

BIOMEDICAL TRANSLATION



Katrina L. Kelner is the Editor of *Science Translational Medicine*, AAAS, Washington, DC 20005, USA. E-mail: kkelner@aaas.org



Marcia McNutt is Editor-in-Chief, *Science* journals, AAAS, Washington, DC 20005, USA.

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Five Years of Advancing Science, Improving Health

IN OCTOBER 2009, THE NOBEL COMMITTEE AWARDED PRIZES FOR BASIC RESEARCH on ribosomes and telomeres. In the same month, AAAS launched a new journal with a different focus—*Science Translational Medicine (SciTM)*—staking out a central role for the organization in advancing human health. One year later, awards at the pinnacle of science also recognized more translational achievements (1).

Worldwide, scientists are thinking more about the translational value of their work, and big efforts have been funded to create institutes that bridge basic research and clinical practice. Over the past 5 years, there has been an exciting outgrowth of research programs and funding resources focused on discoveries at this interface. With the guidance of Elias Zerhouni, *SciTM*'s founding Chief Scientific Advisor and former director of the U.S. National Institutes of Health, the journal shaped its mission: to provide an interdisciplinary forum for research that makes tangible progress toward improvements in clinical medicine by applying basic biological research and engineering science. Then, and now—with Chief Scientific Advisors Elazer R. Edelman and Garret A. FitzGerald at the helm—*SciTM* publishes findings from all areas of biomedicine, including those with roots in engineering and in the physical sciences.

On this 5-year anniversary of *SciTM*, the journal's progress and support of this exciting and vital “bench-to-bedside” enterprise can be traced through its published papers that have spurred encouraging translational progress. Early success was reported in 2011 with the treatment of two advanced leukemia patients with T lymphocytes engineered to attack tumor cells (2). These therapeutic immune cells—decorated with chimeric antigen receptors—seemed to be long-lasting memory T cells, raising hopes that remission would be permanent. Today, these patients remain cancer-free. Numerous biotech and pharma firms are now genetically engineering T cells, and the approach appears to work for other blood cancers. At present, 52 clinical trials employ these engineered receptors for targeting cancers ranging from leukemias to neuroblastoma. Cancer immunotherapy was chosen as *Science*'s 2013 Breakthrough of the Year, and the field is poised to make more major leaps.

SciTM also published a key resource for exploring the links between disease and the human microbiota—a mouse model in which microbes of the human gut set up residence in the mouse gut for study under controlled conditions (3). Since then, this model has shown that intestinal microbes transferred from obese or malnourished people confer these maladies to recipients and that gut microbes contribute to colon cancer and fatty liver disease. Further elucidation of microbe-disease associations using this model will lead to treatments and preventions that improve health.

In an early application of bioengineering to cancer, *SciTM* reported an implantable vaccine depot built from a polymer matrix (4). Loaded with a soluble signal to attract immune cells, the polymer triggers an immune response in the host, just like a natural infection. Mice carrying the implant produce lymphocytes that kill cancer cells and squelch undesirable immune cells, resulting in tumor regression and longer survival. This fruitful collaboration among materials scientists, bioengineers, and immunologists has led to a clinical trial of a small disklike sponge inserted under the skin of patients with melanoma—the first test of the system in humans.

Some of the research published in *SciTM* targets more distant translational horizons. For example, in 2010, Scherzer and his colleagues gave us a glimpse into the future of biomedicine (5). With the aid of a systems biology approach to Parkinson's disease, the investigators zeroed in on the mitochondrial enzyme *PGC-1 α* as a key determinant of pathology. Inhibitors of this pathway, identified by large-scale drug screens, are now poised to enter clinical trials. This approach presages an era of routine discovery of disease-driver networks from computer-supported, integrative analysis of omics data sets.

Engineering is teed-up to profoundly change medicine in the next decades. Digital medical devices and biosensors will allow collection of unprecedented amounts and types of data in clinical trials and remote health care. The marriage of innovative materials, devices,

and biological components has paved the way for new therapeutic modalities and drug-discovery approaches. In *SciTM's* pages, Ingber and co-workers (6) first validated one of the many “organs on a chip” by showing that an experimental drug for pulmonary edema effectively treated lung cells grown in a “breathing” microfluidic device; the results were replicated in dog and rodent models of pulmonary edema, as reported in the same issue (7). Such artificial devices, born of deep understanding of biological tissues and materials, promise to expand our drug-screening repertoire and enable the discovery of new classes of drugs.

Biomedical discovery and translation also require innovations in funding, education, data-sharing, regulatory science, health care delivery, and patient participation—as well as the policy changes that make innovation possible. *SciTM* will continue to feature, in our freely accessible commentary articles, the community’s timely debates on a variety of policy issues (bit.ly/10pmBi7).

Although awards and citations are intellectually satisfying, nothing compares with knowing that one’s research has had an impact on the future well-being of society. With its focus on innovation, the translational-medicine community continues to create new opportunities for facilitating the application of science to clinical medicine. *Science Translational Medicine* looks forward to showcasing the results of these efforts.

– Katrina L. Kelner and Marcia McNutt

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