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THE BROKEN PIPELINE: LOSING OPPORTUNITIES IN THE LIFE SCIENCES

HEARING

OF THE

COMMITTEE ON HEALTH, EDUCATION, LABOR, AND PENSIONS

UNITED STATES SENATE

ONE HUNDRED TENTH CONGRESS

SECOND SESSION

ON

EXAMINING FUNDING OF THE NATIONAL INSTITUTES OF HEALTH, FOCUSING ON OPPORTUNITIES IN THE LIFE SCIENCES AND BIOMEDICAL RESEARCH

MARCH 11, 2008

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C O N T E N T S

STATEMENTS

TUESDAY, MARCH 11, 2008

ADDITIONAL MATERIAL

THE BROKEN PIPELINE: LOSING OPPORTUNITIES IN THE LIFE SCIENCES

TUESDAY, MARCH 11, 2008

U.S. SENATE,
COMMITTEE ON HEALTH, EDUCATION, LABOR, AND PENSIONS,
Washington, DC.

The committee met, pursuant to notice, at 11:02 a.m., in Room SD–430, Dirksen Senate Office Building, Hon. Edward M. Kennedy, chairman of the committee, presiding.

Present: Senator Kennedy, Mikulski, Brown, and Enzi.

OPENING STATEMENT OF SENATOR KENNEDY

The CHAIRMAN. We will come to order. I welcome our committee members to today's hearing on the funding of NIH and its impact on innovation. I welcome President Faust, Dean Miller and other distinguished witnesses and look forward to hearing their conclusions and recommendations.

Imagine holding a hearing on medical research 100 years ago. At that time even the idea of vaccines against polio or measles or whooping cough would have seemed far fetched. A hearing 50 years ago might have spoken of effective treatments for cancer as a distant dream, perhaps never to be achieved.

Twenty years ago the participants at such a hearing might have raised the hope of treatments for AIDS, but would have cautioned that this hope might not become a reality for decades. Even 15 years ago witnesses might have spoken of a far off day when the complete sequence of the human genome would be decoded. Today breakthroughs that were once distant dreams are reality that make a difference in the lives of patients in every community in America. They draw their inspiration from many sources, but they all have two core elements in common, the brilliance of medical researchers and the support of the American public.

What will be discussed at a hearing on medical progress in 5 or 10 years from today? Will we review a decade of continued progress with new breakthroughs in diabetes, spinal injury, Alzheimer's disease and other serious afflictions or will we look back in regret at a decade of missed opportunities and squandered potential?

The actions that Congress takes in the coming months will help to determine which of these two possible futures becomes a reality. We cannot close our eyes to the consequences of continued failure to capitalize on the progress that we've made in medicine in recent years. Thanks to thoughtful research and scholarship at a consortium of universities that includes many of our Nation's leading cen-

ters of innovation, we have before us a chilling statement of where our current budget policies for NIH will lead.

The report conclusions are a call to action for Congress and the Nation. President Faust of Harvard, one of the authors of the report, will present the findings in more detail. Even a brief review of some of the major conclusions should shock those who hear them.

Due to inadequate funding the success rate for grant applications has dropped 32 percent in 1999 to 24 percent today. For young researchers the situation is even more dire. Their success rate in applying for first independent research grants has dropped from 29 percent in 1999 to 12 percent today. That means a young researcher has just one chance in eight of getting a grant.

As a result, the age at which a researcher gets his or her first independent research grant has risen from 39 years old in 1990 to 43 years old today. Many young scientists conclude that it's not worth the wait and pursue other career options. Even though scientists who do get funded are forced to spend more time writing grants and less time doing research at the bench. Many turn to industry jobs where they can benefit from funding security despite losing the freedom to pursue academic research.

I recommend that every committee member look at the excellent comments from scientific leaders that are included in the report. One to me was particularly striking. It was my friend Joseph Boger, the CEO of Vertex Pharmaceuticals in Cambridge and President of Vioxx summarized the risk of our current course this way.

> "You can lose a generation of researchers pretty fast, 5 or 10 years. You create such a discouraging atmosphere they just go somewhere else instead of academic research. We don't have to lose 50,000 researchers, just 50 really good ones. Once it happens we won't get those people back."

If we lose the talents of a generation of young researchers, we put in peril, not only medical progress, but America's leadership in life sciences too. The culture of innovation and discovery does not just happen it must be nurtured or it will wither.

The United States has a long tradition of being a global innovative leader, but we can't take our leadership for granted. Today it's at risk. Thirty years ago U.S. researchers published 90 percent of all scientific literature on information technology. Today it's less than half. Unless we invest in the life sciences we'll lose our global leadership in biotechnology.

As a nation we must make a choice between continued progress or the stifling of innovation.

I thank President Faust, Dean Miller and all our distinguished witnesses for joining us today to give their recommendations on this important issue. I look forward to your comments and to our discussions. I'll be delighted to hear from our friend, Senator Enzi and then Senator Mikulski who's been such a leader in terms of NIH. Not just funding but in policies and so many different areas. We're delighted to have her.

OPENING STATEMENT OF SENATOR ENZI

Senator ENZI. Thank you, Mr. Chairman. I appreciate you holding today's hearing. I want to thank our roundtable participants for taking the time to join us. I look forward to hearing your views, your insights, your suggestions about our life sciences system and what's working well and what needs to be improved.

Your recommendations will greatly assist us in the effort to insure that we not only make progress in this field but continue to be a world leader in the effort to research and find cures for the diseases that continue to inflict so many Americans. Throughout the history of our Nation generations of American scientists have looked for ways to improve the human condition and address the problem of disease and the afflictions of old age. As they conducted their research each scientist's work was built on the discoveries that preceded it. The results they achieved over the years have enabled us to live longer, healthier, more productive lives.

Over the years the progress we've made depended on new generations of scientists taking up and carrying on the work of those who came before them. The Federal Government played a central role in that effort by providing the funds that were needed to sustain and support the work they were doing and train those who were doing the research. Our investment in life science and NIH has been a central part of that effort.

NIH-funded research has played an integral role in most of the discoveries of the past 50 years that have improved human health. In the United States alone NIH research has lead to an 80 percent overall 5-year survival rate for childhood cancers, a 70 percent decline in AIDS-related deaths between 1995 and 2001, a more than 40 percent decline in Sudden Infant Death Syndrome rates between 1994 and 2000, 41 and 51 percent declines respectively in the death rates from heart disease and stroke between 1975 and 2000, the ability to eliminate or greatly reduce symptoms in 80 percent of schizophrenia patients and to improve the quality of life for more than 19 million individuals suffering from depression and a blood supply that's the safest in the world.

In addition to saving lives, our investment in research has lead to the creation of a new industry and the jobs that were needed to sustain it. Because of the investment in NIH and the technology that spun out of it, the United States has been a world leader in health care. We have developed a long list of vaccines, therapeutic medicines and devices to combat disease. To ensure that the NIH continues to be a driver of innovation we passed the NIH Reform Act during the last Congress.

This act provided the Director of NIH with the flexibility and the resources needed to address a changing list of priorities. I'm pleased that the Director, Dr. Zerhouni has used the authority to create new programs, to encourage young investigators and to then fund innovative, cross cutting research. It's particularly worth noting that he was able to do this with an appropriation that did not meet the authorization levels that this committee enacted.

Appropriations that match authorization levels are important to allow administrators and the NIH to plan and budget. It's also important to remember that our resources are finite. Ultimately, the

NIH needs to have the flexibility to put the resources it's given where they can be used to the best advantage, funding scientists and science that are deemed the most appropriate to fund. That's our current status, but it may not stay that way for much longer.

The budget and the priorities that we set are continuing to be squeezed tighter and tighter by the demands of each years mandatory spending. It's a difficult problem with planning and a compelling vision for the future; it's one that can be overcome. Although this hearing will focus on NIH, it's important to remember the fact that the research arm of the Federal Government is made up of more than just the NIH.

The National Science Foundation, the Department of Defense, the Department of Energy, the National Aeronautic and Space Administration and the USDA are important components of the Federal Government's commitment to science and research. Just like life sciences, material sciences, mathematics, aerospace and electronics are crucial to our future health and well-being. Further it's clear that advances outside of the health sciences drive the advances made in life sciences.

As we examine this report it's important that we look to the experience at NIH and apply these lessons to the National Science Foundation. President Bush's announcement that the Administration wants to double the National Science Foundation should serve as an invitation to learn from the NIH doubling experience and the success it's proven to be.

I want to thank all of you for coming today. I look forward to your discussion and the implications on this issue. There will be no greater influence on the quality of our future than the ability of people to lead happy, healthy and fully productive lives.

I thank you, Mr. Chairman for making this possible. I look forward to the comments of the Senator from Maryland who has played a great role in all of this.

The CHAIRMAN. Thank you very much, Senator Enzi. Senator Mikulski, would you like to say a word?

STATEMENT OF SENATOR MIKULSKI

Senator MIKULSKI. Well thank you very much, Mr. Chairman. I will be brief. I'm very excited about this hearing today and look forward to hearing from our wonderful panel from people distinguished in academia medicine and research and heading up our great universities and the young people themselves who want to have a career in these fields and make this world a better place to live in.

For many years I've been a strong supporter of increasing the funding at NIH. I was so proud to be part of a bipartisan effort to double the funding of NIH. You know when we work together we actually make a difference.

We have worked in a bipartisan basis to double the funding. Yet, when we look at the President's budget this year, he's coming in with a request for $29.5 billion. That sounds like a lot, but really that's a couple of weeks in Iraq.

It is flat funded at the 2008 level which means that it's actually shrinking because of what it takes to be able to do research and the rising cost of even energy and utilities to keep the lights on in

the lab let alone keeping the lights of hope and opportunity on for our young researchers. What's so frustrating is that we were on a trajectory to increase NIH, but in 2003 it stopped. So now we're just sputtering and turning our wheels because once we hit 2003 with the stagnation that occurred in these last 5 years, there has not only been less money and less opportunity to pursue research grants, but there is a lack of predictability. It's a disincentive for people to either choose the field or stay in the field.

Now as a U.S. Senator from Maryland I just have a spectacular job. The National Institutes of Health is in my State. What a great thing to be able to say because every day I know thousands of people are getting up every day to make this world and people's lives a better place.

Not only that, because of the genius of the American system working with academic Centers of Excellence in my own State, of course, Johns Hopkins University as well as the University of Maryland. Again using the best of academic medicine where people who have the responsibility for not only research but training the next generation of medical and health leaders. At the same time actually treating people and taking medicine from the bench to the bedside and working on it together.

We have these fantastic places. Not only that, Mr. Chairman, we not only have the greatest civilian places where research is done, but in my own State, too we have military installations, like Fort Detrick, that has the responsibility to protect us against biological and chemical attack. While we're looking at protecting the war fighter against malaria. Fighting malaria, as Senator Brown has so long advocated, around the world—a lot of that research is being done in the civilian sphere.

We really want to listen and we want to learn. we need to act. We need to have both the will and the way. We need to have a national will, a national commitment and then a national wallet.

We have seen the changes that have been made. I'll just speak to one area of women's health. When I came to the U.S. Senate, women were not included in the protocols at NIH. That famous study, "take an aspirin a day keep a heart attack away" occurred through 10,000 male residents. While working together through this committee, with the leadership of Dr. Bernadine Healy and NIH, we changed that. We established the Office of Women's Health.

So what does all that mean? I'll tell you what it means. Through the work that was done by this committee—funding what it needed to do and NIH being what it is—working both at NIH and with academic centers came the famous longitudinal study on hormone therapy.

What came out of that? Be careful. What came out of being careful and re-evaluating the use of hormone therapy, breast cancer has declined in this country by 15 percent. Wow, what a difference.

Then when we looked at something we finally got around to, taking that aspirin a day to see if it would prevent a heart attack or what it does in women. What do we now know? Women experience cardio symptoms differently. We need different focus. We need different tools of identification and we're dealing with it and preventing it.

We could go through all the research. Then there's this other issue that we've worked on which is called diversity in science. When I came again, everybody said, "gosh, science is all white guys." Well, the white guys did a pretty good job, but we wanted to open it up to all of America.

All of America began to dream and they didn't only focus on great institutions like Meharry, our premier institution for educating African-American doctors. We reached out. We wanted to include people. We wanted to do more.

Now that we've begun to increase our diversity which is women coming into research, people of color choosing this field that's so wonderful and exciting. We begin to turn off the spigot. We're turning off the spigot to our own future.

This Congress has focused on something called innovation. We were even self congratulatory because we passed something called the America Competes Act. Pat ourselves on the back. Let's move on.

When we passed this legislation where does it leave us? We know that we still are not in a competitive place. A country that does not innovate stagnates. If you stagnate, you fall behind.

This is our future. Miss Lewis is our future. We need to meet the future because the future is us.

I believe that in this year's budget, this year's appropriation, we have a rendezvous with destiny to get us on the right track. To make sure we all understand this, colleagues, I'll say this and I'll conclude, whatever we pass this year for the NIH appropriations will be the operating budget for the first year of the first term of the next President. The next President gets sworn in January 2009. We pass the appropriations in October 2008. October 2008 to October 2009 is the operating budget for the first year of the first term of the next President.

Let's meet our responsibility. Let's meet our rendezvous with history. Let's take our lessons learned and let's get with it.

I conclude my statement.

The CHAIRMAN. Good. Thank you so much. Senator Mikulski always has a way of getting to the nub of the problem quickly and eloquently and passionately. We always welcome her comments.

Senator Brown, I think you would like to be recognized to make an introduction.

STATEMENT OF SENATOR BROWN

Senator BROWN. Thank you, Mr. Chairman. Senator Enzi and Senator Mikulski, thank you. While we don't have NIH in Ohio, we have some great research universities like Ohio State and I'm so thrilled to represent them.

I want to start by presenting my former colleague in the House and friend, Eric Fingerhut, who's the new Chancellor of Education in Ohio and the terrific job he's doing. He's here and Eric, welcome.

I would briefly reiterate what Senator Mikulski said. That I was in the House at the time as the Ranking Member of the Health subcommittee at the time when we doubled NIH funding while having a Democratic President and Republican Congress. There was almost, perhaps, unanimity, close to unanimity on doubling

the research budget of NIH with the understanding that scientists were making good decisions as we move forward.

Understanding then, if my recollection is right, that the government was funding something like one in three, one in four, applications. That's the number we should aim at again where now my understanding is 1 in 9 or 10 applications. Understand what that does to young scientists that want to make their living. Some of the young, brightest scientists in our country and how difficult it is as those grants are more likely to go to older scientists who are contributing much. Perhaps not in our future as much as the younger scientists, who are perhaps less skilled in working out the grant applications, but equally skilled and with a future that they have.

