

Applying Nanotechnology to Medicine

Dr. Mauro Ferrari on biotechnology and cancer treatment.

To many, nanotechnology is viewed simply as a “small scale” technology that will someday change the world. They would be surprised to know that the technology arrived long ago, and that it has already changed our lives in ways we don’t fully appreciate. In fact, one research report projects the global market for nanotechnology-based products to exceed \$1.6 trillion by 2013, thanks in no small part to its biomedical applications.



One of the leading authorities of this multi-disciplinary technology is Dr. Mauro Ferrari, PhD, President and CEO, Ernest Cockrell Jr. Distinguished Endowed Chair at The Methodist Hospital Research Institute, and President of the Alliance for NanoHealth, in Houston. Dr. Ferrari’s address at the September 22, 2011 meeting of “PIB-Professionisti Italiani a Boston” provided not only technological insights, but a look into the life and personal motivation of an internationally recognized expert in the

development, refinement and application of biomedical nanotechnology.

Dr. Ferrari grew up in Udine, the capital of Friuli, in the northeast corner of Italy close to Austria and Slovenia. He traced his life beginning as a youth who developed passions for basketball and jazz. He teased the PIB audience with the complaint that years later, nobody cares to discuss those erstwhile talents. Subsequently, he trained in mathematics, engineering and medicine, and he has published approximately 200 peer-reviewed articles.

The profound impact of his family upon his career decisions became clear when he faced the death of his wife, which was a turning point in his life. Doctors informed him that their inability to treat his wife was primarily a function of not being able to deliver the right drugs to the right place in time to treat her illness.



At that time, Dr. Ferrari was working in the field of physics, and he made the decision to turn to medicine. Understanding that he needed formal training beyond his engineering background if he were to make meaningful contributions in applying nanotechnology to medicine, he enrolled in medical school at the age of 43, the oldest person in his class.

To Dr. Ferrari, the future of cancer therapy lies in personalized medicine, which is the use of clinical, genetic and molecular information to tailor treatments for individual patients. He emphasized that nanomedicine is synergistic with molecular medicine, which is the branch of medicine that deals with the influence of gene expression on disease processes and with genetically based treatments such as gene therapy.



In his review article, “Cancer Nanotechnology: Opportunities and Challenges” (Nature Publishing Group, Volume 5, March 2005), Dr. Ferrari points out that decades of significant advances in cancer biology have not translated into remotely comparable advances in the clinic. He emphasized that the translation of bench, or discovery, work to the clinic remains one

of the biggest challenges in development new treatments for diseases.

To increase the efficacy of both therapeutic and imaging agents, scientists and clinicians need to improve the selectivity of such agents for their disease-related targets. In addition, they need to build into these products the means to overcome the layers of biological barriers that stand in the way of reaching those targets.



Finally, new therapies would be ideally designed to reach, inhibit and destroy molecules and cells at the earliest stages of disease development.



According to Dr. Ferrari, the real excitement is not simply in manufacturing nanomedical

products but in integrating them into a larger environment and thus moving them into the “real world.” He outlines a number of related priorities to achieve this goal in “Seven Challenges for Nanomedicine” (Nature Publishing Group, Volume 3, May 2008).



They include: (1) determining where nanoparticle carriers actually go in the body (their distribution) following systemic administration; (2) developing ways to visualize such distribution over time; (3)

understanding how nanoparticles cross barriers in the body; (4) and (5) developing new mathematical and computer models that will serve to predict risk and benefit; (6) establishing standards and consensus protocols to assist in developing novel classes of materials; (7) constructing a toolkit for nanop pharmaceutical manufacturing.

Dr. Ferrari pointed out that success in these complex endeavors requires a broadly collaborative effort from many partners, none of whom can solve any one of them alone. The potential of nanotechnology in the field of medicine is still largely untapped but beginning to be realized. Its overall goal is simple to understand and harkens back to a turning point in his life: get the right drugs to the right place at the right time.

Text by Bill Boni, pictures by Dawei Ye.

Reports and pictures from PIB's 2011 events are at <http://www.PIBoston.org>. The organization's goals for 2012 include expanding partnerships and with existing groups of Italian professionals in several cities of the world, and creating new ones when needed.

PIB gratefully thanks the sponsors of this event:

