Politics and Nanotechnology in the Health Care Industry

The relationship between politics and science is a topic that is often avoided in academic circles, due to the degree of ambiguity associated with it. On one hand, as scientists and engineers, we tout the fundamentality of scientific research, with adherence only to the laws of Nature. On the other hand, the pragmatic issue of financing an individual research group, which operates to some extent as a small enterprise, requires us to justify our research proposals as being perceived to be important by politicians, media, and our community. These competing forces driving the development of science are a source of both obstacles and accomplishments, and have fueled personal successes and tragedies of many scientists and engineers. History contains many examples of technically gifted people who served politicians solely for the benefit of personal power and wealth. It also knows many cases where scientists tried to stand up against the authorities in power and failed. There are also great examples where scientific discoveries and technical inventions strongly affected governing policies. From this perspective, there should be a balance between these conflicting currents of science and politics; this Editorial is an attempt to move in this direction.

Currently, the most active debate in the U.S. is about healthcare reform. Since a large part of nanotechnology research is focused on biomedical applications, we can first consider this debate from a technical perspective. The basis of the problem is the increase of the cost of healthcare outpacing the benefit to the consumers, especially in the U.S. The U.S. spends more *per capita* on health care than similar developed countries, including Germany, France, Switzerland, Norway, Ireland, Finland, Czech Republic, and others. At the same time, life expectancy in the U.S. is 77.5 years, lower than the average of 79.3 years in developed countries. The statistics on infant mortality, which is one of the key healthcare indicators, are even worse. Infant mortality is 6.6 per 1000 births in the U.S., as opposed to 5.4 in Canada and 3.3 in the majority of developed countries.[1] *Per capita* costs are 2−3× higher than in these countries with better major healthcare indicators (Figure 1). Thus, a lot of money is being spent, but the results indicate poor efficiency of this spending. Overall, it means that the additional billions of dollars do not result in concomitant health benefits for most U.S. citizens.

There is a notion in Washington that the primary reasons for rising healthcare costs are costly innovations and the expensive research these new technologies require.[3] However, this is far from being true. An analysis of the contributing factors to healthcare costs rising above inflation rates in 2006−2007 supports this point. These factors are reduced competition from providers (48.0%), cost shifting (31.3%), and higher priced technologies (25.0%).[4] The breakdown of these components is quite revealing. The actual advances in treatments that would benefit both patients and doctors account for only a quarter of the costs. This is an inappropriate distribution of consumer money. It is also indicative of a systemic problem in the industry, which might be analogous to that which resulted in the recent bank crisis.

Moreover, the cost of technological advances itself is not spent well. There are data that $700 billion are spent in the U.S. on unnecessary medical tests,[5] which contributes to the excess in healthcare spending as cited above. Anecdotally, there is evidence that a blood test in the U.S. can cost up to $800 (which my students and postdocs sometimes pay from their own pockets), whereas in other countries, the same test can cost less than $80 and yield results of equal quality.

What does it all mean from the perspective of nanotechnology research and its medical applications? As scientists and engineers, I do not think our time would be well-spent trying to fix the systemic problems of the healthcare industry, beyond that which we spend in the voting booth. This is what elected officials do. However, there are ways to affect considerable change in the system through the development of effective technologies that can reduce the pervasive role of the middlemen between the doctor and the patient. For example, personalized testing and in-home diagnostics can eliminate unnecessary spending

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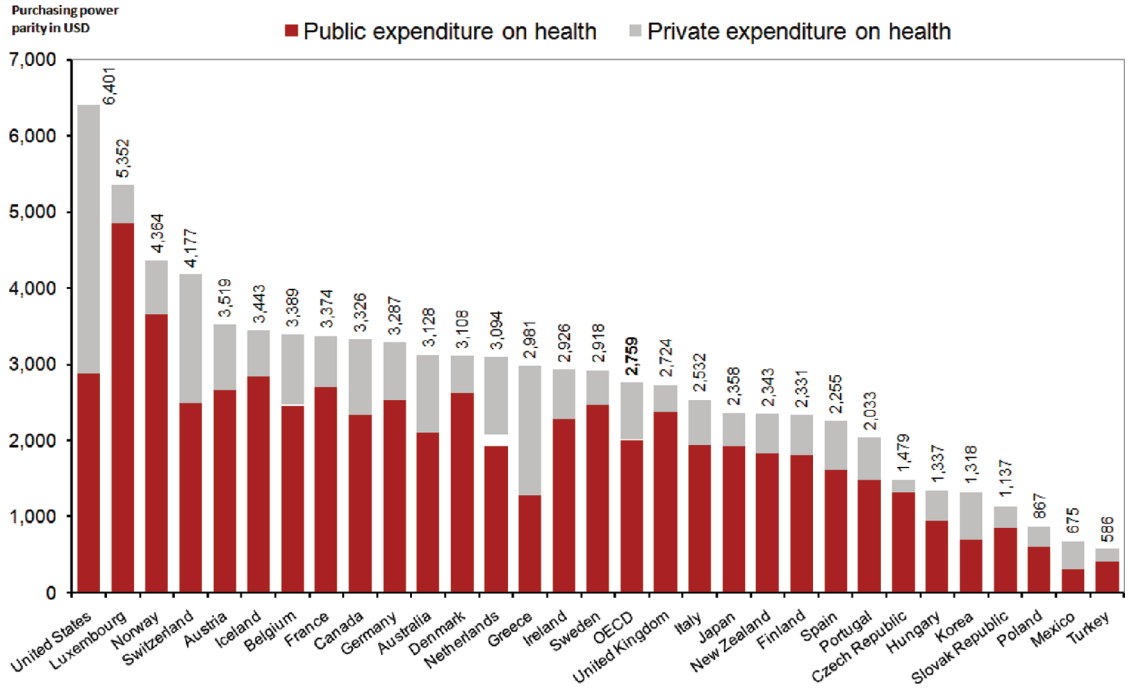

Figure 1. A global, *per captia* comparison of health care expenditures in 2005. Reproduced with permission from ref 2. Copyright 2007 Organisation for Economic Co-Operation and Development (OECD).

or simplify the application of medical tests, and thus appear to me to be one of the key technologies that can change the *status quo* of the health industry. There will be issues to address with respect to the quality of these in-home tests, their unbiased nature, and the delivery of the test results to an individual's doctor; however, these solutions are not hard to find and to implement, especially considering the rapid development of information technologies. As these new methods of medical testing become more common, even more innovative devices will become available and progress in this area will be difficult to stop. This is indeed the area where nanoscale materials and new sensing methodologies can make a tremendous societal impact, and we have already seen much fundamental progress in this area and on our pages.[6,7]

There are other benefits to funding research toward advances in point-of-care diagnosis and treatment that will extend beyond the healthcare industry. Point-of-care testing is a critical technology in global and homeland security, as Michael Natan points out in his Nano Focus in this issue,[8] in the development of hand-held devices for the detection of biological and chemical agents. Here too, nanomaterials can have a significant impact.

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