Introduction
Statement of the Director, NIH

Reflection on the origins of NIH aptly frames assessment of the current state of biomedical and behavioral research. After World War I, scientists sought funding to establish an institute that would apply their rapidly growing knowledge of chemistry to the field of medicine. When no philanthropic money materialized, the visionary Senator from Louisiana, Joseph E. Ransdell, led Congress to pass a bill in 1930 that would transform the Nation's small Hygienic Laboratory into the "National Institute of Health" (singular). The change in title underscored a much more significant change—toward public support for medical research. This was a defining moment in the history of biomedical research and health care for our country and for the world. Years later, in 1945, the noted scientist and intellect Vannevar Bush recognized the importance of research to the Nation when he said that *"scientific progress is one essential key to our security as a Nation, to our better health, to more jobs, to a higher standard of living, and to our cultural progress."*

Transformation! The payoff of the investment in NIH

In the over 70 years since the Ransdell Act, NIH transformed modern research and medicine in countless ways—some well known, others so much a part of daily life that their scientific origin is forgotten. We made tremendous improvements in the recovery from heart disease and stroke. For patients with clogged arteries, NIH scientists developed a stent imbedded with the cancer drug Taxol®, which prevents scars from forming during its slow release. This revolutionary drug-device combination dramatically reduced artery reclosing rates to 3-6 percent and is expected to substantially reduce the number of open-heart bypass surgeries—previously the only alternative for some patients. What seems obvious today—for example, knowing about the importance of a healthy diet and the benefits of exercising—are the results of research studies pioneered by NIH. Pregnant women get the most detailed advice available about what foods to eat and what environmental exposures to avoid—again, the result of NIH research. In another example, prostheses known as cochlear implants now allow hearing-impaired children to hear and speak. Worldwide, nearly 100,000 individuals are fitted with cochlear implants, and, in the United States, roughly 22,000 adults and 15,000 children have them. NIH-supported scientists showed that profoundly deaf children who receive cochlear implants at an early age develop language skills at a rate comparable to children with normal hearing.

Our research breakthroughs extend to vision-impaired patients. Eight million older Americans are at high risk for advanced age-related macular degeneration (AMD), with 1.3 million developing AMD within 5 years if untreated. However, a large NIH-sponsored clinical trial established that a daily regimen of antioxidant vitamins and minerals delays the onset of advanced AMD by 25 percent. New drugs (Macugen and Lucentis) that block abnormal blood vessel growth, a hallmark of AMD, also are now available to stave off and, in some cases, reverse vision loss. We possess more effective drugs for treating diseases affecting bones and joints; for example, for patients with moderate to severe knee pain, injections of hyaluronic acid lubricate the damaged joint and may slow progression of disease. We developed new virus-like particle technology that formed the basis for new commercial vaccines that target specific cancers. In June 2006, the U.S. Food and Drug Administration approved the vaccine Gardasil, which is highly effective in preventing infections with the human papillomavirus types that cause the majority of cervical cancers. Worldwide use of this vaccine could save the lives of 200,000 women each year. We funded research that led to the discovery and development of antiretroviral therapies to treat people with HIV infection. As of today, antiretroviral therapies are the most effective means of treating HIV infections, resulting in improved quality of life and life expectancy for those with access to these drugs. A recent study indicates that highly active antiretroviral therapy has saved approximately 3 million years of life in the United States alone.

An important public health success story is the reduction in tobacco use and related diseases. In the last decade, overall cancer death rates dropped for the first time in a century, driven largely by the dramatic reduction in male smoking from 47 percent in the 1960s to less than 23 percent today. This success has been a trans-HHS victory, with significant research investments over the last 50 years made by many Institutes and Centers.

These are just a few examples by which NIH research laid the foundation for modern medicine, generating enormously better health for the population worldwide. Partly as a result of research, the disability rate in our elderly population has declined by 30 percent since 1982.