I was just, a moment ago, given this blue wristband—it's Autism Awareness week—and was talking about NIH funding for them and environmental causes and all the things that we need to look at. The work that all of you do as scientists is so very, very important to us.

Dr. Paul DiCorleto, who's head of the Lerner Research Institute in the Cleveland Clinic in northern Ohio says that Ohio institutions that support biomedical research can't afford to make up the shortfall in grant money. We've lost some $88 million over the past 2 years. This is in one State alone. Multiply that throughout the country and you can see the direction that we shouldn't be going in that we, unfortunately, are going in.

It's my pleasure to introduce today, Associate Professor to the Department of Molecular and Cellular Biochemistry at Ohio State, Dr. Rafael-Fortney. We welcome you and thank you for your service.

I would add, Mr. Chairman, I'd like to enter into the record an article from today's Columbus Dispatch about her visit here. She might not have seen this yet. It will be in the record if the Chairman would——

The CHAIRMAN. It will be so included.

[The information previously referred to follows:]

[The Columbus Dispatch, March 11, 2008]

(By Suzanne Hoholik)

OSU SCIENTIST TO TESTIFY ABOUT NEED FOR FUNDING

COLUMBUS, OHIO.—An OSU Medical Center researcher has found that a protein is either gone or severely reduced in the hearts of patients with heart failure.

Her next step would be to prove that the loss of this protein, called claudin 5, causes heart failure, but a decline in Federal grant money has slowed progress.

Jill Rafael-Fortney is an Ohio State University associate professor in the Department of Molecular and Cellular Biochemistry. She needs four people in her laboratory working on the project. She's down to one full-time person and a part-timer.

She received a $250,000-a-year grant for 5 years from the National Institutes of Health but is unsure whether it will be renewed. She hopes so, for the fate of some of the 5 million Americans living with heart failure.

That's what Rafael-Fortney plans to tell members of the U.S. Senate Committee on Health today when she talks to them about increasing funding so research such as hers can continue.

National Institutes of Health grants have been flat for the past several years at about $20 billion each year. They haven't kept up with inflation, meaning researchers are doing more with less.

Besides raising taxes, some researchers see one solution.

"Decreasing the war effort, I think, would be No. 1," said Caroline Whitacre, vice dean for research at Ohio State.

OSU is among seven academic medical centers—including Harvard, Vanderbilt and Duke—sending people to Washington today to talk with lawmakers and the news media about researching funding.

The universities are concerned that if Federal funding stays the same, frustrated "young" investigators who don't get their first Federal grant will leave the field. The average age of a scientist getting a first grant from the National Institutes of Health is 43.

Fewer scientists with creative research ideas could mean the Nation will lose out.

"The type of medicine that we're going to be receiving in the future depends on the research being done now," said David Moore, senior associate vice president for government relations for the Association of American Medical Colleges.

"It will take longer for new cures, longer for new diagnostic procedures to get to the American public."

Despite flat Federal funding, OSU Medical Center has received increases in grants—$119 million last year, compared with $79.8 million in 2003.

Getting more is important because the grants are a key component to Ohio State achieving its goal of being a top 20 academic medical center.

The trip to Washington is about more than OSU or the six other medical centers. It's about small universities seeing declines in Federal grants and faculty members who get discouraged when grant applicants are repeatedly denied.

"It's a morale issue at the moment," said Sandra Degen, vice president for research at the University of Cincinnati.

"I haven't seen it yet, but that's the worry—that we might start losing very good people."

Senator BROWN. Thank you.

The CHAIRMAN. Delighted.

Senator BROWN. It gets better press out of the Columbus Dispatch than I do, Mr. Chairman.

[Laughter.]

I work sometimes.

The CHAIRMAN. I think you do ok.

[Laughter.]

We'll hear from Dr. Drew Gilpin Faust, President of Harvard University, accomplished historian. Dr. Faust served as the first dean of the Radcliffe Institute, was the Annenberg Professor of History, Director of Women's Studies program, University of Pennsylvania, has served as part of the faculty for 25 years. She's been aware of the issues facing young scientists and engineers for 25 years, and oversaw the Harvard Task Force on Women in Science and Engineering in 2005.

Dr. Jill Fortney is an Associate Professor at the Department of Molecular Cellular Biochemistry at Ohio State, University of Medicine. Her laboratory studies muscular and heart disease in order to design treatments for muscular dystrophy and heart failure. In addition to publishing 40 research papers she's received support from the NIH, American Heart Association, Muscular Dystrophy Association, and was the recipient of the Burrough's Wellcome Fund Career Award.

Senator MIKULSKI. Mr. Chairman, could I talk about Dr. Miller.

The CHAIRMAN. Sure.

Senator MIKULSKI. I'm sorry. I didn't mean, if you were finished with Dr. Fortney's extensive and stunning accomplishments.

Dr. Miller is the Chief Executive Officer at Johns Hopkins. He's the Dean of the School of Medicine and also Vice President for the Hopkins University. He himself is a scholar who's focused on cardiovascular effects of anesthetic drugs and published over 100 scientific papers, abstracts and chapters.

What I also think is important is, Dr. Miller comes and says, "What does it take to run a great institution?" and also, "what does it take to train that next generation of leaders?" And how do we? He has seen them from their bright and shiny days of when they walk into the Medical School or the School of Nursing or the School of Public Health, all eager and ready to go. And then as they choose a career in research where do they go?

His practical insights, I think, will be very helpful to the committee on both policy and budget. We're happy to have him.

The CHAIRMAN. Dr. Miller, we welcome you here as well. I have valued our opportunity to spend some time together on different occasions and certainly support what Senator Mikulski has mentioned.

Ms. Dana Lewis is a sophomore major in public relations and political science, University of Alabama. Since her diagnosis of Type I diabetes 5 years ago, she has worked as an advocate for others suffering from the disease. In 2005, she was appointed the American Diabetes Association National Youth Advocate and continues to volunteer locally and abroad and empower the young people with diabetes. You are very welcome.

Dr. Samuel Rankin is the Executive Director of the Washington, DC office of the American Mathematical Society. Prior to coming to Washington, Dr. Rankin was Professor of Mathematics at West Virginia University, Worcester Polytechnic Institute, Virginia Tech. Dr. Rankin also serves as Chairman for Coalition for National Science Funding and Association Advocate for the National Science Foundation. We're glad to have him here today.

Dr. Faust, we welcome you. We congratulate you on all their good work on this program. You've had a banner year at Harvard and leading the way in terms of opening up new opportunities to students who attend our great universities and with limited incomes. And you have set really a very important example that's being followed by many other colleges and universities. Needless to say, author of a very distinguished book which I've had the good opportunity to get partially through.

[Laughter.]

I look forward to finishing it during this next Senate break. It's a very stirring, moving story for those of us who are always fascinated by the Civil War and the starkness of that conflict and the loss of life in that conflict. You bring an insight into that whole subject matter that is unique and special and incredibly informative and moving.

We're here today on another reason to hear from you. We'll certainly look forward to your comments.

STATEMENT OF DREW GILPIN FAUST, Ph.D., PRESIDENT, HARVARD UNIVERSITY, CAMBRIDGE, MA

Ms. FAUST. Thank you very much, Chairman Kennedy, Ranking Member Enzi and members of the committee for this important opportunity to come before you to illustrate some troubling findings about how Federal funding of the National Institutes of Health is affecting both the pace and the direction of medical research.

For decades universities and the Federal Government in partnership with States and philanthropists have built and sustained a

brilliant, powerful and vibrant research and educational enterprise that has moved the world improving health, growing economies and indeed growing whole industries and seeking always the next frontier. This underlying theory of the partnership resonates as clearly today as at its inception. Investment in basic research at our universities delivers transformative research today and simultaneously trains the next generation of scientists, engineers and seekers of cures.

To borrow a term from biology, this pluripotent system regenerates our research capacity. Seamlessly assuring that tomorrow's leaders will be ready to fill the shoes of those giants of yesterday and today.

We are here today because we know that these powerful structures of innovation are also very fragile. I have come to speak to you because of what I am hearing from post-doctoral fellows and students considering careers in basic research. They find themselves confronting new limits, not in ideas, energy, intelligence or enthusiasm, but in opportunity.

First, Senator Kennedy and members of the committee, I want to thank you for your thoughtful leadership in higher education but specifically today, for your consistent support for the National Institutes of Health and for the biomedical enterprise in the United States. Your dedication over decades has helped build a system that is the envy of the world. A system that countries around the world are working hard to replicate.

As you know the bipartisan doubling of the budget in the NIH between 1998 and 2003 had a critical impact on biomedical research. This support enabled the research community to harness powerful new tools and complete the human genome project launching the United States and the world into a biological science revolution.

The critical infusion of funds fertilize whole promising new fields like genomics and proteomics. This has unleashed our researchers to analyze biological phenomena beyond our reach only a decade ago. It has resulted in new therapies that are improving patient outcomes, has produced a host of medications that are currently in clinical trials and has transformed the scientific foundation upon which today's researchers are building new approaches to vaccine public health problems.

At a time when many lament the ability of Congress to collaborate on great issues of our day, one need only point to the commitment for supporting NIH as a resounding example of bipartisan cooperation and accomplishment. However, as the committee is well aware, funding since 2003 has been virtually flat. Erosion through inflation has been taking a significant toll.

In 2006 your committee completed a comprehensive review of NIH when you crafted reauthorization. One of your most important recommendations was a call for substantial increases above inflation for funding at NIH through 2009. Sadly those increases have not been realized.

To quote a recent commentary in the New England Journal of Medicine, "The Nation's biomedical research enterprise has never experienced a recession of this magnitude or duration." Today a consortium of seven institutions is releasing a new report, "A Bro-

ken Pipeline? Flat Funding of the NIH Puts a Generation of Science at Risk." This report follows a related report issued last year just this time entitled, "Within our Grasp—or Slipping Away? Assuring a New Era of Scientific Medical Progress." Attached to my testimony is a full list of the 14 institutions and the 32 researchers who contributed to the findings of these two reports as well as the leading associations that have supported this work.

What these reports show is that the 13 percent loss in real dollars over the last 5 years is having a cascading impact that is slowing progress and threatening future research that could lead to cures and even to ways to prevent disease entirely. Leading scientists with quality grant proposals are caught in a protracted review process that plays out often over years, not months. As a result investigators are downsizing labs, slowing research and producing more conservative, less ambitious proposals, more likely to secure funding.

Junior faculty who witnessed the struggles of their advisors are asking themselves how they can possibly compete with their mentors for a piece of the reduced research pie. At the same time, they are working to encourage the next generation of students who could and should be tomorrow's pioneers in science. The result too often is a ladder of discouragement that we hope our country recognizes and begins to address today.

Says Anil Potti, a young researcher from Duke University who's using genomic strategies to improve the outlook of patients with lung cancer, "I worry most about what this means for patient care. It takes a long time, not only to get approved, but also to get the funding once you are approved. The whole cycle can take 12 to 18 months and that's if you're successful on the first or second try. In the meantime I'm seeing patients everyday who could benefit from this research."

When we produced the first publication in 2007 every one of the 20 senior researchers interviewed expressed optimism at the scientific possibilities created by the powerful Federal investment Congress made in NIH at the turn of the century. They enthusiastically describe their ongoing work and their plans to prevent the ravages of Alzheimer's, to attack cancer, to stop the twin epidemics of obesity and diabetes, to repair spinal cord injuries or fight emerging infectious diseases. Their elation has been dampened by years of tightened budgets which they say are eroding their ability to harness and advance those potential breakthroughs.

Perhaps the most alarming message we heard was the growing sense among senior researchers that the future may be at risk. Because those most affected by the budget crisis are the emerging, young investigators. We interviewed 12 brilliant junior faculty at seven institutions across the country who work in several different fields. While they each remain powerfully drawn to the promise of alleviating pain and suffering they are confronted with a reality that diminishes many of their hopes and dreams.

Anne Giersch, an assistant professor at Harvard told the interviews,

> "I don't think one researchers funding plight means anything much in the scheme of things, but I think my difficult experience is being played out many times over. I hate to think of

> all the lost opportunities for scientific progress that are going unfunded and the loss of economic competitiveness that will accrue if these funding trends continue."

These young scientists have the best training, were mentored by leaders in their scientific fields have been recognized for their early work and hold tremendous promise for the future of science. If these scholars are struggling it is clear that as a nation we must have a problem.

Consider a few facts. The average age of a first time recipient of R01 grant, the premier NIH research grant that launches careers is 43 years old, up from 39 in 1990. The success rate on an R01 grant application when first submitted is only 12 percent today, a severe drop from the 29 percent it was in 1999.

For even top senior scientists success may mean two or three submissions of a grant application over an 18-month to 2-year period. This results in significant time taken from science for grant writings and re-writings. Ultimately yields grants whose sizes have been substantially reduced from 5 years ago.

Nancy Andrews, the Dean of the Duke University Medical School puts it this way. "What a strange business this is," she says.

> "We stay in school forever. We have to battle the system with only a 1 in 8 to 1 in 10 chance of getting funding. We give up making a living until our 40s. We do it because we want to help the world."

There is a related issue we all need to be concerned about. Through our long-term commitment to funding medical research the United States has built a system of scientific innovation that simultaneously trains our own best and most talented people and attracts the best and the brightest from all around the world. We have in-sourced talent, combined it with our own, and pushed the boundaries of innovative approaches to fighting disease that has served the world.

Today, China, India, Singapore and others have adopted biomedical research and the building of biotechnology clusters as national goals. Suddenly those who train in the United States have significant options elsewhere.

Mr. Chairman and members of the committee, we are well aware that the scientific justification for financial support will always outstrip our ability to fully invest and that your very difficult job is to strike the appropriate balance. It's also a fact that NIH will spend $30 billion this year in labs across the country that will continue to produce startlingly new results.

We thank you for this sincerely. Where will we be in 10 years if we discourage a generation of trail blazers. We simply cannot afford to tread water.

Last year we reported that our ability to harvest the fruits of previous scientific investments was truly slipping away. Today we present new evidence in a report with a more troubling message. The current system is discouraging our best minds from entering or remaining in academic biomedical research.

The message in both these reports should be a wake up call to all of us. We agree with Dr. Zerhouni, the Director of NIH when he says,

"Without effective national policies to recruit young scientists to the field and support their research over the long-term in 10 to 15 years we'll have more scientists older than 65 than those younger than 35. This is not a sustainable trend in biomedical research."

Nor, I would add, is it a sustainable trend for these gifted young scientists, nor for the tens of thousands of Americans whose lives would be improved, prolonged, perhaps even saved by their discoveries. Thank you very much.

