DEPARTMENT OF HEALTH AND HUMAN SERVICES

NATIONAL INSTITUTES OF HEALTH

The Future of Biomedical Research

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Good morning, Mr. Chairman and distinguished Members of the Subcommittee. I am Francis S. Collins, M.D., Ph.D., Director of the National Institutes of Health (NIH). It is an honor to appear before you today to provide an overview of NIH's critical role in enhancing our nation's health through scientific discovery.

As the nation's biomedical research agency, NIH's mission is to seek fundamental knowledge about the nature and behavior of living systems and to apply that knowledge to enhance human health, lengthen life, and reduce illness and disability. I can report to you that NIH leadership, employees, and grantees continue to believe passionately in this mission.

Before I discuss the tremendous strides we have made and the exciting scientific opportunities on the horizon, I want to thank you, Mr. Chairman, and Ranking Member DeLauro, as well as your colleagues, for the recent Fiscal Year (FY) 2014 Omnibus Appropriation bill. The Subcommittee came together in a bipartisan way to increase funding for NIH and we are truly grateful for your action. The past year has been challenging for us: the sequester reduced funding for groundbreaking medical research and affected the morale of the scientific community. This impact was further exacerbated by the shutdown.

There is much good news to report about the science that we support. NIH has been advancing our understanding of health and disease for more than a century; scientific and technological breakthroughs generated by NIH-supported research are behind much of the gains our country has enjoyed in health and longevity. For example, deaths from heart attack have fallen by more than 60 percent over the past 40 years, while deaths from stroke have declined 70 percent. Cancer death rates have been dropping about 1 percent annually for the past 15 years—life expectancy gains that save the nation billions of dollars. HIV/AIDS treatment and prevention now enable us to envision the first AIDS-free generation since this virus emerged

more than 30 years ago. NIH research also has given us vaccines to protect against an array of life-threatening diseases, including cervical cancer, influenza, and meningitis. We can look forward to a future in which advanced prevention and treatment strategies such as these allow everyone to have a significantly better chance of living a long and healthy life.

These statistics tell you how far we have come—but our aim is to go even further, faster. Let me describe a few of the many areas in which NIH-supported research is opening up extraordinary opportunities to improve the health of the American public.

A major program that began this year is the Brain Research through Advancing Innovative Neurotechnologies (BRAIN) Initiative, for which thanks are due to this Subcommittee for its FY 2014 support. NIH is a major player in this pioneering multi-agency venture that will enable the creation of new tools capable of examining the activity of billions of nerve cells, networks, and pathways in real time. By measuring activity at the scale of circuits and networks in living organisms, we can begin to decode sensory experience and, potentially, even memory, emotion, and thought. Successful pursuit of the BRAIN Initiative will revolutionize neuroscience, providing a foundational platform for major advances in Alzheimer's disease, autism, schizophrenia, epilepsy, traumatic brain injury, and many other brain disorders.

As technology allows us to tackle mind-boggling tasks like recording the activity of billions of nerve cells in the brain or determining the DNA sequence of tens of thousands of human genomes, researchers are generating enormous quantities of data at an unprecedented pace. The challenge posed by this revolution is how to store, retrieve, integrate, and analyze this mountain of complex data—and transform it into knowledge that can improve human health. To address this challenge that affects virtually all areas of biomedical research, we have just launched the Big Data to Knowledge (BD2K) initiative. The goals of BD2K are to develop and

disseminate new analytical methods and software, enhance training of data scientists, and facilitate broad use and sharing of complex biomedical datasets. With sustained investment and effort, we will overcome the challenges associated with Big Data to accelerate real-world applications of basic science discoveries.

We are also excited about another area of intense interest: the development of therapeutics. Recent advances in genomics, proteomics, imaging, and other technologies have led to the recent discovery of more than a thousand risk factors for disease—biological insights that ought to hold promise as targets for drugs. But drug development is a terribly difficult and failure-prone business. To the dismay of researchers, drug companies, and patients, the vast majority of drugs entering the development pipeline fall by the wayside. The most distressing failures occur when a drug is found to be ineffective in the later stages of development—in Phase II or Phase III clinical studies—after years of work and millions of dollars have already been spent. A major reason for such failures is that scientists often have not had enough information to choose the right biological targets. If a drug is aimed at the wrong target, it won't work against the disease it was intended to treat.

With that challenge in mind, we were thrilled last month to launch the Accelerating Medicines Partnership (AMP). This unprecedented public-private effort will use cutting-edge scientific approaches to sift through a very long list of potential therapeutic targets, and choose those most likely to lead to success. Besides NIH, the AMP partners include the FDA, 10 biopharmaceutical firms and a number of non-profits, including patient advocacy groups. This pre-competitive partnership, which will share all data openly, will initially focus on three disease areas that are ripe for discovery: Alzheimer's disease, type 2 diabetes, and the autoimmune

disorders, lupus and rheumatoid arthritis. Through this team effort, we believe we can reach our shared goals of treating and curing disease faster.

Preventing disease is another top priority, and influenza is one area of prevention in which we are poised for rapid progress. Currently, to provide protection against the rapidly evolving influenza virus, a new vaccine must be produced each year and we all need to get an annual flu shot. Also, despite best efforts, the vaccine isn't always ideal. In an average year, the flu claims up to 49,000 American lives and costs the U.S. economy about $87 billion. But it does not have to be that way. NIH-funded researchers are now working on a universal flu vaccine—designed to protect people against virtually all strains of the flu for extended periods of time and, thus, potentially reduce the need for annual flu shots. Of critical importance, such a vaccine could also protect against a future global flu pandemic.

While we are several years away from having a universal flu vaccine available to the public, our researchers have already demonstrated proof of concept and are testing a number of approaches, including two-stage "prime boost" vaccines and ferritin nanoparticles. Clearly, the prospect of a universal flu vaccine is not science fiction. Early clinical studies are already underway. With sustained investment, the United States may be a few years away from realizing its potential to benefit our health and our economy.

As impressive as a universal flu vaccine would be, it is not the only trick we are teaching our immune systems. We are also aiming to harness the body's own immune system to fight cancer. Until recently, our weapons for attacking cancer have been largely limited to surgery, radiation, and chemotherapy—treatments that carry risks and cause adverse side effects. Now, after years of intense basic and translational research, we have an exciting new possibility: cancer immunotherapy.

Researchers have long been puzzled by the uncanny ability of cancer cells to evade the immune response. What stops the body from waging its own "war on cancer?" As it turns out, our bodies have built-in checkpoints to prevent our immune systems from going into overdrive and killing healthy cells. Now, NIH-funded researchers have discovered a way to genetically modify certain white blood cells called T-cells—the soldiers of the immune system—to attack tumor cells. In this new approach, T-cells are collected from cancer patients and engineered in the lab to produce special proteins on their surface, called chimeric antigen receptors (CARs). When the modified cells are infused back into patients, they multiply and, with guidance from their newly engineered receptors, seek and destroy tumor cells. Promising results in patients with leukemia prompted *Science* magazine to name this its 2013 Breakthrough of the Year.

Today, I have provided a very brief overview of NIH's past successes and continuing commitment to basic, translational, and clinical research. Our nation has never witnessed a time of greater promise for advances in medicine. With your support, we can anticipate a future of accelerating discovery across NIH's broad research landscape, from fundamental scientific inquiry to human clinical trials. The "National Institutes of Hope" is ready to move forward.

This concludes my testimony, Mr. Chairman. I look forward to your questions.