DEPARTMENT OF HEALTH AND HUMAN SERVICES

NATIONAL INSTITUTES OF HEALTH

Driving Innovation through Federal Investments

Witness before the

Senate Appropriations Committee

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Introduction

Good afternoon, Chairwoman Mikulski, Vice-Chairman Shelby, and distinguished Members of the Committee. I am Francis S. Collins, M.D., Ph.D., the Director of the National Institutes of Health (NIH).

It is a great honor to appear before you today on this panel of distinguished and dedicated leaders within the Administration to discuss how, as a nation, we can drive innovation through federal investments in science and technology.

On behalf of the NIH and the biomedical research enterprise, I want to thank Members of this Committee for your continued support of biomedical research and for having this hearing today. You may be familiar with a recent book that has been in the financial press by Mariana Mazzucato titled, "The Entrepreneurial State." Professor Mazzucato challenges us to look to the United States government – not to the private sector – as the economy's entrepreneur, the investor, risk-taker, and innovator. She points out that DARPA/DOD funded the Internet and Siri, the military's Navstar program funded GPS, and the touchscreen display was funded by two grants from the CIA and NSF. For science, the Human Genome Project and subsequent genomics research, funded by the NIH, has spurred numerous genetic and genomic advancements to develop new diagnostic tests, treatments, and technologies. The Federal government truly is the indispensable entrepreneur as the agencies represented here demonstrate.

Today, I want to share with you many promising opportunities for biomedical research innovation and how these discoveries provide economic growth opportunities. 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. All of us at NIH, our leaders, employees, and the grantee community, believe passionately in this mission.

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 public health. For example, our nation has gained

about one year of longevity every six years since 1990.[1] A child born today can look forward to an average lifespan of about 78 years – nearly three decades longer than a baby born in 1900. Deaths from heart disease have been reduced by more than 70 percent since I was born. HIV/AIDS treatment and prevention may now enable us to envision the first AIDS-free generation since the virus emerged more than 30 years ago. Cancer death rates have been dropping about 1 percent annually for the past 15 years. In a study by Kevin Murphy and Robert Topel of the University of Chicago the authors state, "…. a permanent 1 percent reduction in mortality from cancer has a present value to current and future generations of Americans of nearly $500 billion, while a cure (if one is feasible) would be worth about $50 trillion."[2]

NIH and Economic Growth

NIH is the largest funder of biomedical research in the world and invests approximately $30 billion annually in medical research that benefits the American people in many ways. Approximately 83 percent of NIH's budget is awarded through nearly 60,000 research and research training grants to more than 2,500 of the nation's finest institutions, small businesses, and researchers. This investment drives the advances in the science of human health, and sparks innovation in diagnosis, treatment, and prevention of disease. The President's FY 2015 Budget request invests $30.2 billion in NIH, or $200 million above the FY 2014 enacted level. To further spur scientific progress, the Opportunity, Growth, and Security Initiative proposes an additional $970 million, which would support at least 650 additional new research project grants and further increase funding for the BRAIN and DARPA initiatives proposed in the base request, and invest in other critical priorities.

Investments in biomedical research continue to improve the health and longevity of populations in the United States and abroad, and provide ongoing benefits to our economy as well. Multiple economic analyses by many authors, using a variety of models, all confirm the" roughly 2:1 return on investment of federal support of biomedical research.[3], [4] According to the

[1] http://www.cdc.gov/nchs/data/nvsr/nvsr61/nvsr61_04.pdf
[2] Murphy, K.M., & Topel, R.H. (2006), The value of health and longevity. *Journal of political Economy,* 114(5), 871-904.
[3] *In Your Own Backyard* , Families USA, 2008.

Milken Institute's 2012 report, "*Estimating Long-Term Economic Returns of NIH Funding on Output in the Biosciences*," a $1 increase in NIH funding will increase the size (output) of the bioscience industry by at least $1.70. The long-term effects could be even greater: for every $1 spent by NIH, the output in the bioscience industry could increase to $2.15 using a five-year moving average model.[5]

Investments in NIH research spur job creation. United for Medical Research estimates that in fiscal year (FY) 2012, NIH funding supported more than 402,000 jobs and $57.8 billion in economic output nationwide. Discoveries arising from NIH-funded research are a foundation for the U.S. biomedical industry (i.e. pharmaceutical and medicinal manufacturing, medical equipment manufacturing, and research and development in biotechnology), contributing$69 billion to our GDP and supported 7 million jobs in 2011. [6] NIH support is critical to the bioscience industry.