[The prepared statement of Dr. Faust follows:]

PREPARED STATEMENT OF DREW GILPIN FAUST

Thank you Chairman Kennedy, Ranking Member Enzi and members of the committee for this opportunity to come before you to illustrate some troubling findings about how stagnant Federal funding of the National Institutes of Health is affecting both the pace and direction of medical research.

For decades, universities and the Federal Government, in partnership with States and philanthropists, have built and sustained a brilliant, powerful and vibrant research and educational enterprise that has moved the world: improving health, growing economies—indeed growing whole industries—and seeking always the next frontier. The underlying theory of this partnership resonates as clearly today as at its inception: Investment in basic research at our universities delivers the research "goods" today and simultaneously trains the next generation of scientists, engineers and seekers of cures. To borrow a term from biology, this "pluripotent" system regenerates our research capacity, seamlessly assuring tomorrow's leaders will be ready to fill the shoes of the giants of yesterday and today.

This fierce force of innovation is also a fragile chain. A link in the chain is wearing thin and I am compelled to be here today because of what I am hearing from post-doctoral fellows and students considering a career in basic research. They see a future defined by new limits—not in ideas, energy, intelligence or enthusiasm—but in opportunity.

Today, a consortium of seven institutions is releasing a new report, *"A Broken Pipeline? Flat Funding of the NIH Puts a Generation of Science at Risk."* This report follows a related report issued last March, *"Within our Grasp—or Slipping Away? Assuring a New Era of Scientific Medical Progress."* Attached to my testimony is a full list of the 14 institutions and the 32 researchers who contributed to the findings of these two reports as well as the leading associations that have supported this work.

First, Senator Kennedy and members of the committee, I want to thank you for your thoughtful leadership in all areas related to higher education, but specifically today for your consistent and persistent support for the National Institutes of Health and the biomedical research enterprise in the United States. Your dedication over decades has helped build a system that is the envy of the world—a system that countries around the world are working hard to replicate.

As you know, the bi-partisan doubling of the budget of the NIH between 1998 and 2003 was a transformative force for biomedical research. This support enabled the research community to harness powerful new tools and complete the Human Genome Project, placing the United States—and the world—at the crossroads of a biological science revolution. The critical infusion of funds fertilized whole new promising fields like genomics and proteomics. It unleashed our researchers to analyze biological phenomena beyond our reach only a decade ago. It has resulted in new therapies that are improving patient outcomes, produced a host of medications that are currently in clinical trials, and transformed the scientific foundation upon which today's researchers are building new approaches to vexing public health problems. When the public laments the inability of Congress to collaborate on great issues of our day, one need only point to the commitment for supporting NIH as a resounding example of bipartisan cooperation.

However, as the committee is well aware, funding since 2003 has been virtually flat and erosion through inflation has been taking a significant toll. In 2006, your committee completed a comprehensive review of NIH when you crafted the reauthorization. One of your important recommendations was a call for funding increases at NIH for 2008 and 2009 of 7 and 8 percent respectively. Sadly, those numbers, which the reauthorization was built around, have not been realized and flat or below inflation increases have persisted.

Two years ago, concerned that protracted flat funding in biomedical research at NIH was damaging our ability as a nation to capture the true promise of the doubling, a group of concerned institutions set out to closely examine what was happening on campuses and in medical centers as a result of this downturn in the funding trajectory. These results were captured in the two reports being discussed today.

What we have found is that the 13-percent loss in real dollars over the last 5 years is having a cascading impact that is slowing progress and threatening future research that could lead to cures and even ways to prevent disease.

Leading scientists with quality grant proposals are caught in a protracted grant review process that plays out often over years, not months. As a result, investigators are downsizing labs, slowing research and producing more conservative, less ambitious proposals that are more likely to secure funding.

Junior faculty who witness the struggles of their advisors are asking themselves how they can possibly compete with their mentors for a piece of the reduced research pie. At the same time, they are mentoring their own students and working to encourage the next generation of scientists who could and should be tomorrow's pioneers. The result too often is a ladder of discouragement that we hope our country recognizes and begins to address today.

Says Anil Potti, a young physician researcher from Duke University who is using genomic strategies to improve the outlook and treatment of patients with lung cancer:

> "I worry most about what this means for patient care. It takes a long time not only to get approved . . . but also to get the funding once you are approved. The whole cycle can take 12–18 months, and that's if you're successful on the first or second try. In the meantime, I'm seeing patients every day who could benefit from this research."

When we produced the first publication in 2007, every one of the 20 senior researchers interviewed expressed optimism at the scientific possibilities created by the powerful Federal investment Congress made in NIH at the turn of the century. They enthusiastically described their ongoing work and their plans to prevent the ravages of Alzheimer's, attack cancer, stop the twin epidemics of obesity and diabetes, repair spinal cord injuries or fight emerging infectious diseases. Their elation has been dampened by years of tightened budgets, which they say is eroding their ability to harness and advance those potential breakthroughs.

Perhaps the most alarming and consistent message we heard was the growing sense among senior researchers that those most affected by the budget crisis are the emerging young investigators. Their careers are being stifled. We were told repeatedly that brilliant young researchers, whose training coincided in some degree to the excitement of the doubling, are stuck behind their mentors in a funding queue that is stalling promising careers in academic research and pushing many with substantial promise to seek alternative paths.

Fearful that our Nation's dampened commitment to biomedical research was hindering scientists' ability to speed therapies to the bedside, our attention was collectively drawn to an even more damaging longer term impact—the loss and discouragement of a generation of researchers.

We sought this year to find out more. We interviewed 12 brilliant junior faculty at seven institutions across the country, who work in several different fields. The findings are more uniform and obvious than any experiment any of them are likely to do in their careers. While they each remain powerfully drawn to the promise of alleviating pain and suffering, they are confronted with a reality that diminishes many of their hopes and dreams.

Michael Rodriguez, a physician-researcher at UCLA says,

> "24 hours a day, 7 days a week, you're thinking about your grant proposals and wondering how to survive in this world where fewer people are getting funded, and proposals that are funded aren't being fully funded or are being cut."

Anne Giersch, an assistant professor at Harvard told the interviewers,

> "I don't think one researcher's funding plight means anything much in the scheme of things, but I think my difficult experience is being played out many times over. I hate to think of all the lost opportunities for scientific progress that are going unfunded, and the loss of economic competitiveness that will accrue if these funding trends continue."

These researchers were trained at some of the best institutions in the world, mentored by leaders in their scientific fields, have been recognized for their early work, and hold tremendous promise for the future of science. If these scholars are struggling, it is clear that as a nation we most certainly have a problem.

Consider a few facts:

• The average age of a first-time recipient of an R01 grant—the premier NIH research grant one needs to establish credibility—is 43 years old, up from 39 in 1990.
• The success rate of an R01 grant application when first submitted is only 12 percent today, a severe drop from the 29 percent it was in 1999.
• For even top senior scientists success may mean two or three submissions of a grant application over an 18-month to 2-year period resulting in a grant whose size has been substantially cut from 5 years ago.
• The response to rejected grants are downsized labs, lay-offs of post docs, slipping morale, and more conservative science that shies away from the big research questions.
• After multiple submissions and a protracted process, only about 20 percent of grants will ultimately be funded.
• The percent of R01's that will go to first-time investigators was 25 percent in 2007, down from 29 percent in 1990.

Nancy Andrews, Dean of Duke University Medical School, puts it this way:

> "What a strange business this is: We stay in school forever. We have to battle the system with only a 1 in 8 or 1 in 10 chance of getting funded. We give up making a living until our forties. We do it because we want to help the world. What kind of crazy person would go for that?"

There is a related issue we all need to be concerned about. Through our long-term commitment to funding medical research, the United States has built a system of scientific innovation that simultaneously trains our own best and most talented people and attracts the best and brightest from around the world. We have "in-sourced" talent, combined it with our own and pushed the boundaries of innovation for our economy and, indeed, the world.

Today, China, India, Singapore and others have adopted biomedical research and the building of biotechnology clusters as national goals. Suddenly, those who train in America have significant options elsewhere.

Mr. Chairman and members of the committee, we are well aware that the scientific justification for financial support will always outstrip our ability to fully invest, and that your difficult job is to strike the appropriate balance. It is also a fact that NIH will spend $30 billion this year in labs across this country that will continue to produce startling new results—for which we thank you sincerely.

We cannot afford to simply tread water. Last March, Dr. Joan S. Brugge, Chair of the Department of Cell Biology at Harvard Medical School, testified before the Senate Committee on Appropriations where she discussed the impact of the aging baby boomer generation and warned,

> "We cannot afford to stand still—the demographics are against us. There is an impending increase in cancer due to the baby boomers aging into their cancer-prone years, which has been referred to as an impending tsunami. You are all keenly aware of the ramifications for government of Medicare entitlements associated with this surge in cancer. Unlike a real tsunami, which comes unexpectedly with no time for preparation, we are well aware of this impending crisis. We know that the congressional investment in basic and cancer-focused research has positioned the cancer research community to make more rapid progress in translating basic discoveries into diagnosis, treatment, and eventually, prevention of cancer."

Past investment has positioned us to make key advances on the broad range of disease and we cannot afford to retreat.

However, the New England Journal of Medicine recently featured a commentary proclaiming that, *"the Nation's biomedical research enterprise has never experienced a recession of this magnitude or duration."*

Last year, we reported that our ability to harvest the fruits of previous scientific investments is truly slipping away.

Today we present new evidence in a report with a more troubling message, delivered by 12 of the Nation's most promising junior researchers. They are telling us that the current system is discouraging them and their peers from entering or remaining in academic biomedical research. We may be creating a climate where our position as the primary destination for the best and brightest researchers from around the world may be challenged.

The messages in both of these reports should be a wake up call to all of us. We agree with Dr. Elias Zerhouni, Director of NIH, when he says:

> "Without effective national policies to recruit young scientists to the field, and support their research over the long term, in 10 to 15 years, we'll have more

scientists older than 65 than those younger than 35. This is not a sustainable trend in biomedical research and must be addressed aggressively."

Thank you Chairman Kennedy and Senator Enzi for this opportunity to provide this testimony on behalf of the consortium of concerned institutions that sponsored these reports. I look forward to your questions.

ATTACHMENT—CONTRIBUTING INSTITUTIONS AND RESEARCHERS

INSTITUTIONS

Report—"Broken Pipeline? Flat Funding of the NIH Puts a Generation of Science at Risk"

Brown University
Duke Medicine
Harvard University
The Ohio State University Medical Center
PARTNERS$_{TM}$ Healthcare
UCLA
Vanderbilt University

Report—"Within Our Grasp—or Slipping Away? Assuring a New Era of Scientific Medical Progress"

The University of California
Columbia University in the City of New York
Harvard University
Johns Hopkins Medicine Johns Hopkins University
PARTNERS$_{TM}$ Healthcare
The University of Texas at Austin
Washington University in St. Louis
The University of Wisconsin Madison
Yale University

RESEARCHERS

Report—"Broken Pipeline? Flat Funding of the NIH Puts a Generation of Science at Risk"

Nancy Andrews, M.D., Ph.D., Dean, Duke University Medical School
Carthene Bazemore-Walker, Ph.D., Assistant Professor, Department of Chemistry, Brown University
Joshua Boger, Ph.D., Founder and CEO, Vertex Pharmaceuticals, and Chair, Biotechnology Industry Organization
Isla Garraway, M.D., Ph.D., Assistant Professor, Department of Urology, University of California Los Angeles
Rachelle Gaudet, Ph.D., Associate Professor of Molecular and Cellular Biology, Harvard University
Anne Giersch, Ph.D., Assistant Professor, Harvard Medical School and Brigham & Women's Hospital
Denis Guttridge, Ph.D., Associate Professor, Department of Molecular Virology, Immunology, and Medical Genetics, The Ohio State University
William Lawson, M.D., Assistant Professor, Division of Allergy, Pulmonary, and Critical Care Medicine, Vanderbilt University
Susan Lindquist, Ph.D., Member and Former Director of the Whitehead Institute, and HHMI Investigator and Professor of Biology, Massachusetts Institute of Technology
L. Kristin Newby, M.D., M.H.S., Associate Professor of Medicine, Duke University
Anil Potti, M.D., Assistant Professor of Medicine, Duke University
Jill Rafael-Fortney, Ph.D., Associate Professor, Department of Molecular and Cellular Biochemistry, The Ohio State University
Michael Rodriguez, M.D., M.P.H., Associate Professor, Department of Family Medicine, University of California Los Angeles
Larry Schlesinger, M.D., Professor of Medicine, Molecular Virology, Immunology, Medical Genetics, and Microbiology, The Ohio State University
Tricia Serio, Ph.D., Assistant Professor, Department of Molecular, Cellular Biology, and Biochemistry, Brown University
Pampee Young, M.D., Ph.D., Assistant Professor, Department of Pathology, Vanderbilt University

Report—"Within Our Grasp—or Slipping Away? Assuring a New Era of Scientific Medical Progress"

Joan S. Brugge, Ph.D., Chair of the Department of Cell Biology, Harvard Medical School

Jon Clardy, Ph.D., Professor in the Department of Biological Chemistry and Molecular Pharmacology, Harvard Medical School

Richard Davidson, Ph.D., Vilas Professor of Psychology and Psychiatry, University of Wisconsin-Madison

Jorge Galán, D.V.M., Ph.D., Professor of Microbial Pathogenesis and Cell Biology and Chair of the Section of Microbial Pathogenesis, Yale University School of Medicine

Carol W. Greider, Ph.D., Director of Molecular Biology and Genetics at the Institute of Basic Biomedical Sciences of The Johns Hopkins University School of Medicine Baltimore, MD; Co-winner of the 2006 Albert Lasker Award for Basic Medical Research

Brent Iverson, Ph.D., University Distinguished Teaching Professor of Organic Chemistry and Biochemistry, The University of Texas at Austin

Thomas M. Jessell, Ph.D., Investigator, Howard Hughes Medical Institute (HHMI); Professor, Department of Biochemistry and Molecular Biophysics, Columbia University

Eric Kandel, M.D., University Professor, Columbia University; Investigator, HHMI; Nobel Laureate, Physiology or Medicine (2000)

M. Daniel Lane, Ph.D., Professor of Biological Chemistry in the Institute for Basic Biomedical Sciences of The Johns Hopkins University School of Medicine, Baltimore, MD

Ira Mellman, Ph.D., Sterling Professor of Cell Biology and Immunology and Chair of the Department of Cell Biology at Yale University School of Medicine, New Haven, CT

Vamsi K. Mootha, M.D., Assistant Professor of Medicine at Massachusetts General Hospital and Assistant Professor of Systems Biology at Harvard Medical School; Recipient of a 2004 MacArthur Foundation Award

Nicholas A. Peppas, Sc.D., Fletcher S. Pratt Chair and Director of Center on Biomaterials, Drug Delivery, Bionanotechnology and Molecular Recognition, The University of Texas at Austin; Member of the National Academy of Engineering

Lee Riley, M.D., Professor of Infectious Diseases and Epidemiology at University of California, Berkeley

Robert Siliciano, M.D., Ph.D., Professor of Medicine and Investigator, HHMI, at The Johns Hopkins University School of Medicine, Baltimore, MD

Samuel L. Stanley, Jr., M.D., Director, Midwest Regional Center of Excellence in Biodefense and Emerging Infectious Diseases Research; Vice Chancellor for Research, Washington University in St. Louis

Stephen Strittmatter, M.D., Ph.D., Professor of Neurology and Neurobiology, Yale University School of Medicine

Leon J. Thal, M.D., Professor and Chair of the Department of Neurosciences at the University of California, San Diego; Winner of the Potamkin Prize for research in Alzheimer's disease in 2004

Amparo C. Villablanca, M.D., Professor of Internal Medicine and Cardiovascular Medicine and Director of the Women's Cardiovascular Medicine Program at the University of California, Davis, School of Medicine

Richard K. Wilson, Ph.D., Professor of Genetics and Microbiology and Director of the Genome Sequencing Center, Washington University in St. Louis

Jerry Chi-Ping Yin, Ph.D., Professor of Genetics and Psychiatry, University of Wisconsin-Madison

The CHAIRMAN. Thank you very much. Very compelling testimony.

