Comment

# Medicine man

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*"The surest road to health, say what they will,*
*Is never to suppose we shall be ill.*
*Most of those evils we poor mortals know*
*From doctors and imagination flow."*

Charles Churchill

I live with a physician/scientist. Her father is a physician/scientist. Her ex-husband is a physician/scientist, and her oldest son is in medical school. I'm surrounded by doctors, so you might imagine that when I'm sick, I receive excellent medical attention. Nothing could be further from the truth.

Depending on my condition, the attention I get usually takes one of two forms. If there's something seriously wrong - say, my left arm is hanging by a tendon and the socket is gushing arterial blood - the typical response is: "Oh, that's nothing. Don't be a baby." Minor ailments, however, provoke a different reaction. Suppose, I cough. They say, "Is something the matter?" "No," I say, "just a cough." "Hmm," they say, "maybe. But, you know, it could be Hammacher-Schlemmer Syndrome, where your teeth turn green and then you die."

You may laugh (I hope), but these two reactions sum up rather nicely two of the fundamental facts that guide much of the practice of medicine today. The first is that most things get better by themselves. Treat the symptoms, keep the patient alive, and the extraordinary power of the human body to repair itself or fight off invading organisms can work seeming miracles. The second fact is that it is remarkable that we are ever well at all, because the number of things that can go wrong with the human body is almost infinite.

Living with physicians is one of the things that have made me conscious of what doctors know and what they need to know. My having taught freshman chemistry, largely to premedical students, for 25 years is another. It seems to me that there is a great disconnect between what medical schools say they want doctors to know and what we teach aspiring physicians before they get to medical school. Since the premedical curriculum is driven by the Medical College Admission Test (MCAT), a standardized test that nearly every medical school requires of its applicants, this disconnect is hard to understand. Yet, a glance at the subjects covered by the MCAT turns up topics like inclined plane problems (part of the physics requirement), the Grignard reaction (part of the chemistry requirement), various aspects of calculus and so on. It does not turn up the biochemical basis of prion disease, for example, or any of the basic facts about the human genome revealed by the human genome sequence. I don't know about you, but if I were lying in the hospital about to undergo open-heart surgery, I'm not sure the first thing I would want to know about my surgeon was whether he had mastered the Grignard reaction. Nor would I forego checking his or her medical credentials, saying instead, "Tell me, Doctor, if we have a 100 kg crate which is sliding down a plane inclined at an angle of 30 degrees, and the coefficient of friction between the crate and the incline is 0.3, what is the acceleration of the crate?" and recoiling in horror with a "get away from me, you quack!" when he doesn't know the answer (which, in case you care - and you shouldn't - is 2.35 m/s/s).

A number of medical schools are finally starting to examine not only their own curriculum, which in my view (and theirs) spends too much time teaching medical students the basic science they should have learned as undergraduates, but also the requirements for admission. The most enlightened ones have the sense that the issue should not be what courses the applicant has taken but whether or not they have learned a set of fundamental concepts and have developed certain essential competencies. It is becoming clear that the existing premedical curriculum does a very poor job of both, and wastes a lot time teaching things that are completely irrelevant to medicine.

In the US today, most premedical students are required to take two semesters of general chemistry, two semesters of

calculus, two semesters of physics (at least one of which, as far as I can tell, is entirely devoted to inclined plane problems), two semesters of organic chemistry (the Grignard reaction!) and two semesters of biology. They are encouraged, but usually not required, to take a semester of biochemistry. What is not required? Genetics, cell biology, physiology, statistics, and microbiology, among other seemingly useless topics.

Here's a modest proposal to change the present curriculum, which at best is archaic and at worst is criminally stupid. Of course, the MCAT would have to change with it - in fact, it may be necessary to change the MCAT first, since that would force the universities to alter their premedical programs. Given the conservatism of, for example, the typical chemistry department, such forced reform may be the only practical approach.

I see no need for more than a semester of general chemistry. It should be followed immediately by a single semester of organic chemistry. Both of these should emphasize biochemical examples. (The Grignard reaction does not occur in biology.) In the second year, a two semester course in biochemistry and physiology would be required. The year of calculus would be replaced by, at most, one semester. In place of the second semester of calculus, statistics should be taught with a biomedical slant. The year of physics would be replaced by one semester, which emphasizes medically relevant physics such as fluid flow and mechanical stress. Anyone caught teaching inclined plane problems in this course would be pilloried. Instead of the second semester of physics, there should be a required course in genetics, one that emphasizes human genetics and genomics. The year of biology stays, but it should be taught with a cell biology slant. And here's the most interesting thing about this new curriculum: I think it would be absolutely suitable for students who intended to go on to graduate study in biomedical research as well as for medical students.

Like it or not, the emphasis in biological research is shifting towards one that favors human biology and human disease. To do such research properly, one doesn't just need a firm grounding in the basic principles of cell biology, biochemistry and biophysics. One needs perhaps a smattering of anatomy, at least a soupcon of organismal physiology, a pinch of pathology, and a heaping helping of statistics. The modern biologist needs to know how the work he or she is doing relates to disease, and they need to understand the disease as well. Not only does today's medical student require essentially the same basic science training as the modern biologist; I think that biologist would benefit from having some of the same training the medical student gets in his or her first two years of medical school.

I speak from experience here. My own research interests include the neurodegenerative diseases such as Alzheimer's and Parkinson's diseases. There are fascinating basic science questions presented by these disorders, but the more I work on them, the more I find I need to know about neuroanatomy, pathology, neuropharmacology, and other clinical subjects. In other words, the more my basic research involves human physiology and human disease, the more I wish I knew what doctors know.

Charles Churchill, whose poem opens this column, had it wrong. Most of the evils that we poor mortals know come neither from doctors nor the imagination (admittedly, he may have been right in his century, the 18th). As genomics and other branches of modern biology deepen our understanding of the true origins of disease, it becomes imperative that our doctors bring to the practice of medicine a true scientific perspective, by which I mean the use of evidence to reach conclusions and an understanding of the basic biological and biochemical principles that govern all living organisms. But I also think in this era, when biology is trying to bridge the formidable gulf between molecules and cells, between pathways and organisms, it may be just as important that those of us doing biomedical research try to learn more of what doctors know.

I'd write more, but I had a slight cough this morning, and I've got to go check the color of my teeth.