According to Battelle's *2014 Global R&D Funding Forecast,* "large research initiatives like the Human Genome Project or the War on Cancer… have high rates of social and economic return over the long term." [7] Battelle's *The Impact of Genomics on the U.S. Economy* describes the staggering economic return from genomics research: Our government's $3.8 billion initial investment in the human genome project (HGP) plus the additional $8.5 billion in HGP-related research and support has resulted in nearly $1 trillion of economic growth – a 178-fold return on investment, after adjusting for inflation. In addition these investments have generated 4.3 million job-years of employment from 1988-2012. Amazingly, this 24-year federal investment in HGP-related genomics research was achieved at the cost of only $2 per year for each U.S. resident.[8]

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[4] http://www.milkeninstitute.org/pdf/RossandAnuNIHpaper.pdf

[5] http://www.milkeninstitute.org/pdf/RossandAnuNIHpaper.pdf

[6] http://www.unitedformedicalresearch.com/wp-content/uploads/2013/07/UMR_ProsperityReport_071913a.pdf

[7] http://www.rdmag.com/sites/rdmag.com/files/gff-2014-5_7%20875x10_0.pdf

[8] http://web.ornl.gov/sci/techresources/Human_Genome/publicat/2013BattelleReportImpact-of-Genomics-on-the-US-Economy.pdf

This is the good news. We know how to do this! Reports like those produced by the Milken Institute, Battelle, United for Medical Research, and others, are providing solid data and examples of how supporting basic research through the NIH ultimately leads to live-saving products, licensable technologies, and discoveries that spur the medical innovation ecosystem that together ultimately produce cures for patients.

The fiscal situation for biomedical research in the United States is slowing the momentum of scientific discovery and innovation, and leading some to forgo careers in the biomedical sciences. The past several years have been challenging for us. Since 2003, the NIH has gradually lost purchasing power due to inflation. In 2013, the sequester cut more than $1.5 billion funding for groundbreaking medical research and affected the morale of the scientific community. This resulted in NIH funding 752 fewer grants in FY 2013. Which of these unfunded grants might have prompted a major new insight into Alzheimer's disease, cancer, or diabetes? Which of these grants that were cut caused the layoff of a promising young student scientist who might have been on the path to win the Nobel someday?

The American Society for Biochemistry and Molecular Biology, along with 15 other science organizations, conducted a survey in 2013 of more than 3,700 frontline scientists across all 50 states, the District of Columbia, and Puerto Rico and asked them about the effects of the recent losses in federal funding. Nearly half of the respondents said that they had laid-off researchers, while 55 percent have had a colleague who has lost his or her job. In addition, 53 percent have turned away promising young researchers due to the lack of funds. [9] Similar results were obtained in a 2014 survey by the *Chronicle of Higher Education*.[10]

What keeps me awake at night is the impact of these financial strains on our most critical resource – the talented scientists in our nation's finest universities who have been the source of phenomenal innovative breakthroughs over the decades, making America the envy of the whole world. These challenging fiscal times are impeding our ability to recruit and retain the brightest minds in science. Successful biomedical research relies on the talent and dedication of the scientific workforce and a steady supply of highly trained people who can bring new insights to

[9] http://www.asbmb.org/uploadedFiles/Advocacy/Events/UPVO%20Report%20V2.pdf

[10] Baskin, P. & Vossen, P. *The Chronicle of Higher Education* Strapped Scientists Abandon Research and Students. February 24, 2014.

our understanding of biology and advance the translation of these insights to improve health for all. If you want talented, young scientists to pursue long-term, high-risk and high- reward research, they need timely and stable funding.

NIH and American Competitiveness in the Global Research Environment

This leads me to America's place in the global research environment. Other countries have seen our success and are scaling up their own research investments. Between 1999 and 2009, Asia's share of worldwide research and development (R&D) expenditures grew from 24 percent to 32 percent, while U.S. R&D expenditures declined from 38 percent to 31 percent.[11] The rate of growth of China's R&D budget is projected to significantly outpace the U.S. R&D budget during the next few years, and by 2022, if the current growth rates hold, China's R&D funding will surpass that of the United States.[12] The European Commission has urged its member nations to increase their investment in research substantially, recommending budgets of €80 billion ($180 billion U.S. dollars) in 2014-2020, a 40 percent increase over the previous seven-year period. [13] While we welcome investments by other countries to the global research enterprise, we want to ensure our own role is maintained because the health and economic benefits are so compelling.