Dr. Rafael-Fortney. Thank you.

STATEMENT OF JILL A. RAFAEL-FORTNEY, PH.D., ASSOCIATE PROFESSOR, THE OHIO STATE UNIVERSITY, COLUMBUS, OH

Ms. RAFAEL-FORTNEY. Good morning and thank you, Chairman Kennedy, Ranking Member Enzi, who's not here at the moment, and Members of the HELP committee. My name is Jill Rafael-Fortney. I'm an Associate Professor in the College of Medicine at Ohio State University.

My laboratory conducts biomedical research with the goal of transforming health care for patients with muscular dystrophy and for those with heart failure. We have a potential new target for the treatment of heart failure. This exciting research is sitting in the freezer because our grant did not get funded as a direct result of the flattened NIH budget.

My story is one of countless others. I am here to represent the best and the brightest young scientists and implore this committee to consider the effects of an NIH budget that does not keep up with inflation. The current NIH budget has led to a funding crisis where the most innovative ideas that are most likely to lead to the biggest breakthroughs are not being funded.

This situation is beginning to drive even the most talented, the most well-trained and the most passionate scientists out of biomedical research and young physician scientists into private practice. Behind us we're losing the generation of students that we're training.

At a time when we're poised to make the most momentous discoveries in biomedical research, losing these generations of scientists and their science will be devastating and this situation will have catastrophic effects on the future of health care in our great country. Thank you very much.

[The prepared statement of Dr. Rafael-Fortney follows:]

PREPARED STATEMENT OF JILL A. RAFAEL-FORTNEY, PH.D.

I would like to sincerely thank Chairman Kennedy and Ranking Member Enzi for holding this hearing on the very important topic of the serious threat to scientific discovery in our country.

When I was 6 years old, I started watching the Jerry Lewis telethon for Muscular Dystrophy every Labor Day weekend. I found it horribly sad that children just like me were living their lives in wheelchairs and facing a certain death before I would graduate from college. I did what I could at the time; I saved up my allowance and donated it to the telethon every year and vowed that I would spend my adult life trying to help these children.

In 7th grade science class I first learned about genetics, and I realized that this was the road to fight neuromuscular diseases. I looked for Universities where I could gain hands-on skills in genetic research. For 3 years as an undergraduate student at Cornell University and during the summers I conducted a research project in a genetics lab and completed an Honor's thesis. I also spent a summer in a clinical genetics setting where I was able to make an informed decision to not seek a medical degree, so that I could spend more of my young life doing research and more time trying to find cures instead of telling patients that I couldn't help them.

After graduating in the top 10 percent of my class from Cornell, I went to the most competitive Human Genetics Ph.D. program in the country at University of Michigan. I trained with the leaders in the muscular dystrophy field; Jeff Chamberlain as a Ph.D. student, and Kay Davies as a post-doctoral fellow at the University of Oxford in England. Professor Davies has been honored by the Queen of England for her contribution to biomedical research in the UK and is now a Dame. As a graduate student and post-doc, I published over 20 peer-reviewed papers on muscular dystrophy, including some in the very best journals such as Cell and Nature Genetics.

I accepted a tenure-track faculty position at The Ohio State University because of the clinical strength in neuromuscular and cardiac diseases. I did so with the vision of carrying out breakthrough basic and translational research focused on the skeletal muscle and heart pathologies of muscular dystrophy. Rather than merely continuing some aspect of the work ongoing in the labs of my mentors, I took the difficult path of initiating research projects in my own lab to address two different important scientific questions that weren't being addressed elsewhere. The first project focused on heart disease in Duchenne muscular dystrophy. The second focused on identifying novel mechanisms at the neuromuscular junction.

The neuromuscular junction is the site where the nervous system controls muscles and the root of the problem in neuromuscular diseases. My lab identified receptors that had never before been documented at this site. This discovery highlights how new knowledge will never be learned if you're only looking for what you already know is there.

Patients with Duchenne and other muscular dystrophies also have heart failure in addition to debilitating skeletal muscle problems. Therefore, we also focused on defining the mechanisms of this heart disease with the long-term goal of identifying novel targets for treatment. We found a gene that is specifically downregulated in muscular dystrophy cardiomyopathy that progresses to heart failure. We confirmed that the protein is lacking only in heart cells of this heart failure model. In collaboration with an OSU cardiologist, we next looked to see if this protein was missing in patients with heart failure. Surprisingly, we found that at least 60 percent of heart samples collected from patients who had heart transplants showed an absence or major reduction in the levels of this protein. What is so significant about this number is that it represents 60 percent of people who develop heart failure as a result of a wide variety of primary causes, not just muscular dystrophy. It could be a common pathway to heart failure for at least 60 percent of the 5 million people who are living with heart failure in the United States today and the 500,000 additional cases diagnosed every year. I want to emphasize that these are not people who suffer heart attacks and either quickly recover or die from them. Rather, people with heart failure are hospitalized for long periods of time, are on life support, and are on the waiting list for heart transplants. One can just begin to imagine the economic and quality-of-life benefits that would result from a way to prevent heart failure from this or similar research. To pursue this line of research, we submitted an R01 application to the NIH proposing the next set of definitive experiments. The application proposed to determine the ability of this protein to cause and prevent heart failure in mouse models and to test specific hypotheses in patient samples of how this protein is lost. It represents a collaboration between me (a molecular geneticist), a cardiac physiologist (Paul Janssen), and a cardiologist (Phil Binkley). That application received a score that would have been funded a few years ago, but missed the funding line in the current environment. This example is just one of hundreds of exciting, potentially groundbreaking biomedical science projects that are not being funded today.

While we can't predict exactly how these research projects will benefit patients or impact the economics of the U.S. healthcare system, biomedical research is on the cusp of a breakthrough. It has been said that the 20th century was the Century of Physics with incomprehensible advances in flight, communication and silicon technology. The 21st century is the Century of Biology. The Director of the Research Institute at Nationwide Children's Hospital, Dr. John Barnard, gave a perfect example in a speech I heard a few days ago. At the beginning of the Century of Physics the Wright Brothers probably couldn't envision that their invention would evolve into the global companies of Boeing or Netjets or that John Glenn would travel into Space, but they knew they were on to something big. At the present, while we can't predict where we'll be at the end of the century, or even in 10 years, we know we are on to something big. We have advanced to the point of having all of the right tools and all of the background knowledge. We, as scientists, know that we are on the verge of major breakthroughs in Biology and Medicine.

What's the problem with the flat NIH budget? Well, it comes down to the same economic issue as everything else. A flat budget equates to a loss of buying power. It is certainly not going to flamboyant salaries, although I'm happy to report that we do provide healthcare for our trainees and employees. In addition to this obvious economic issue, funding of individual investigator-initiated innovative science via hypothesis-driven R01 grants has been impacted to an even greater extent. The public push to translate everything in the research pipeline into clinical applications has led to the creation of milestone driven research. While milestone-driven translational research is important and certainly should be funded by the NIH, research designed to meet milestones results in discarding any novel observations made along the way. This type of research design will push anything with clinical potential out of the pipeline. The question is: what will fill the pipeline?

The individual initiated R01 is the grant mechanism that feeds the pipeline. The payline for R01's is currently around the 10th percentile. From my perspective also as a grant reviewer, you have to bet on 1 grant out of a pile of 10. When you can select only 1 grant, it is against human nature to not select the grant from the established lab with the long track record, where many of the proposed experiments are already complete. As one colleague said, "it has the horrible consequence of pushing research agendas to the 'tried and true' variety rather than the risky, innovative, and high pay-off, even for senior investigators." That effect is even more dra-

matic for junior investigators who have not built powerhouse labs, but have the really innovative ideas that are not getting funded. These junior investigators are spending inordinate amounts of time writing and re-writing their proposals instead of actually conducting innovative research. The low NIH budget is driving young scientists into teaching careers, industry, publishing, or sending them to law school. We're losing a generation of scientists.

They're people like me. People who graduated at the top of their classes from Ivy League Universities; people who were trained by the best scientists in the world; people who have had a passion for what they do their whole lives. I'm not talking about people who were never successful. I'm talking about people who have multiple first author papers in the best scientific journals: Cell, Nature, Science. They're people who may have had their first R01 successfully funded, but can't get a renewal funded; and will lose all of the trained personnel in their labs while they're trying. We're losing them. The United States, which has been a world leader in scientific discovery is falling behind.

We're losing physician scientists who have had enough passion for finding new ways to treat human disease to obtain both M.D. and Ph.D. degrees or who do a research fellowship. My clinician scientist colleagues are going into private practice when they can't get their R01's funded. They're making this decision not based on personal financial reward, but based on the funding situation that prohibits their progress towards what they passionately believe will aid humankind.

Behind us, we're losing the students and postdocs that we're training, because they don't want to go through the rejection and adversity that they're seeing us go through. We're really losing two or more generations of scientists.

As we allow inflation to erode NIH funding, it declares to the international community that the United States does not believe that science will play a role in the development of its society. It is short-sighted.

To me, the biggest disappointment is that we've come to a point where science and medicine have so much overlapping technology and there is so much common knowledge between the bench and the bedside, that scientists and physicians are really poised to work together to do momentous things. The effects of losing our generation will be devastating.

What will I do if my R01 doesn't get funded? I'll still be a co-investigator on a milestone-driven multi-investigator translational project that will support a part-time person in my lab. I'm part of another large translational application that will be reviewed soon. If that gets funded, my salary won't get cut and it will keep my lab slowly moving along, but only to refine what we already know, not on any of our promising new discoveries. While working in large groups of clinicians and scientists on these large translational projects are also exciting and have immediate potential impact on patients, they're not enough for me. They let me use my organizational and technical skills, but not my passion that leads me to innovate and envision the potential to make the completely novel breakthroughs. I feel fairly confident that I could get funded to do research on some minutia of the known, but that's not a good enough reason to spend that much time away from my wonderful 5-year-old son and 2-year-old daughter.

I am confident that the innovative research from my laboratory will lead to dramatic improvements in the quality of life for patients with muscular dystrophy and heart failure while at the same time dramatically decreasing healthcare costs. There are countless other cases like mine. If NIH funding was in the same relative state a decade ago, children with leukemia would still be dying, instead of going on to live normal lives. We would not have the imaging capabilities to detect and prevent many cases of breast and prostate cancer and the treatments that extend survival and improve quality of life. In the next decade we are likely to have treatments for diabetes, Alzheimer's disease and heart disease, but not if the NIH funding crisis continues. As a country, we should be thinking not of how we are going to solve this crisis for the coming year, but we should be developing a 50-year plan to maintain the expertise of scientists and remain at the forefront of scientific discovery and applications to healthcare. We need to invest in the next generations of scientists and we need to do it now.

The CHAIRMAN. Thank you. Thank you very much.

Dr. Miller.

STATEMENT OF EDWARD D. MILLER, M.D., DEAN OF THE MEDICAL FACULTY, THE JOHNS HOPKINS UNIVERSITY SCHOOL OF MEDICINE, BALTIMORE, MD

Dr. MILLER. Senator Kennedy, Senator Mikulski, Senator Brown, thank you very much. I'm Ed Miller. I'm the Dean and CEO of Johns Hopkins Medicine and I've done it for 12 years now.

I think I have a pretty good insight into some of the issues. You may wonder why we're here today even though the doubling of the NIH ended in 2003. I think you're really now seeing the very depths of what that flat funding has meant—actually a decrease in funding.

I want to thank you for your sustained support over the years, especially Senator Kennedy and Mikulski that have really allowed us to do what we needed to do. What we need at NIH is actually sustained funding now that is better than the rate of inflation so that young investigators and also older investigators will be able to be funded.

One of the things that I'm noticing now is that our older investigators are having difficult times. They are the mentors for the younger investigators. If they need to spend more and more time writing grants so that they can have their funding in tact, it's less time for the young investigators to be mentored by them.

One of the issues that I think is very important is that we have a sustained level of funding over a period of years, 10 or 15 years that will allow us to go forward. I also think that your support of the reauthorization of NIH was extremely important. It has allowed the Director to be able to be more flexible in the use of the funds and to address issues that affect the country in a more rapid way then they have in the past. I think you can see that we have been able to meet that challenge.

And last, I think it's very important to not forget the past. As you pointed out in your opening comments, incredible progress has been made in the care of the Nation because of the funding of NIH. I think we do not want a generation of researchers to be lost and therefore lose our chances to improve the health of this country.

Again, I think it's very important we have sustained funding of NIH that goes over periods of time that will support both the young investigator, but also the older investigators. Thank you, Senator Kennedy.

[The prepared statement of Dr. Miller follows:]

PREPARED STATEMENT OF EDWARD D. MILLER, M.D.

INTRODUCTION

Mr. Chairman and members of the committee, thank you so much for inviting me to testify today at this very important hearing. I am Ed Miller, Dean of the Medical Faculty and CEO of Johns Hopkins Medicine. Johns Hopkins Medicine is the organization that represents the Johns Hopkins University School of Medicine and Johns Hopkins Health System.

I am pleased to be here to give you my perspective on the findings of the report: "A Broken Pipeline? Flat Funding of the NIH Puts a Generation of Science at Risk." The report highlights, in a very personal way, the impact of the current funding environment on the careers of some of our country's most promising young scientists. As the person charged with the privilege and responsibility for the operation of one of the many institutions across this country whose mission is to train future physicians and researchers, as well as provide patient care, I can tell you that my coun-

terparts at other universities and I struggle everyday to help all our investigators navigate the current funding climate.

