, unexpected problems arise, and unanticipated solutions emerge.

In medicine, we have seen, over the last several hundred years, movement away from mysticism and faith-based healing into an era of evidence-based, empirical diagnosis and management in the developed world. For the most part, this has been a positive evolution – life expectancy, particularly infant survival, has greatly increased. Infections are more quickly recognized and managed before they become pandemic, and the body of medical knowledge continues to grow exponentially.

What, then, are the problems facing medicine as we move through the 21<sup>st</sup> century, and how shall we address them? One approach is to look at the morbidity and mortality of the most common conditions and set about finding solutions, cures. This has been the approach over the last 200 years, addressing first, the plagues and infections, then cancers, and most recently degenerative diseases. Another approach identifies patients at risk for disease and looks for ways to modify that process before the individual becomes “sick”.

An alternative approach to defining the problems facing medicine is to view healthcare as a system and to ask whether the tools within that system are optimally used to meet the ends defined. If we have all the cures, but not the means of delivering them to patients, what have we accomplished? If we have the healthcare practices to manage disease, but the cost is so great that it crushes the patient and the economy, will those practices ever be implemented broadly across societies?

Medicine has lagged behind other sectors in terms of systems analysis. Systems change comes slowly to medicine, in part because of a necessary conservatism born of our prime directive to “first, do no harm”. To be sure, technology has kept pace in the development of diagnostic tools and pharmacologic interventions, for example. But in terms of integrating the exponential expansion in medical knowledge across all fields into healthcare delivery, medicine is still mired in a model that was developed in the eighteenth century.

As a neurologist and headache specialist, I will use my own field as an example, but the application to any area of medicine should be readily apparent. Accept, for a moment, that I am a recognized world expert in headache medicine. I have board certification, I publish widely, I lecture, I am current with the literature in my field, I maintain a lively dialogue with my colleagues, and so forth.

Now, assume there is a young woman with a headache. Would she not want to seek advice from a recognized world expert in headache, possessed of the broadest experience, the latest research, and the greatest resources?

Unfortunately, it is most unlikely this patient will see a specialist in headache medicine with her initial complaint of headache. Why? She has a headache, I have the knowledge base and resources to help her. Several obstacles will prevent her from seeing me, none of which are medical in nature. First, there is the issue of scale: in the U.S. there are just over 400 board certified headache specialists. There are an estimated 60 million headache sufferers. That means I need to see 150,000 patients. One can argue that not every headache patient needs to see a headache specialist, but clearly, the best way to assure that a patient is receiving optimal care is for her to see the best qualified physician in that field. Second, she lives 800 miles from the nearest headache specialist. Third, her insurance carrier will not allow her to see a specialist until she has seen a generalist.

We say for her to see me is neither practical nor possible. But we say this because of the archaic model we have for health care delivery. Suppose for a moment that we were talking about the delivery, not of health care, but of household goods or a particular recording artist's latest work. Our patient could go online to buy that set of towels or listen to that song without having to travel to a towel manufacturer or to attend a concert. It is technology that makes this possible, and we accept it readily.

The technology to eliminate the obstacles of scale, distance, access, and cost all exist and are being used in many sectors of society. The first fumbling steps are already being taken. Telemedicine, while unable to address the issues of scale, offers a solution to geographic isolation and uneven distribution of healthcare resources. Health apps have begun to allow patients to address modifiable risk factors for degenerative, chronic diseases. Wearable devices can monitor activity and communicate with devices and physicians.

Returning to our isolated headache sufferer, she can now go online, complete a questionnaire designed by headache specialists and programmers utilizing decision tree analytics, rules-based engines, and artificial intelligence to allow her and all 60,000,000 headache sufferers to tell their story to an electronic “headache specialist”. The technology can then turn around and generate a narrative report, including clinical impression, red flags and treatment options to that patient's primary care physician.

The technology exists today to provide every patient with expert advice that will help them work with their primary care provider to diagnose and manage their medical conditions, anticipate developing or worsening conditions, and maintain health, while reducing healthcare costs.