NIH research also is a key driver for the private sector, as predicted by Vannevar Bush in 1945. As an example, between 1998 and 2004 alone, a total of 3,114 new technologies were brought to market by 185 universities, hospitals, and private research institutions. From 1980 to 2004, a total of 4,543 new companies were formed around technologies developed by research institutions, many of them directly funded by the NIH. NIH is, indeed, a tremendous asset for America.

Imagine! Where are we going?

We still have a long road in front of us. But thanks to a steady flow of basic research discoveries, NIH is well-positioned to find new treatment and prevention strategies for a host of our most debilitating diseases. These research breakthroughs of the future will more quickly feed into routine medical practice. The health care system itself will undergo a rapid change. It must, since the current trends—surging costs coupled with the rapid rise of chronic diseases such as obesity and diabetes, the increasing mental health needs in our modern society, the aging population, the emergence and reemergence of infectious diseases—are unsustainable. Science needs to tell us how to strike these diseases before they strike us.

Our goal at NIH is to provide the scientific evidence base that will usher in an era where medicine is ***predictive, personalized, preemptive, and participatory***. This will be a profound transformation from the current model of late-stage "curative" interventions, and one that this Nation must undergo in the coming decades if we are to succeed in providing access to care for all Americans at reasonable costs.

To reach this long-term goal, NIH is strategically investing in research to further our understanding of the fundamental causes of diseases at their earliest molecular stages so that we can reliably ***predict*** how and when disease will develop and in whom. Because we now know that individuals respond differently to environmental conditions according to their genetic endowment and their own behavioral responses, we can envision the ability to precisely target treatment or other interventions on a ***personalized*** basis. Ultimately, this individualized approach will allow us to ***preempt*** disease before it occurs, utilizing the ***participation*** of individuals, communities, and health care providers as early as possible in, and throughout, the natural cycle of a disease process. The discoveries we are making today are paving the way to make this future a reality.

Consider how more predictive and personalized treatments could improve the safety and effectiveness of medications. We know that drugs are not in the "one size fits all" category. The same medication can help one patient and be ineffective for, or even toxic to, another. With the emergence of a field of research called pharmacogenetics, we will be increasingly able to know which patients will likely benefit from treatment and which patients will not.

What are the roadblocks en route?

Major speed bumps confront NIH on the road to success. While we have made progress in discovering specific aspects of disease and generated numerous treatments that deliver desirable outcomes, large gaps remain in our fundamental understanding of health and disease. Disease and injury are constant threats to humankind. For example, military casualties suffering from blast injury pose an immediate challenge and highlight how the gaps in our knowledge on these and other traumatic brain injuries hinder medical researchers who are striving to optimize regenerative treatments. Infectious diseases remain among the leading causes of death worldwide. More than 30 newly recognized infectious diseases and syndromes emerged in the last two decades alone, including HIV/AIDS and

SARS. Infectious diseases that once seemed to be fading, such as tuberculosis and malaria, have resurged, and the emergence of antibiotic-resistant bacteria is making many common infections increasingly difficult to treat. There is concern that a new influenza virus will emerge with the capacity for sustained human-to-human transmission. Because the new strain would be unrecognized by the human immune system, it could lead to widespread infection, illness, and death, similar to what occurred in three such 20th century pandemics in 1918, 1957, and 1968.

The tragic events of September 11, 2001, and the deliberate release of anthrax spores in the Nation's capital drove home the realization that certain deadly pathogens, such as smallpox or anthrax, have the potential to be used deliberately as agents of bioterrorism against the civilian population. Similar potential exists for radiological, nuclear, and chemical threats.

To unravel the intricacies of the human body, we must find out what is happening at several levels—molecules, cells, organs—and how a dizzying number of interactions at each of these levels contribute to the health of the whole system. Efforts to prevent, detect, and treat disease require that we understand the complexity of the many biosystems of the human body. As the questions become more complex, and even as knowledge grows, science itself grows more multifaceted. We recognize that to effectively push science forward, researchers and scientists must begin to work more collaboratively to develop unifying principles that link apparently disparate diseases through common biological pathways and therapeutic approaches.