I believe we may lose a generation of enthusiastic, inquisitive scientists if they conclude NIH grants are out of reach. The statistics are very discouraging. Today only one out of every four grants is ever funded—8 years ago it was one in three. Only 12 percent are funded after the first submission. For first-time applicants these odds seem insurmountable and they are discouraged. They spend many weeks and countless hours preparing their proposals only to be told their score was not high enough and they should rewrite and resubmit. Or worse yet, they are not scored at all. No wonder they are discouraged. I also believe that in the quest to obtain funding, all of our scientists, both young and more senior, are becoming risk-averse, and curtailing their proposals and the most cutting edge science may remain undone because in an environment of scarce resources only the safe-bets are funded.

First, I commend you and your colleagues in Congress for their historical commitment to biomedical research and National Institutes of Health (NIH) and the support this provides to our Nation's research universities. What many Americans may not realize is that 85 percent of the funding that Congress provides to NIH actually comes back to their local communities. Many of the startling advances in identifying early indicators and causes of diseases are the result of those well-spent Federal research dollars. I am convinced we are on the cusp of a dramatic transformation in health science discovery and cures. Unfortunately, since 2004 the levels of funding for the NIH have not kept pace with inflation and NIH has lost upwards of 13 percent of its purchasing power. Not only have we lost ground to inflation, but at Johns Hopkins we have seen an actual decrease in our total awards from our peak level in fiscal year 2005. This is having an impact across our entire institution but has had a particularly insidious effect upon our young investigators.

Going forward, NIH needs at a minimum, funding increases at least equal to the biomedical research inflation index (BRDPI). Anything less, is a real cut to science, threatens the careers of our young faculty and will weaken the Nation's role as a worldwide leader in the biomedical field. The current projection for BRDPI for fiscal year 2008 through 2013 is 3.5 percent. But if past is prologue (in fiscal year 2007 it was 3.9 percent and fiscal year 2006 was 4.6 percent) one might expect actual BRDPI levels to exceed current projections. The biomedical research community is seeking an increase of $1.9 billion which represents BRDPI plus 3 percent. This infusion of $1.9 billion will allow research labs to keep pace with rising costs and provide resources for new and innovative projects.

We, in academia, are cognizant of the overall fiscal situation that Members of Congress and this and future Administrations face. We are also aware that there are many compelling demands upon the discretionary funds available to appropriators. Nonetheless as a community, we feel it is critical that we come before you to reiterate how important it is to support biomedical research not only for ourselves but future generations. The plight of our young investigators exemplifies perfectly both the current and future risk of allowing our international leadership in this area to erode.

FUNDING CLIMATE HINDERS HIGH IMPACT RESEARCH

I hear from my faculty that NIH study sections, with the limited funding available to them, tend to favor safer bets. Study sections look for increasingly more preliminary data in grant applications. In essence they are seeking so much preliminary experimental information that many applicants say most of the proposed project would have to be already done before they get funding. They are funding incremental steps, not bold initiatives. This modus operandi clearly discourages creativity and cutting edge ideas.

I also hear that because the chance of being funded is much lower, all investigators—especially the younger ones—are spending more of their time in grant writing instead of doing the creative research. I fear that their goal then is not to do creative research but to survive by going for more sure bet type of research for the sake of securing continuous funding.

We also hear that many highly accomplished investigators are also suffering with limited funding. The upshot is that the government has invested tremendously in the past into our intellectual capital, and now we may not reap the benefits.

Let me share an example that clearly demonstrates the tremendous value of supporting our young investigators and the nature of cutting edge research. In September 2006, Carol Greider, Ph.D. (Professor and Director of Department of Molecular Biology and Genetics, Johns Hopkins University School of Medicine), Elizabeth Blackburn, Ph.D. (Professor of Biology and Physiology in the Department of Biochemistry and Biophysics, University of California, San Francisco) and Jack Szostak

Ph.D. (Professor Department of Genetics, Harvard Medical School), Harvard were awarded the most prestigious prize in American medicine—the Lasker Award. They shared the award for their work in telomerase: an enzyme that helps maintain the ends of chromosomes. The award is based on findings the three made with respect to cell function and genetics, 22 years ago, and is considered today to be one of the most advanced areas of biomedical research. At the time Dr. Greider was in her early 20's. Her more senior colleagues Szostak and Blackburn were in their early and mid-30's respectively. These three were well below today's average age of 43 for obtaining the coveted first R01 grant. Subsequent research has revealed that telomerase is elevated in more than 85 percent of all human cancers. It enables cancerous cells to divide indefinitely, making them virtually immortal. Several biotech companies are now devising anti-cancer drugs to block telomerase. If Doctors Greider, Blackburn and Szostak were seeking funding for this same body of work today, would current success rates provide them funding?

I can not help but worry that groundbreaking work such as this is being delayed or left completely undone today. A case in point is that of Joel L. Pomerantz, Ph.D. an Assistant Professor in the Department of Biological Chemistry and the Institute for Cell Engineering at Johns Hopkins University School of Medicine. He wants to use new technologies that are the keys to ground-breaking biomedical discoveries. These new technologies or high-throughput methods provide an opportunity to examine entire biological systems, which are large networks of interacting molecules. The high-throughput technologies have provided young investigators new "microscopes," with which to observe thousands of genes in complex biological systems and generate new hypotheses, producing ground-breaking ideas.

His laboratory has developed ways for using such methodology to screen for genes involved in the normal immune response (lymphocyte activation), and also for genes that function in signaling pathways that are dysregulated in different forms of human cancer and in autoimmune disease. Thus, his screens promise to yield genes that could advance our knowledge of basic immunology and cell biology but might also emerge as targets for the development of novel therapies for cancer, autoimmunity and other diseases of aberrant cell growth and function. It is important to note that it has only recently been possible to do such research. This has been made possible by: the sequencing of human, mouse and other genomes, and the emergence of RNAi technology and the ability to generate genome-wide RNAi libraries that can interrogate the function of most, if not all, known or predicted human or mouse genes.

We now find that study sections are slow to embrace this more novel, creative and unbiased global approach, preferring the traditional hypotheses that link one event to another in a linear way; yielding a potential biased view of a complex system. Dr. Pomerantz and others tell us, given that these technologies cannot guarantee a specific outcome, their use to screen for genes involved in specific pathways or disease status in an unbiased way has been met with resistance. As such, the more traditional, simple hypotheses are proposed rather than the more creative, unbiased way to discover critical biological and disease pathways. This situation is particularly heightened because of the limited NIH funding—leading to a regression rather than progression in the way we do science.

Fortunately for Dr. Pomerantz and the members of his lab, Johns Hopkins has been able to provide some institutional support and private foundations have funded his research on a small scale, and they have already made interesting insights in only a few years. But the conventional wisdom is that the NIH will not support such ventures in an R01 application, unless the applicant is already well-established, well-funded, and one of the very, very few lucky recipients of a Pioneer or Innovator award.

Dr. Pomerantz is 40 years old, has tremendous credentials (degrees from Brandeis and the Massachusetts Institute of Technology and has trained with two Nobel Prize winners: Philip Sharp and David Baltimore), and a very promising career before him. He recently submitted an R01 application which was scored on the first round, but failed to meet the 12 percent payline. He now has 2 more chances to re-submit. Without NIH funding, the fate of Dr. Pomerantz's proposal is uncertain.

Let me share the story of one more of our faculty whose experiences also parallel with what you see in the "Broken Pipeline" report released today: Ben Ho Park M.D., Ph.D. Dr. Park is an Assistant Professor of Oncology with a joint appointment at the Johns Hopkins Whiting School of Engineering, Department of Chemical and Biomolecular Engineering who has some novel ideas about treating breast cancer. Using powerful molecular genetic techniques, his lab is attempting to identify genes involved with clinical drug resistance. It has been previously demonstrated that loss of tumor-suppressor genes and/or their downstream effectors can confer resistance against certain chemotherapies. The lab hypothesizes that there are other genes

where inactivation in a recessive manner can also lead to clinically relevant drug resistance. This problem is of extreme importance to clinical oncology, as the emergence of drug-resistant cancers is what limits the effectiveness of current therapies.

The lab is also trying to understand pathogenic mechanisms of growth/hormone receptor signaling. The continuous exposure of breast tissue to estrogens and other growth factors likely plays a role in the carcinogenic process that transforms a normal breast epithelial cell into a cancer. The lab is trying to elucidate the molecular mechanisms of aberrant receptor signaling that contributes to this process.

Returning to our focus today, the young investigator, I believe it is critical to point out that most ideas that turn into Nobel Prizes come from investigators before they reach the age of 40. While we can not pinpoint today, whose work will ultimately be recognized in this way, it exemplifies why support for their work must continue and why we must support "out-of-the-box" thinkers during the early stages of their careers. Who knows, perhaps the work all these scientists are conducting—or would hope to conduct if funding were more readily available—could be as critical to future breakthroughs in healthcare as that of past Nobel and Lasker award winners. It would be a shame to never know.

Instead of thinking about breast cancer research, Park says he is spending 90 percent of his time chasing grants. He even has his trainees applying for their own grants to make up for the lab's drop in NCI dollars. He reports that 9 out of 10 applications do not get funded and for those that do, R01 awards are then reduced 29 percent. His $218,000 grant is now only $155,000.

Park says he has not had to let people go from his lab, but "I can't think about science any more. I have to focus on getting grants" from foundations and philanthropists. Even those grant applications from his trainees have to be reviewed and rewritten by Park to give them the best chance of getting approved. It means time away for all from their research into developing novel means for treating breast cancer.

Dr. Park reports that, unfortunately, his story is not unique and he worries that if the current funding environment is not reversed soon, we are going to lose a lot of very talented people in science. In a letter to the editor that appeared in the Baltimore Sun last spring Dr. Park and a fellow cancer researcher at the University of Maryland wrote:

> The tragedy stems from our inability to continue to do bold new research that can ultimately affect the prevention, diagnosis and treatment of a myriad of diseases such as cancer. Working in academics is a privilege because it affords scientists the ability to strike out on new creative and innovative projects that would not be allowed in most biotech or pharmaceutical companies. . . . Thus, the ultimate repercussion of decreased Federal funding is not loss of academic scientists, but rather the millions of lives that biomedical research could have otherwise saved.

CONCLUSION

Federal support for biomedical research has helped to transform our ability to detect disease, treat patients, and deliver healthcare with greater effectiveness and affordability. At the same time, the return on investment for the American taxpayer has been high, as research has fostered discoveries that have led to new patents and products, and to the creation of new companies and job opportunities.

The recent enactment of the America COMPETES Act as well as the NIH reauthorization legislation enacted at the end of the last Congress, demonstrates that the President and Congress have embraced the notion that funding for basic research is essential to strengthening America's competitive standing in the world. However, the funding levels envisioned in neither bill have been realized—particularly with respect to NIH. The reauthorization bill called for appropriations of $30.3 billion for fiscal year 2007, NIH only received $29.1 billion. For the current fiscal year 2008, $32.8 billion dollars was authorized, NIH received only $29.5 billion. For the upcoming fiscal year 2009 the bill authorized "such sums as are necessary." The President has proposed a freeze at the 2008 level and I understand that the budget resolution currently before the Senate calls for an increase to $30 billion. The fact is: Federal investments in biomedicine and basic science across the disciplines have taken the United States to the leading edge of innovation. The question we now face is whether as a country we are willing to pay the price to remain in the lead.

The CHAIRMAN. Miss Lewis.

STATEMENT OF DANA LEWIS, STUDENT AND DIABETES ADVOCATE, AMERICAN DIABETES ASSOCIATION, HUNTSVILLE, AL

Ms. LEWIS. Thank you and good morning. My name is Dana Lewis and I battle Type I diabetes. Five years ago when I was first diagnosed I was sure my doctor would prescribe me medicine and I would be all healthy. But, I was wrong.

I am here today because there is currently no cure for diabetes. I walk, talk, sleep and dream for a cure, but it does not yet exist. Type I diabetes means that my body does not create insulin on its own. I must administer insulin throughout the day in order to survive.

Diabetes is more than just daily injections. It is the need for a constant balance of insulin with the carbohydrates I ingest, the exercise I get while assessing factors such as emotions, stress and illness. I strive for tight control because research has established that this is the way to avoid the devastating long-term complications of diabetes.

I have benefited from the incredible value of diabetes research technologies. When I was first diagnosed I tested my glucose levels 12 to 15 times per day using a meter that is bigger and heavier than a blackberry. I also had to self administer insulin two to three times everyday.

Thanks to innovations in research, today I use a continuous glucose monitoring system and wear an insulin pump. The monitor provides a 24-hour view of my blood sugar instead of 15 still photos throughout the day. The pump has eliminated my need to administer multiple insulin injections each day. Instead I inject insulin directly into the pump every few days. This combination is much less evasive to my body and allows me to more easily maintain good control.

All the wonderful technologies only help fight the battle to stay healthy while I wait for a cure. When you are a young adult like me, it is difficult and frustrating to add diabetes and thoughts of future health complications into a busy academic and social schedule. Knowing that research for diabetes in ongoing provides me with hope. Again, thank you for letting me speak with you today.

[The prepared statement of Ms. Lewis follows:]

PREPARED STATEMENT OF DANA LEWIS

Mr. Chairman and Senators of the committee, good morning. Thank you for the opportunity to speak today. My name is Dana Lewis and I am from Huntsville, AL. I am a sophomore at the University of Alabama pursuing degrees in Public Relations and Political Science, with a minor in Computer-Based Honors. I have an interest in working in public health. I appreciate you holding this hearing on the importance of research funding opportunities. My interest in this field and reason for speaking with you today stems from my battle of living with type 1 diabetes.

Tired, achy, always hungry, always thirsty—these symptoms, combined with losing around 15 pounds, preceded my diagnosis of diabetes during my freshman year in high school. Being diagnosed seemed like it should be the end of my problem—my doctor should have said the magic phrase, "I think you have diabetes," hand me some medicine, and I'd be all healthy again. But that isn't what happened. My diagnosis was not the end but rather the beginning of a love-hate relationship that has played a significant role in my life for the past 5 years, one that will remain with me until I die.

There are 20.8 million Americans living with diabetes, a condition in which the pancreas either does not create any insulin, which is type 1 diabetes, or the body doesn't create enough insulin and/or cells are resistant to insulin, which is type 2

diabetes. Insulin is a hormone that allows glucose or sugar to move from the blood stream into the cells where it is used for energy. Since my pancreas no longer produces any insulin, I must administer it throughout the day in order to survive. After diagnosis, I quickly learned that diabetes is more than just daily injections. While a normal pancreas is able to secrete just the right amount of insulin, I have to balance these doses of insulin with the number of carbohydrates I ingest. It is not a simple puzzle that can be solved by filling in the right formula, nor does diabetes pose as a sphinx, requiring a correct answer before letting you cross the road to good health. When this balance is off, I suffer from what is referred to as high blood sugar (hyperglycemia) or low-blood sugar (hypoglycemia).

