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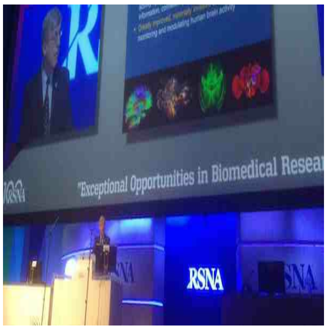
# RSNA 2014: NIH Director: Imaging Research Offers Great Opportunities




Director of the U.S. National Institutes of Health (NIH), Francis S. Collins, MD, PhD, today addressed RSNA meeting delegates about opportunities in biomedical research for imaging researchers. He noted that what is happening in imaging is “up there in the list of the most exciting opportunities in biomedical research - the excitement is palpable.” However, cautioned Collins, it is not the easiest time to be pursuing medical research given the strain on resources. The paradox is that science has never been more exciting and resources rarely more stresed.

The NIH is the steward of medical and behavioural research for the United States. Its mission is science in pursuit of fundamental knowledge about the nature and behaviour of living systems and the application of that knowledge to extend healthy life and reduce illness and disability. 145 NIH-supported researchers have become Nobel Laureates. Collins outlined biomedical research’s impact on the health of the United States. For example, cardiovascular disease death rates have fallen more than 70 percent in the last 60 years. Cancer death rates are decreasing by around 1 percent a year; each 1 percent drop saves around $500 billion.

Collins outlined the major opportunities for biomedical research:

**1. Apply breakthrough knowledge and technologies to enhance understanding of biology and disease.**
As an example, Collins cited the Brain Research Through Advancing Innovative Neurotechnologies (BRAIN) <> initiative. At best this work is 10-12 years. The first five years will have an emphasis on technology development. The second five years will emphasise discovery-driven science.

**Example deliverables: 5 years**

- **Census of neuronal and glial cell types** in animal models (“parts list”) plus intellectual framework for cell classification
- Methods to **map neural connections** in human and animal brains with improved speed, cost, resolution, throughput
- Technologies for **high density electrical and optical recording** of neural activity in local and distributed circuits
- Technologies for **perturbing electrical and biochemical activity** in defined sets of neurons, at cellular resolution, < **in real time**
- Integrated teams of clinicians, scientists, engineers, ethicists, regulatory specialists for **advancing human subjects research**

**Example delivera**bles: 10 years

- **Extension of cell type census to humans** : tools to deliver genes, proteins, drugs to defined cell subpopulations
- **Integrated systems for combining measurements** of brain activity dynamics with perturbation, behaviour, cell type information, connectivity maps, theory
- **Greatly improved, minimally invasive** technologies for monitoring and modulating human brain activity
- **Systematic theories** of how information is encoded in the chemical and electrical activity of the brain

Collins asserted that the Brain initiative will push imaging technologies to the next level. Roderic Pettigrew, Director of the National Institute of Biomedical Imaging and Bioengineering (NIBIB) at the NIH wrote an editorial in Science Translational Medicine about the initiative.

Another example Collins cited was the Human Genome Project, 1990-2003. We have had the human genome for 11 years, but application is still lacking on what to do with information. The NIH HapMap project will develop a public resource that will help researchers find genes associated with human disease and response to pharmaceuticals. Collins noted that the cost of sequencing a human genome has fallen from 100 million dollars in September 2001 to around 5000 dollars now.

The Enhancing Neuro Imaging Genetics Through Meta Analysis (ENIGMA) project which looks at brain imaging and genomics has discovered the spon1 gene variation, which influences dementia severity.

The Cancer Genome Atlas is a coordinated effort to accelerate understanding of cancer through genome analysis to improve diagnosis, treatment, and prevention. It provides analysis of more than 20 types of cancer, including leukaemia, breast, colon, bladder, brain, lung, ovary, thyroid. The Cancer Imaging Archive links the imaging archive and genome atlas. Currently it has 45 datasets consisting of 30,000+ subjects, There are over 26 million images and over 50,000 unique visitors from 159 countries. The images are de-identified, curated and freely accessible.

Big Data to Knowledge (BD2K) IS NIH’s six year initiative to:

- facilitate use/sharing of large, complex biomedical data sets through new policies, resources, standards
- develop new analytical methods and software
- enhance training of data scientists, computer engineers, bioinformaticians, other researchers
- establish centres of excellence to address biomedical analytics, computational biology, medical informatics

The first grant awards for this programme were announced in October 2014.

**2. Translate Basic Science into Better Treatments**
The NIH's National Center for Advancing Translational Sciences (NCATS) works on delivering new treatments to patients faster. An example is the Accelerating medicines partnership (AMP), a partnership between NIH and 10 pharma companies. As drug dvelopment can take 14 years and failure rates are high, the project is looking at unjamming bottlenecks. In particular AMP is looking at treatments for Alzheimer's disease, lupus, diabetes and rheumatoid arthrities. It is designing a research plan that includes go/ no go timelines and has 50/50 research funding from NIH and pharma companies. Importantly, the data is immediately accessible to anyone who wants it. The AMP has a pilot project on Alzheimer's disease that aims to incentivise use of exploratory biomarkers in clinical trials to develop biomarkers of disease progression and surrogate endpoints. It will work with the Food and Drug Administration (FDA) to ensure a clinical path forward for biomarkers, and conduct network analysis using human brain samples to identify genetic nodes and networks to support target validation. The project aims to identify people who are high risk, before the onset of symptoms.

**3. Improve Healthcare Through Science**
An example is MR elastography, which combines MRI and acoustics to quantitatively assess the mechanical properties of tissue. It is used in the liver and for surgical planning for meningioma.

THE NIBIB-RSNA Image Sharing Network has the goal of a patient-centred medical imaging sharing web-based system. As at October 2014 there are 7 centres, 60 thousand exams, 13 million images, with exponential growth to 30 centres in 6 months. It offers great potential for use in clinical trials.

Regarding clinical trials, the NIH will insist that data is available within 13 months of the last data collection from the last patient. Collins wrote about it in the NIH Director's blog: "Honoring our promise". Patients participate in clinical trials because they want to help someone else. There is no longer an excuse to hide the data.

**4. Sharpen Focus on Global Health**
Global is not the opposite of domestic, noted Collins. On example is a partnership in India, which produced a piece of equipment, based on optical coherence tomography and costing $1,000 to provide low-cost screening for oral cancer. Such projects can also lead to "reverse innovation", technology transfer from low-resource to high-resource settings.

**5. Reinvigorate the Biomedical Research Community**
The NIH aims to support innovative people with various awards. It is also enhancing the diversity of the biomedical research workforce, with better mentoring and research experiences.

Collins concluded by emphasising that there is a 2- to 7-fold return on every dollar invested in the NIH. There is currently a gridlock in fiscal decision making in the U.S., and the fact that NIH funding comes from a discretionary budget does not help. He expressed his concerns about the reduction of spending in the U.S. on research, compared to other countries, even those in recession, that are increasing the percentage of Gross Domestic Product (GDP) invested in research.

**Links**
NIH Director's Blog
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*Claire Pillar*
*Managing Editor*
*HealthManagement*

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