The New Yorker recently described how B.G.I., the world's largest genetic-research center with 178 sequencing machines located in Shenzhen China, now produces more than 25 percent of the world's genomic data, more than what the NIH or any other scientific enterprise produces. While our country led the discovery of this technology, other countries are moving ahead of us in using it.[14]

[11] http://www.unitedformedicalresearch.com/wp-content/uploads/2012/07/Leadership-in-Decline-Assessing-US-International-Competitiveness-in-Biomedical-Research.pdf

[12] http://www.unitedformedicalresearch.com/wp-content/uploads/2012/07/Leadership-in-Decline-Assessing-US-International-Competitiveness-in-Biomedical-Research.pdf

[13] http://ec.europa.eu/programmes/horizon2020/en/what-horizon-2020

[14] Michael Specter, The New Yorker. The Gene Factory: A Chinese Firm's bid to crack hunger, illness, evolution – and the genetics of human intelligence. January 6, 2014.

NIH and Promising Opportunities for Innovation

While these statistics are alarming, they need not discourage us. Scientific opportunities have never been more numerous or promising. American bioscience is not limited by ideas or talent, but by dollars. Let me focus on an example where the promise of major advances with dramatic clinical benefit has begun to appear. Recent advances in genomics, proteomics, imaging, and other technologies have led to the 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 never emerge as patient-ready therapies. 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 don't know how to choose the right molecules to target. If a drug is aimed at the wrong target, it won't work against the disease it was intended to treat. In order to translate basic science findings into innovative therapeutics, we need to create new, collaborative opportunities.

With this 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 long list of potential therapeutic targets and biomarkers, and choose those most promising for therapeutic intervention. Besides NIH, AMP partners include the FDA, 10 biopharmaceutical firms and a number of non-profits, including patient advocacy groups with government and its partners equally contributing to the initiative and sharing data openly.

Accelerating Medicines Partnership (AMP)

Government	Industry	Non-Profit Organizations
NIH	AbbVie	Alzheimer's Association
FDA	Biogen Idec	American Diabetes Association
	Bristol-Myers Squibb	Arthritis Foundation
	GlaxoSmithKline	Foundation for the NIH
	Johnson & Johnson	Geoffrey Beene Foundation
	Lilly	Juvenile Diabetes Research Foundations
	Merck	Lupus Foundation of America
	Pfizer	Lupus Research Institute/Alliance for Lupus Research
	Sanofi	PhRMA
	Takeda	Rheumatology Research Foundation
		USAgainstAlzheimer's

This "pre-competitive" partnership 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 truly innovative and collaborative approach, we believe we can learn how to treat and cure disease faster.

Another way we are accelerating the development and application of innovative technologies is with a major program that began this year – the Brain Research through Advancing Innovative Neurotechnologies (BRAIN) Initiative – and we are grateful to this Committee for its FY 2014 support. NIH is a major player in this pioneering, multi-agency venture that will enable the creation of new tools to examine 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. 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.

Scientific advances are also leading to new strategies against cancer. Until recently, our weapons for attacking cancer have been largely limited to surgery, radiation, and chemotherapy– all of which can be effective, but carry risks. Recent advances have given us insights into the intricate workings of the cancer cell, and a whole new generation of targeted therapeutics is emerging, ushering in an era of individualized precision medicine. Now, after years of intense basic and translational research, we have an exciting new possibility: cancer immunotherapy.

Researchers have long been puzzled by the ability of cancer cells to evade the immune system. What stops the body from waging its own "war on cancer?" White blood cells, called T-cells, play a critical role in our bodies' immune response. But, as it turns out, they have built-in checkpoints to prevent our immune systems from going into overdrive and killing healthy cells. A molecule expressed on the surface of T-cells, called PD-1, is a checkpoint regulator and acts as an off-switch on T-cells, preventing further attack on cancer. NIH-funded researchers have discovered a way to prevent PD-1 from turning off the T-cell response. In this new approach, antibodies that bind to PD-1 block the checkpoint, allowing the T-cells to keep attacking tumor cells. Promising results in clinical trials prompted *Science* magazine to name cancer immunotherapy its 2013 Breakthrough of the Year.

Conclusion

Today I have provided you with examples of how investments in biomedical research through NIH are advancing human health, spurring innovations in science and technology, and providing significant economic benefits to our nation. The opportunities have never been better, but America is now at a critical juncture. Continued investment in biomedical research will lead to health advances and economic growth.

Thank you, Madam Chairwoman, Vice-Chairman Shelby, and Members of the Committee. I would be pleased to answer any questions.