It can be difficult to maintain blood glucose level in a safe range, yet it is essential. I strive for tight blood glucose control because research has established that this is the way to avoid the devastating long-term complications of diabetes. In order to manage my diabetes I need to carefully monitor my blood glucose levels and make adjustments about the amount of insulin I administer, taking into account the food I eat, and the exercise I get, while assessing factors such as emotions, stress and illness that are affecting my body.

One wrong step, one miscalculation, and the consequences can be life threatening. A severe low blood sugar could cause a seizure, unconsciousness, brain damage and even death. While a severe high blood sugar is also very dangerous, and could send me into a coma, in the long term, it is high blood sugars that lead to the many complications of diabetes—including blindness, heart disease, kidney disease, and amputation. Therefore, I constantly test my blood sugar. I test first thing when I wake up in the morning, between classes, walking across campus, before I snack or eat a meal and an hour or so afterwards. I test before I get in the car to run errands, every few hours while studying and each night before going to bed.

Experiences with highs and lows influence my every day routine. I am forced to remain diligent because diabetes affects my behavior. If I receive good news or get excited, adrenaline surges and my blood sugar will skyrocket and later plummet. If I read news of a tragedy or stress over an upcoming exam, my blood sugar slowly creeps upward. When I incorrectly calculate the number of carbohydrates I eat in the dining hall, my blood sugar spikes and I get dehydrated, my brain feels fuzzy, and my eyesight is very unclear. It affects my performance in the classroom because I can't concentrate. If I forget to adjust my pump to give me less insulin before walking across campus, my blood sugar may drop. When this happens, I start weaving on and off of the sidewalk, I stumble, I mumble, and I cannot complete the simplest tasks such as opening a door and then walking through.

If my blood sugar is low or high during an exam, I may not clearly articulate my skills and abilities or may perform poorly. It could affect my grade in the class, my GPA, and possibly my career. I could pass out in the middle of class or worse, never wake up from nights sleep. In addition, if my body develops ketones (acids that build up in the body due to illness or high blood sugars), people can detect the fruity odor on my breath and think poorly of my hygiene or incorrectly assume that I have consumed alcohol. These may seem extreme, but are all part of the many consequences that those of us with diabetes face all of the time.

My life with diabetes is like this because there is no cure. I walk, talk, sleep, and dream for a cure but the truth is, one does not yet exist. Insulin is not a cure. In the meantime, I am thankful that there have been tremendous improvements in the technologies used to care for diabetes in the past 5 years since I have been diagnosed. These improvements have been life-altering.

When I was first diagnosed, I pricked my fingers to measure my blood glucose levels 12–15 times a day and self administered insulin shots 2–3 times a day, adjusting the amount of insulin as discussed above. Additionally, the glucose meter that I used was bigger and heavier than a Blackberry. I had to constantly use it to prick the side of my finger tips. It was cumbersome and left my fingertips looking like I sewed without a thimble. It was also embarrassing to have to test in front of people who didn't know I had diabetes because it looked like an obscure handheld computer monitor. Today, I have a very small glucose meter that weighs less than my cell phone. It fits easily into my pocket or an eyeglass case. It also provides quicker test results and allows for alternate site testing so that I do not always need to use my fingertips.

I went on an insulin pump 18 months after I was diagnosed. Insulin pumps deliver rapid—or short—acting insulin 24-hours a day through a catheter placed under the skin. Going on the pump allowed me to eliminate individual insulin injections and instead inject insulin directly into the pump once every two to three days. Rather than administering insulin injections and matching my life to how the insulin reacted, the pump has allowed me to more easily match insulin around my activities while stabilizing my blood glucose levels within my target ranges.

Last year, I went a step further and began using a continuous glucose monitoring system (CGMS), a device that provides continuous "real time" readings of glucose levels. The CGMS allows me to better manage my diabetes and decreases the frustration of high and low blood sugars. I now have a 24-hour view of my blood sugar activity, instead of 15 still photos that don't tell the entire story. This allows me to not only better understand the current level of glucose, but also see when my levels are rising or falling, and to intervene to prevent it from going too high or too low. The nights I sleep wearing my CGMS set, I do not have to fear not waking-up, because the system has safeguards and alarms that will wake me—even from a dead sleep—if my blood sugar plummets or skyrockets during the night. Because of the extensive research done in developing this device, we are now one step closer to a "closed loop" artificial pancreas system, which could someday regulate insulin delivery and bring us one step closer to a cure for diabetes.

The technology I rely on would not be available if not for the extensive research of dedicated scientists. Research is so important for people with diabetes because it provides hope for a cure. It is difficult to remain motivated day in and day out to keep control of my blood sugar and to keep myself healthy. When you are a young adult, it is frustrating to add diabetes and the thoughts of future health complications into a busy academic and social schedule. My peers without diabetes do not carry syringes, packages of glucose tabs, and spare test strips in every purse or backpack they use. They do not count every bite of food placed in their mouth and they do not need to know exactly how long it will take for different types of food to affect their blood sugar. All the wonderful technologies only help fight the battle to stay healthy while I wait for a cure. For me, knowing that research for diabetes is ongoing is what keeps me fighting.

I am not alone in living with this disease. Many of your wives, children, siblings, parents, cousins, friends, coworkers, and peers are also affected. We are all fighting diabetes and we need the help and support of researchers and Congress to do so. Diabetes will not be cured by apathy and sitting back while more people are diagnosed and suffering complications of this disease. We need additional funding to maintain and increase research to create better technologies and to find a cure for diabetes.

Please help me fight diabetes. Increase funding for diabetes research. Help me get a cure "sooner" rather than "later."

Again, thank you for the opportunity to speak here today.

The CHAIRMAN. Very good. Thank you very much. You know it's never easy to talk about one's own health challenges, but I think your comments are enormously valuable to the committee and have a way of impressing all of us as a result of your own personal kind of experience. We thank you very much.

Dr. Rankin.

STATEMENT OF DR. SAMUEL M. RANKIN III, ASSOCIATE EXECUTIVE DIRECTOR, AMERICAN MATHEMATICAL SOCIETY, WASHINGTON, DC

Mr. RANKIN. Thank you for the opportunity to speak to you today. In the recent fiscal year 2008 Omnibus Appropriations bill, science research was not funded at a level that will ensure our ability to compete globally. The United States must make adequate yearly investments in science research. These investments must be stable in the long-term.

Dependable increases will allow for planning, infrastructure development, feasible expectations, a manageable pipeline of graduate and post-doctoral students and the creation of positions that can be sustained over time. The predictable pattern of funding will facilitate a continuous stream of high level research and researchers. We should consider a mechanism of funding research that insures year over year funding that supports growth and competitiveness of the U.S. science enterprise.

Current modes of budgeting jeopardize jobs and opportunities for researchers and students as well as to have a tendency to create

imbalances in the U.S. science portfolio. We need to develop a budget index for agencies like the NIH and the NSF. This index should be based on economic, competitive and sustainability factors as well as U.S. goals. Without such an index we will continue to have up cycles followed by down cycles and thereby prohibiting our capacity for innovation.

For example, when adjusted for inflation both the NIH and NSF budgets peaked in fiscal year 2004. Currently the fiscal year 2008 budgets for both agencies are less than their respective 2003 budgets. This is not good for research.

It is not good for enticing students to study science, engineering and mathematics. It is not good for planning. It is not good for U.S. competitiveness. Thank you.

[The prepared statement of Dr. Rankin follows:]

PREPARED STATEMENT OF SAMUEL M. RANKIN, III

Thank you, Chairman Kennedy and Ranking Member Enzi for the invitation to speak to the committee today. I am here to speak about the National Science Foundation (NSF), an important Federal agency supporting science research and education and about the importance of the United States having a sustained investment in science research.

In the recent fiscal year 2008 Omnibus appropriations bill, science research was not funded at a level that will ensure our ability to compete globally. The United States must make adequate yearly investments in science research, and these investments must be stable over the long-term. Dependable increases allow for planning, infrastructure development, feasible expectations, a manageable pipeline of graduate and post-doctoral students, and the creation of positions that can be sustained over time. A predictable pattern of funding will facilitate a continuous stream of high level research and researchers.

We should be developing a mechanism that ensures year over year funding that supports the continued growth and competitiveness of the U.S.-science enterprise instead of the practice of doubling agency budgets over some time period. After reaching a goal of doubling an agency's budget, the temptation is to consider the "job" done and at best to level funding the agency for a considerable number of years in the future. This mode of funding ignores the expectations of the scientific community supported through the agency as well as the loss of positions and opportunities for researchers and students. Current funding methods have a tendency to create imbalances in the U.S.-science portfolio.

As the primary source of Federal support for non-medical basic research in colleges and universities, the NSF is the only Federal agency whose mission includes comprehensive support for all the sciences, mathematics, and engineering. Equally important are investments in people who will apply new knowledge and expand the frontiers of science, mathematics, and engineering. Through its support of research and education programs, the agency plays a vital role in training the next generation of scientists, engineers, and mathematicians.

Over the past half century, the NSF has had monumental impact on our society. The NSF investment has paid dividends in building the infrastructure of the individual scientific disciplines, as well as laid the groundwork for innovative interdisciplinary research to meet modern day scientific and technical challenges. Many new methods and products arise from the NSF investment in research, such as geographic information systems, World Wide Web search engines, automatic heart defibrillators, product bar codes, computer-aided modeling (CAD/CAM), retinal implants, optical fibers, magnetic resonance imaging technology, and composite materials used in aircraft. NSF-sponsored research has triggered huge advances in understanding our planet's natural processes. This has provided a sound scientific framework for better decisionmaking about Earth's natural environment. These methods, products, and advances in understanding accrue from basic research performed over many years, not always pre-determined research efforts aimed toward a specific result. Furthermore, the NSF traditionally receives high marks for efficiency; less than 4 percent of the agency's budget is spent on administration and management.

Even with all its success in supporting cutting edge research, the NSF has not received adequate funding in the last several years. The 2.5 percent NSF budget increase from 2007 to 2008 has put pressure on many NSF programs and NSF

projects. A few impacts of the fiscal year 2008 budget are: 1,000 fewer new research grants and 230 fewer Graduate Research Grants will be awarded; several major program solicitations and new facilities will be delayed for at least a year, and some existing facilities will be reduced; the Faculty Early Career Development and Research Experiences for Undergraduate programs will be reduced; and start-ups of several planned centers will not occur in fiscal year 2008.

In 2002 the Congress passed and the President signed the NSF Authorization Act of 2002 (Public Law 107–368). Among other things this act authorized the doubling of the NSF budget in the 5-year span 2002–07, which would have brought the NSF budget to $9.84 billion in 2007. Note that the NSF fiscal year 2008 budget is $6.03 billion. In 2007 the America's Competes Act (PL 110–69) was passed into law. This bill implicitly implied a doubling of the NSF in 7 years. The first installment, $6.6 billion, was authorized for fiscal year 2008 and $7.33 billion is authorized for fiscal year 2009 in contrast to the FY 2009 Budget Request mark of $6.85 billion. It is unlikely that the NSF will see $7.33 billion in the next fiscal year.

Using the 1998 NIH budget as the baseline, the Congress focused on doubling the NIH budget by the 2003 appropriation. During this time of doubling, the NIH budget grew at an annual rate of 14.63 percent. However, from 2003 to 2008 the NIH budget increased only at an annual rate of approximately 1.7 percent. This means that over the 10-year span from 1998 to 2008, the NIH budget grew at an annual rate of approximately 8 percent.

In retrospect, a better approach would have been to steadily increase the NIH budget at around 8 percent a year or some other sustainable rate. Ramping up the budget in 5 years raised expectations and promoted increases in the pipeline of students and the number of post-doctoral and research positions in universities. Once this dramatic influx stopped, many of these scientists were put in jeopardy, and research labs could not be sustained at previous levels.

We need to develop an index of growth that makes the funding of Federal agencies transparent. This index should be based on economic, competitive, and sustainability factors as well as U.S. goals. Without such an index, we will continue to have up cycles followed by down cycles. This is not good for research; it is not good for enticing students to study science, engineering, and mathematics; and it is not good for U.S. competitiveness.

The CHAIRMAN. Fine. Thank you very much, Dr. Rankin and all of you.

One of the observations during the build up in the doubling of the NIH which was done, as Senator Mikulski said, in a very bipartisan way—I can remember Connie Mack—I saw him the other day. And I said come on back, Connie, we'll double that budget one more time and put you to work with some of our colleagues. Which was the real potential for very dramatic, important and significant breakthroughs and we've seen them.

I mean this has been in the extraordinary, mapping the human genome, all the imaging aspects here in the medical device area. I mean, they have been just dramatic in terms of what they mean to people in terms of the treatment. It's difficult for me to believe that the American people don't understand that.

It has incredible implications in terms of the health and well-being of people in this country and unbelievable implications in terms of our ability to lead the world in a time of globalization. I mean, just unbelievable. I don't mean just the bottom line in terms of economic with new industries. With the power of dealing with the problems of malaria and other health needs in areas around the world where the United States is lacking influence.

I mean it is profound. We have not been creative, imaginative, or thoughtful enough to try and recognize both the opportunity from a humanitarian point of view. I think really from a political point of view.

I think if for many of us who realize that this really is the period of the life sciences. We're struck by the challenges that we're facing

now with the challenge with global warming. People are concerned about global warming.

The fact is that the research is out there. went out to the NIH just at the end of the year. The Senate had closed down and spent several hours out there. The types of research that are being done in life sciences have some real interesting applications in terms of a lot of the other challenges that we're facing, whether it's global warming or not. I mean this is not a tunnel kind of vision.

I'm just wondering how to develop support. How we drive, Senator Mikulski and ourselves, try to really awaken the American people to understand the incredible opportunity that is out there. It's really unique.

I made speeches 45 years ago about how we needed additional research because of possible breakthroughs. Well now we've got it. This is it. American life science with all of the other kinds of implications it has in these other areas as well, that's going to offer incredible opportunities, you know, for our country in leading the world in terms of our economy. But importantly, we get to be able to influence positive and constructive forces around the world that could give us a more peaceful and progressive world.

Now how do we come to that? How do we illustrate some of that in ways that you think can be appealing to our colleagues? What can you tell us about the opportunities that really are out there.

It ought to be this combination of the progress that's happening. It is happening. All of us should look at the progress we've made in children's cancers, for example. I mean it's been extraordinary.

I mean, maybe Dr. Faust? Could you take a crack at it?