Today, and in the future, NIH research must reflect this new reality. Advanced technologies, including the sophisticated computational tools and burgeoning databases, likewise span diseases and disciplines. The scale and intricacy of today's biomedical research problems increasingly demand that scientists move beyond the borders of their own discipline and apply new organizational models for science. One of NIH's most pressing challenges is to generate and maintain the biomedical workforce necessary to tackle the converging research questions of this century.

Adding to the level of complexity, many of the public health problems NIH confronts have a behavioral component. To confront the escalation in obesity, for example, NIH must address a multitude of intersecting factors, from inherent biological traits that differ among individuals; to environmental and socioeconomic factors; to behavioral factors—which may have both molecular and environmental influences. The obstacles of today's obesity epidemic are daunting, yet the discoveries emanating from previous research investments offer unprecedented opportunities for new scientific research efforts to help meet these challenges.

Innovate! That's the path to a healthy state.

With the NIH Reform Act of 2006 (Pub. L. No. 109-482), Congress provided a statutory foundation for the centerpiece of the NIH Roadmap for Medical Research—a Common Fund that provides “incubator space” to spur innovation. The Common Fund supplies a centralized source of funding for trans-NIH initiatives to meet the research and training needs of the 21st century and stimulate innovation. To garner support from the Common Fund, research initiatives must not only be trans-NIH and fill a gap in our knowledge base, but also be potentially transformative. The Human Microbiome project, launched in 2007, is one such initiative, promising to reveal how bacteria and other microorganisms that are found naturally in the human body (the “microbiome”) influence a range of biological processes, including development, immunity, and nutrition. This effort will not only improve our understanding of how one biosystem (an individual's microbiome) relates to disease, but will also generate resources and support the development of new technologies and computational approaches—all crosscutting outputs that can be applied to investigations of other biosystems. Another new initiative at the biomedical research frontier is the NIH Roadmap Epigenomics Program, which will scan the human genome to study hereditable features that do not involve changes to the underlying DNA sequence, but significantly affect gene expression and are important for informing us about how DNA is regulated. This global analysis of epigenetic changes should reveal new cellular pathways and mechanisms that influence disease progression.

The Common Fund also enables NIH to continue building research teams of the future; growing the Clinical and Translational Science Award Program; sustaining the transformation of the clinical research enterprise, in order to speed new discoveries from bench to bedside; investing strategically at the boundaries between the life and physical sciences, where so much transformative science, such as nanomedicine (the control of matter on the atomic and molecular scale), is taking place; and, through the Pioneer Award Program, nurturing bold ideas that, although they may have more than the usual degree of risk, if successful, will have unusually high scientific impact.

Nurturing a new generation of innovators is critical to our future research endeavors. NIH makes strategic investments at every level of the pipeline to improve the flow of talent drawn from every part and population of America. We produce teaching supplements that help educators from grades 2 through 12 convey difficult concepts through engaging activities, improving health literacy, and hopefully sparking children's interests in careers in research. We have programs that give undergraduate students research experiences, especially geared toward harvesting the vast potential of young people from groups that have been historically underrepresented in the sciences. NIH grants fund graduate students and postdoctoral fellows who go on to fill most every niche in the American biomedical research enterprise—from academic research to private industry, and from venture capitalists to policy makers. To support our new investigators and our most creative scientists, NIH recently established a series of new grants, including the “Pathway to Independence Award” and the “New Innovator Award.” Through these programs, nearly 200 of the most promising postdoctoral scientists will be chosen annually to receive 5-year bridging funds during their transition to research independence, while nearly 40 of the Nation's exceptionally creative scientists will be annually selected to receive 5 years of support while taking unconventional approaches to tackling our most vexing biomedical problems.

We are in an era of unprecedented scientific opportunity. In the past year alone, a deluge of genetic discoveries—the outcome of NIH's Human Genome and HapMap projects—promises to usher in a new epoch of biomedical research. To capitalize on recent research insights and technological advances, with partners from the various sectors of the Nation's health enterprise, NIH will build on past successes in basic, translational, and clinical research to keep America on the road to health through the new millennium. We need to sustain this momentum, as progress in the life sciences in this century will be a major determinant of our Nation's health, competitiveness, and standing in the world.

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