Ms. FAUST. As I listen to your concerns in this area I think about how we, in a sense, are sending mixed messages or the public is hearing mixed messages because on the one hand we are talking about expanding science for undergraduates. We're concerned about science teachers in the elementary schools. We're concerned about education in the stem fields as they've come to be known: science technology, engineering and medicine.

We're talking about that on the one hand. Yet when we do bring brilliant young researchers into the field, we then threaten them with these very difficult career developments. I think about how the message needs to be explained.

That if we are to do the first set of agendas, which means increase our scientific literacy and uphold science and make all these discoveries possible, that there are certain responsibilities that go along with that. That's one thing your comments made me think about.

I think more generally how do we communicate about science to the wider public. What are the ways in which we can share these discoveries and the potential for them. I felt as a historian, looking at what's happening in the biological sciences right now as if we're in another scientific revolution that this is a time of such unprecedented possibility because of the new closeness between basic research and cure and that kind of translational possibilities.

That's the message that we need to spread, I think that this is a moment of unusual promise. And get that word out as universities and as organizations that deal with knowledge.

Ms. RAFAEL-FORTNEY. Chairman Kennedy.

The CHAIRMAN. Yes.

Ms. RAFAEL-FORTNEY. May I have a chance to address that as well?

The CHAIRMAN. Go ahead.

Ms. RAFAEL-FORTNEY. The basic research that we've done to try to understand the heart failure, specifically in patients with muscular dystrophy, has now had this broad impact that we found it in 60 to 80 percent of all patients with heart failure. When I talk about heart failure, I'm not talking about heart attacks where patients either die or recover very quickly. I'm talking about the people who are hospitalized for months and years on life support waiting for heart transplants.

This has an incredible cost to our health care system. If we have a novel target that we can—by studying muscular dystrophy—potentially address heart failure in most of the patients, the 5 million patients in the country currently living with heart failure. The 500,000 patients diagnosed with it every year.

These are the types of outcomes that happen from doing basic research, studying perhaps a particular disease, but have really broad implications, both economically to our health care system and for quality of life issues for patients

The CHAIRMAN. Well, you know, I could, and Barbara please jump in here at any time. It seems to me eventually we're going to get to individualized health care systems. I mean we're going to eventually get there. I mean when you find out the number of prescription drugs people take that are advised that only 30 percent of them do any good at all to anybody. We're wasting all kinds of expenditures.

We're eventually going to be able to find out what you all know about this. You're going to be able to have implants that are going to be able to monitor the distribution of insulin during the course of treatment or could amount to be detectors for different kinds of illnesses and be able to perhaps distribute the kinds of medicines that are going to be needed.

I think we're headed and we're going to go there. In that kind of respect in the possibilities in terms of cost savings are going to be breathtaking.

Ms. RAFAEL-FORTNEY. Amazing.

The CHAIRMAN. If we're looking in the back of our minds in terms of trying to get a national health care and da de da de da. The opportunities in here in terms of what this can mean in broader context, not only in opportunities for breakthroughs, but also try to deal with some of the current mundane kinds of challenges that we're facing in the health care system are profound. I mean, really profound.

You know we're not, at least, we're not talking about it. We're not elevating the discussion to it.

Ms. RAFAEL-FORTNEY. I would like——

The CHAIRMAN. Yes, go ahead.

Ms. RAFAEL-FORTNEY. I would like to make one other point. I think that, of course, I've only been a faculty member for about 8 years. In my perception, the other thing that's very different now than in the past is that clinicians and scientists are speaking the same language.

The CHAIRMAN. Yes, that's good.

Ms. RAFAEL-FORTNEY. And working together. I have a collaborator and we've put in another grant together where she runs the cardiac magnetic resonance imaging lab and she can detect changes in the heart of muscular dystrophy patients 2, 3, or 4 years before echocardiography can detect them. We now have the capability to intervene with patient care so much earlier to save the quality of life and the cost.

We're not getting this funding to move this forward when together as scientists and physicians we can really do amazing things that could never really be done before.

The CHAIRMAN. That's—Dr. Miller?

Dr. MILLER. Just going to say, Senator Kennedy, you're certainly correct. Just delay the onset of Alzheimer's for 5 years you would save a tremendous amount of money. We need that kind of research.

The CHAIRMAN. It would empty two-thirds of the nursing home beds in Massachusetts. I mean, that's what the implications are.

Dr. MILLER. It's just——

The CHAIRMAN. Cost. It's breathtaking.

Dr. MILLER. It's over and over again. You can see various disease states, chronic diseases where we could get a real handle on it.

The other question you raise is how you sell it to our population. How do you sell it to the world. I think most of us would like people to think of the United States as a more benevolent country than it is right now.

The most important thing in a person's life is their health. Yet how do we export this information that we have from basic laboratories in the clinical practice. How do we take that to other parts of the world so that we are helping them with their problems.

Whether it's Sub Sahara and HIV and how you prevent it. Whether it's malaria research. Whether it's global infections. All of these things come out of basic research laboratories that are applied in the United States and then can be applied in the rest of the world.

I think that is a tremendous way to sell what NIH has done in the past and what it can do in the future. It will position us back as a leader in the world.

The CHAIRMAN. I couldn't agree with you more. Ms. Lewis, anything you'd like to add on to these general kinds of observations?

Ms. LEWIS. Thank you. I just have to say, from the patient perspective in the 5 years I've had diabetes—just from the public viewpoint—the public has become much more aware of diabetes, from when I would tell people I was diagnosed. I have Type I diabetes.

People would say what is that? Does that mean you can't eat any sugar at all? Now, when I tell my peers or my teachers or people I meet on the street I have Type I diabetes, they say, "Oh, so you use insulin. You know, how is that? Do you do it with diet and exercise?"

Just from the science at the lab to out in the public there's been huge changes. I think it has to do with the amount of research that has come out of NIH and other places. I think it's important to continue this research. As the research continues it will make its way to the public so more people become aware of this. It has implica-

tions for the public understanding more about diseases as well as for people with diseases like diabetes.

The CHAIRMAN. I think you're absolutely right. I think these associations do a terrific job. You know how the Diabetes Association and cancer, lung, heart, in terms of getting information out and making the public aware, do an incredible job.

It is interesting as you all know—like China, for example, is replicating the NIH. They are replicating in terms of their particular institutes. Not our institutes, not what they need, but what they see us doing, even though they've got different types of health challenges because of the success they got.

They're in phase in terms of increasing their budget that would make your mouth water. They're starting way behind. We won't see, for a few years, obviously, the jump.

They've got a pathway and a pattern that are moving ahead on it. As was mentioned here you can't just legislate brilliant minds and creative minds. We've got some very important advantages. The idea that we can just remain still at anchor is completely unrealistic.

Dr. Rankin, any ideas about how we can energize the public? Senator Mikulski and I are fired up and ready to go. We're interested in what your own sense is.

It's priorities. That's what we're voted in for. Certainly our priorities are in support of what you've outlined here. We've got to convince our colleagues of this.

Mr. RANKIN. Yes, we are, the scientific community, appreciates your efforts and Senator Mikulski's efforts on behalf of science. I think one of the ongoing challenges is to communicate the value of basic research to the general public. I don't believe that the general public always understands what kinds of efforts it takes to develop some of the technologies and the benefits in terms of health care and other things that is caused by science or the results of scientific research.

I also don't think that scientists interact enough with the general public in a way that they can actually show them some of the benefits. Indicate what kinds of efforts it takes to make the discoveries that translate into new results that will help us from a health care point of view or even from a technological and economic point of view.

I don't have any quick answers to solve that problem. I believe it's an ongoing problem. I believe that all of us that value science and especially the scientific community needs to take some responsibility in this type of education to the general public.

The CHAIRMAN. It starts off first of all in respecting science.

Mr. RANKIN. Yes.

The CHAIRMAN. And the truth of science. I mean, we start getting down where we don't respect the truth of science and we have ideology and overriding that and then we get ourselves in a lot of trouble. I mean, that is rather basic.

Senator Mikulski.

Senator MIKULSKI. Yes. Dr. Faust, I'm sorry. Did you want to——

The CHAIRMAN. Did you——

Ms. FAUST. I was just going to make a comment, just two observations listening to my colleagues here. One is that I think we are in a moment when there is a lot of discussion, public discussion about health care and health care delivery and to make research a part of that very widespread discussion now.

I think it would be a real contribution if we could make the conversation not simply about the health care system, but about the ways in which scientific research can have a real impact on cost, deliveries and attainments of the health care system.

The second observation I would make is that these reports are the result of a partnership among universities to try to get the message out about the role that universities have played in scientific research in alliance with the Federal Government. I think universities, through actions like ours today and other actions that we can take in partnership have an important role to explain what they do in this regard. I think it's been either taken for granted or not known by the public. We need to explain ourselves much better in these ways.

The CHAIRMAN. Good. Good.

Ms. FAUST. Excuse me for interrupting, Senator.

Senator MIKULSKI. First of all I think we all agree. I would like to just go though, first to Dr. Rankin.

Dr. Rankin, I'm so glad you brought up the National Science Foundation. Also raised the issue of what happened in last year's appropriation. I chair the subcommittee that funds the National Science Foundation and have been the ranking member for a number of years, and along with Senator Bond advocated its doubling.

Here's what happened, last year in this great euphoria we found out we were in charge and off we went to hold our hearings, to look and see what was under every rock. Under every rock we found another rock and under that we found unfunded good ideas and people looking to get their doctoral fellows to go to school. Our subcommittee, on the bipartisan basis put money into, and really began to implement the America Competes Act.

Then we ran into the President's budget veto. President Bush told our subcommittee, you have to cut it by $3 billion. Now, our overall funding level is about $50 billion, having said that, $3 billion would affect NASA, NOAA, NIST and of course the National Science Foundation. We did it.

Mr. RANKIN. Yes, you did.

Senator MIKULSKI. We did it. What you can see then is exactly what you rightfully say, again the skimpy, spartan, two point something or other percent increase. Now this is not finger pointing, but there was dead silence from those folks who benefit from the NSF community.

The larger community doesn't understand NSF. They understand NIH because it's cures and prevention and so on. We didn't hear from the scientific community at all until much later and then it was sadness and hand wringing and gee, what are you going to do.

One, I think you have to strike when the veto pen is about to strike first. There needs to be an overall advocacy of really going to the White House. That's your genius with all the e-mails and phone calls. I believe in virtual rallies. I believe in virtual protest.

I believe in virtual picketing. I believe in it all because I believe in grass roots.

Because we believe in you, it is to my dismay that the funding of the National Science Foundation is pretty much what we spend every year on our Federal prison budget. Stunning, isn't it? Didn't that just kind of hit you? Well it's the same way for us on the committee.

We spend $6 billion on Federal prisons. We won't even talk about the war and tax cuts and so on. We need to get a lot of the bad guys and some gals off the street, but, and I'm not saying it's a trade here that oh, if we spent more on NSF, maybe it could make a difference, you see.

One, we need your advocacy, of course, on research. Am I right that the National Science Foundation is the premier source of funding for the doctoral fellows in the basic sciences?

Mr. RANKIN. Yes, that's true.

Senator MIKULSKI. Isn't that right?

Mr. RANKIN. Yes, the graduate fellows.

Senator MIKULSKI. Do you want to elaborate on that?

Mr. RANKIN. The graduate fellowships are very important fellowship for young researchers. One of the nice things about the fellowship is it can be taken to any university. It's not connected to any particular school. It's given to the student that wins the fellowship.

Senator MIKULSKI. How many applicants do you think are there at NSF for people who want to get Ph.D.'s in the basic sciences? That would be biology, chemistry, and physics.

Mr. RANKIN. I don't have the number on the top of my head.

Senator MIKULSKI. Well.

Mr. RANKIN. I do know with this 2008 budget that 230 less awards will be made.

Senator MIKULSKI. That's in research.

Mr. RANKIN. Yes.

Senator MIKULSKI. That's in research. In order to do research—so we could increase the research money, but then it comes to the people. Actually what we're understanding is that there's a steady decline in the number of fellows that could be funded.

Dr. Rafael-Fortney, you told a very compelling story about how you got excited in the seventh grade and you wanted to change the world, etc. You went off to Cornell and actually one of the people you studied under at Cornell was Dr. Kay Davis who is from Oxford.

Ms. RAFAEL-FORTNEY. She is at Oxford. I did my postdoctoral fellowship at——

Senator MIKULSKI. Well she was at Cornell with you. She's now at Oxford and she kind of zipped along under that British system where her research has been so recognized that Her Majesty has made her a Dame and you're foraging for money.

[Laughter.]

Ms. RAFAEL-FORTNEY. She was my mentor as a post-doc, but yes, that's true. I'm foraging——

Senator MIKULSKI. I mean isn't that exactly right?

Ms. RAFAEL-FORTNEY. That's true. So she——

Senator MIKULSKI. She's a Dame of the Empire and you kind of feel like Orphan Annie. Now did you get your doctorate under an NSF grant? How did you?

Ms. RAFAEL-FORTNEY. No, under NIH.

Senator MIKULSKI. I don't mean to——

Ms. RAFAEL-FORTNEY. I was on a NIH training grant as a Ph.D. student for 3 years and then a recipient of other fellowships throughout the rest of my graduate training and that was at the University of Michigan and you know the best human genetics department in the country at Francis Collins at NIH was there at the time.

Senator MIKULSKI. Did the NIH take you? Well here—let me get to the point of my question which is one, this sense of discouragement and dismay among our young up and comers. What about student debt?

When you talk about getting a doctorate, whether it's you or your peers, about how much debt do you think someone——

Ms. RAFAEL-FORTNEY. So that——

Senator MIKULSKI [continuing]. Would incur?

Ms. RAFAEL-FORTNEY. The students who work in our labs, who are getting their Ph.D.'s when we're done training them are actually the work horses that produce the research. They're the people in the labs doing the experiment that we design and compose. They're the orchestra conducting the music. They're the ones who do the research.

They actually get paid a very piddly stipend, but enough to pay their rent and eat macaroni and cheese for dinner every night. But they are——

Senator MIKULSKI. They better watch their carbs though, right?

Ms. RAFAEL-FORTNEY [continuing]. Funded by our—this is what our NIH grants pay for is to be able to pay for the people working in the lab doing the experiments in addition to the cost of the reagent. Out of the NIH money, we're creating a huge number of salaries. When I needed to cut my lab from nine people to one and a half people, those are seven and a half people out of jobs.

Senator MIKULSKI. Coming back though, isn't one of the questions and I'll turn now to Dr. Miller and Dr. Faust, that essentially that as people move along, whether it's getting a medical degree for research or a Ph.D. for research because so much of research is also done by Ph.D.'s, that the occurrence of student debt, by the time they're 30 is pretty significant?

Dr. MILLER. I'll be glad to answer that.

Senator MIKULSKI. Dr. Miller.

Dr. MILLER. In terms of M.D. at our school, the current debt would be about $96,000 by the time they finish medical school before they even begin a residency or go into a lab which many of them do, so many of our M.D., Ph.D.'s and so forth can run up much greater debt than that. It does influence where their career choice is, especially if it looks like the funding is not going to be available for sustained research activities they will go to other areas.

The debt becomes an incredibly important factor in direction of where people are going to go.

Senator MIKULSKI. So, when you get out of school you're waiting to get your first grant. You now know it's 43. But, you're 30 years old and you owe a lot of money. You wonder where you're both going to earn a living and pay off this debt and move on. Other fields in industry, financial institutions would be attractive. Is that right?

Now let me go to another question about that if the Chairman is indulgent. You, Dr. Miller, have talked about whatever we do it needs to be sustained and predictable. I'm going to ask you why you emphasize that.

Then I'm going to ask another question. This committee, this Congress loves something called the Manhattan Projects. Whenever something happens, they say "Oh, let's have a Manhattan Project."

First of all, the people who worked on the Manhattan Project probably couldn't get immigration visas. Second, because of their politics, their lifestyle or region or something, they couldn't get that. And third, if you thought about them here where would their money have come from before they were Manhattanized.

Now but when we talk about—I remember after 9/11 we held hearings on vaccines because we were concerned about the biological threat. Everybody was willing to throw lots of money to it. There was panic. There was fear. There was whatever.

There is a belief in this country and challenge me if you think I'm wrong, Doctor. I invite you to do that, which somehow in this time and climate of muzzling science it doesn't occur, Senator Kennedy said. We can't do Manhattan Projects because there aren't people there. The way you do a Manhattan project, is you start with the Bronx and the Brooklyns and the neighborhoods, which means you start by training people as they move through the pipeline. Then they do steadily, more sophisticated work or collaboration within our own country, or around the world for jobs that you're doing, Doctor and so on.

I worry that if there is a crisis there won't be people there. We also fight war against disease, like we fought this war. We don't think through the consequences. We think we can muscle our way through any problem. We don't realize how many people it takes, and what the people who are going to do this need to be able to do this.

Anyway, I'll stop. Could you talk about sustainability, predictability and if we want to come up with another Manhattan Project, whether it's to find the cure for cancer or to save us from possible predatory attacks against the United States.

Dr. MILLER. Let me break it into two parts. First, in terms of an M.D. training. You've got 4 years of medical school and usually 5 years of post-graduate work.

That will just get you through to a point where you may go into a lab. That's just the residency. You may have another couple of years of fellowship. You've got somewhere around 10 or 12 years where people have to be sustained during their residency and then into their fellowship and then into their early years of research.

The Ph.D. side is about 6½ years to get a Ph.D. at our institution. Then most of them do post docs for another 2 or 3 years. We're talking for most of the individuals, 10 years of a need for

support. After that they've just begun their career. This is why the age of the first R01 is age 43, etc, etc.

People need to have that degree of support for a period of time. Then it takes them another 3 or 4 years until they really get good data so that they can continue to have a sustained program. For an investigator to be kind of "independent" takes much more than just 1 or 2 years. It takes—as you know, you're 8 years into that process.

That is one of the, I think, the reasons that you have to have the ability to sustain this over a period of time. You can't just ramp it up. I think you're exactly correct. If we don't have those people that have those basic training skills when an issue comes before us, as the United States, that we need to pull people together and do what you're talking about, we can't do it.

We have to have the fundamental training to be able to do research.

Senator MIKULSKI. Dr. Rankin.

Mr. RANKIN. Yes. Having a sustainable funding mechanism is very important. 1998 was when the doubling for the NIH started. It was doubled between 1998 and 2003. The annual growth rate for the budget, the NIH budget, during that time was around 14.63 percent per year.

If you then look at—I am a mathematician, so I like to do these calculations. If you look at the budget then from 2003 to 2008, the NIH is growing at about 1.7 percent a year. If you put the 10 years together, the NIH budget is growing from 1998 to 2008 is on an annual budget growth rate of 8 percent a year.

Now you can look back in retrospect—is it better, would it be better that the NIH be funded at some consistent rate like 8 percent a year from all those 10 years rather than what's happened where they ramped up and then they're watching the deterioration of all that capacity that was built. The sustainability aspect of funding is very important.

Ms. RAFAEL-FORTNEY. May I address that as well?

Senator MIKULSKI. Certainly.

Ms. RAFAEL-FORTNEY. I'm not trying for my first R01. I was against the odds, I guess, by the ages up there. I had my first R01 at the age of 32 and my faculty position at the age of 29. It's now where I'm trying to renew that grant that we've hit this funding crisis.

In the meantime as people graduated in my lab and post docs left, I couldn't hire anyone else because there wasn't enough money and I couldn't promise them a salary for an extended period of time. I now have to let people go who had 8 years of experience. When the grant finally does hit, which hopefully it will—I'm an optimist and keeping my fingers crossed—I'll have to spend the first year re-training people instead of having the trained staff who knew how to do everything, who knew where everything was, who knew how to get things done, you know within the university and where the different rooms are that have the different pieces of equipment. I mean just that re-investment. It costs money rather than keeping a consistent flow of some amount of funding to individual labs.

Senator MIKULSKI. Most of all the predictability would enable both recruitment and retention.

Mr. RANKIN. Right.

Ms. RAFAEL-FORTNEY. Correct.

Senator MIKULSKI. I know our time is running out. Now I want to ask iconic caustic questions. Dr. Miller, I'll turn to you and then any others.

First of all should we begin to challenge the way NIH decides research? I don't mean for us to micro-manage or earmark or whatever. Look what you said here, that they decide on the safe stuff.

Where, and again, this is not my position. I'm putting it out for conversation and discussion. Is that a dated thing here or should we——

Dr. MILLER. Well.

Senator MIKULSKI. In other words, why do they go for the safe stuff? Do we need to shake that up?

Ms. RAFAEL-FORTNEY. Sorry, I feel the need to address this as well. It's not them, it's us. We're the ones who serve on the study section conducting peer review.

I'm going to a study section next week, as a matter of fact, week after to review grants. When you have to pick—I have a pile of 10 grants and basically one of those is going to get funded. When it comes down to picking 1 out of a pile of 10, you're splitting hairs over the 2 or 3 that are really outstanding research that could move their respective fields forward.

But, it is us. I don't think there's anything broken in the peer review system and there's actually recently been——

Senator MIKULSKI. I didn't say broken. It just seems stuffy.

Ms. RAFAEL-FORTNEY. But it's us and it's not stuffy. It's just very hard when you're comparing a grant. I'm going in——

Senator MIKULSKI. Maybe. I'm not saying that it is, but it sounds like it is.

Ms. RAFAEL-FORTNEY. Well, to give you an example.

Senator MIKULSKI. They say, "Well there's not enough money" and that which they fund is really safe and it's linear. And it's glacial.

Dr. MILLER. I think you have a mechanism in place. I totally agree with you in terms of the peer review. If there are more dollars you wouldn't be micro-managing it at that level. I also think the Director's Fund allows for some of the pioneering work to be done.

There is a new mechanism available to kind of identify people that are really doing risk taking research and to be able to find funding for that. I think there are mechanisms in place to do that. With more dollars coming to NIH I think we can accomplish both of these things.

Senator MIKULSKI. This is my last question. This was supposed to be the century of biology. The 19th century and the 20th was tachometry and physics and we benefited. The 20th century, we were all so excited. It was going to be goodbye to genocide and war and hello to peace and saving the planet, but it was going to be the year of biology, both environmentally, personally.

Here we are, having this conversation in 2008. One of the things that happened was new ideas, primarily in mathematics in the use

of computation, where through computational biology, now quantum computational techniques, etc. My question is, do you think that we could and also, if we really organize methodically and with predictability, that we could change also the way research is done which is to accelerate the pace of discovery for research because there are new techniques?

Mathematics has really been stunning in its computation. I mean we would not have cracked the human genome without computational biology. Whether you did it in a methodical way that Francis did at NIH or Solera and Craig Venter did.

Either way it was a race and it was great. They were using new mathematical techniques as well as new biological insights and so on. Are we on that verge?

Dr. MILLER. Oh, I think we are. I think everywhere——

Senator MIKULSKI. Not only in terms of doing more.

Dr. MILLER. You see, whether it's at Harvard or Hopkins or Penn or whatever, looking at where schools of engineering working with the schools of medicine working across public health, working with mathematics departments. We know that a collision of two sciences together are going to make the biggest step changes in real discoveries.

I think you just take a look at what's happening in the whole area of imaging, where that area is going, early molecular markers of diseases and new ways to find those molecular markers. Over and over again you see where you can bring one technology or knowledge base from one field and apply it to something in medicine. Then you will get the kind of changes you're going to see.

There's no question. I think it's the right way to go. The Director's Fund for example, is an example of trying to make those bridges happen. The CTSA grant is working with industry to make that happen. All of those, I think are the right science. We just need the dollars to do it and we need it sustained over a period of time.

Senator MIKULSKI. Mr. Chairman, I don't have any other questions. I would also just like to thank, Ms. Lewis. I'd like to thank you, Ms. Lewis for what you stand for which is the citizen advocates. You know people do vote, not only in voting booths, but all of the great philanthropic work around this country and in terms of cures has been done through citizens, whether it's the famous Race for the Cure for breast cancer, or the walks for cures for juvenile diabetes.

People do vote with their feet and they're willing to raise private dollars. Philanthropy cannot be a substitute for public policy for public funding. Those marches need not only to be for money, but also that we have the will, as well as the wallet.

I just want to thank you for being you. I want to thank all of the people all over this country who every weekend are doing things to either raise money for research or to raise awareness. It's great to have you here.

The CHAIRMAN. Very good. The committee will stand in recess. Thank you all very much.

[Additional material follows.]

ADDITIONAL MATERIAL

PREPARED STATEMENT OF SENATOR BINGAMAN

Let me thank the Chairman for holding this important hearing on health professions supply. This deserves our serious attention.

In New Mexico, 30 of our 33 counties are federally designated as health professions shortage areas or medically underserved areas.

With a low per capita income, and a high uninsured population, having a health provider in our towns can mean the difference between getting care while problems are manageable, or waiting until problems became so serious that they require hospitalization or worse.

In New Mexico, we have worked on creative interdisciplinary models of health delivery, such as the Health Commons models that provide an enhanced primary care home, including medical, behavioral, and oral health, to our most needy populations.

We train our health professionals in these venues, and they end up working in them at two to three times the rate of other trainees when they graduate. These programs work. Title VII funding supported their success. New Mexicans depend on these programs for health care.

These programs are under severe threat. The President proposed eliminating title VII funding, severely cutting title VIII funding, and unilaterally changing Medicaid rules through CMS that will devastate training programs and will unravel our tenuous safety net in New Mexico, and across our Nation.

We have witnessed the unprecedented growth of our uninsured under this Administration with 48 million Americans who are medically uninsured and over 100 million who lack oral health coverage.

This would be exactly the wrong time to cut funding, as the President has proposed. While I support the President's call to expand community health center funding, it is cynical, it is illogical, to cut the funding of the title VII programs that assure staffing of those centers.

While 21 percent of the U.S. population live in rural areas, only 10 percent of our physicians work in rural areas.

Our population will grow by 25 million per decade, and those over age 65 will double by year 2030. Those over age 65 have twice the number of doctor visits as younger individuals.

Our Nation faces physician shortages which will grow to over 200,000 by 2020, while nursing shortages may exceed 1 million. Currently, few dentists accept Medicaid and access is impossible for our uninsured.

Let us focus our legislative attention on our pipeline of health professionals and the distribution of these graduates into the areas where they are most needed.

Let us support new interdisciplinary models of service and learning, with a balance of urban and community-based experience—addressing our Nation's most pressing health needs, while admitting health professions students are more reflective of our Nation's diversity.

It is time for us to pass measures, using funding mechanisms like GME and IME through Medicare and Medicaid, to assure

training of health professions to address our current and future health workforce and access needs. CMS should not be cutting funding of these programs through rule changes that will blow up our pipeline supply when shortages are severe, and getting worse.

Americans deserve, and should expect, better health professions outcomes and return on our Federal investment. We should expand funding to programs that produce the types of health professionals most needed, and that succeed in placing them in the cities and towns where we most need them.

It is time for Congress to address these shortages, to support the hard-working health professionals both in our cities and in our small towns, and to fund programs that clearly and conclusively work, including title VII and title VIII physician, nurse and dental training, scholarship, diversity, and loan repayment programs.

PREPARED STATEMENT OF SENATOR CLINTON

I look forward to working with my colleagues on the HELP Committee to reauthorize the title VII health professions program. These programs have a great impact on New York, both as a State with multiple health professions schools, and as a State that has underserved communities who benefit from these programs. Our State has 15 medical schools with over 15,000 residents in training and 11 accredited nursing schools. Our rural and urban communities have critical needs for primary care physicians, dentists, nurses and other health professionals. Over 50 of New York's 62 counties have Medically Underserved Areas (MUA's) and many of those counties have multiple MUA designations, in both urban and rural areas. In some of our rural regions, there has been a significant decline in the number of health professionals filling demand, and at this point, we do not have enough primary care providers to meet the growing needs.

In addition to ensuring adequate workforce for both rural and urban underserved areas, I believe that the title VII programs are an important tool in addressing the growing diversity of the U.S. population, which is not yet reflected in our health workforce. New York State has a minority population of 36 percent, yet enrollment in our medical schools by minority students lags far behind at 10 percent. This under-representation is associated with poor health outcomes in minority communities, and I think that by improving the number of underrepresented minorities in the health professions, we can reduce health disparities. Title VII Health Professions Programs address these issues by providing educational pipelines that target minority students at all levels of education, helping them to gain interest in and pursue careers in health care.

The President's proposed budget for New York health professions' programs this year is $13 million, compared to $29 million only 5 years ago. Yet the shortage of primary care providers only continues to grow. If we are to meet the needs of underserved communities in New York and the Nation, we must increase our support for the title VII programs that are an essential component in improving access to care for all Americans.

I believe that the title VII programs should be re-authorized to a level that will make them effective in providing a pipeline to encourage a diverse range of participants to enter the health profes-

sions, retain a commitment, through years of training, and to serve in the urban and rural communities where they are most needed.

We need to assure that training programs are aligned with healthcare needs. These programs should be amended to improve data collection in order to track health professionals, identify shortage areas, and evaluate specific outcomes.

We need to address the primary care shortage by improving linkages between health professions schools to medically underserved areas.

[Whereupon, at 12:29 p.m. the hearing was adjourned.]

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