Congressional Briefing

Russell Senate Building
Washington, D.C.
July 25, 2012

Today's Agenda

- Introduction: Michael Milken, Milken Institute
  - Francis Collins, National Institutes of Health
  - Harold Varmus, National Cancer Institute
  - Stephen Spielberg, U.S. Food and Drug Administration
  - William Nelson, Johns Hopkins Medicine
  - Ross DeVol, Milken Institute
  - Margaret Anderson, *FasterCures*
- General discussion and Q&A

Photos from the Briefing

(1) Francis Collins and Margaret Anderson chat before the briefing. (2) Bill Nelson greets attendees. (3) Mike Milken introduces the speakers and frames the day's discussion, highlighting that as much as half of all global economic growth over the past two centuries can be traced to advances in health.

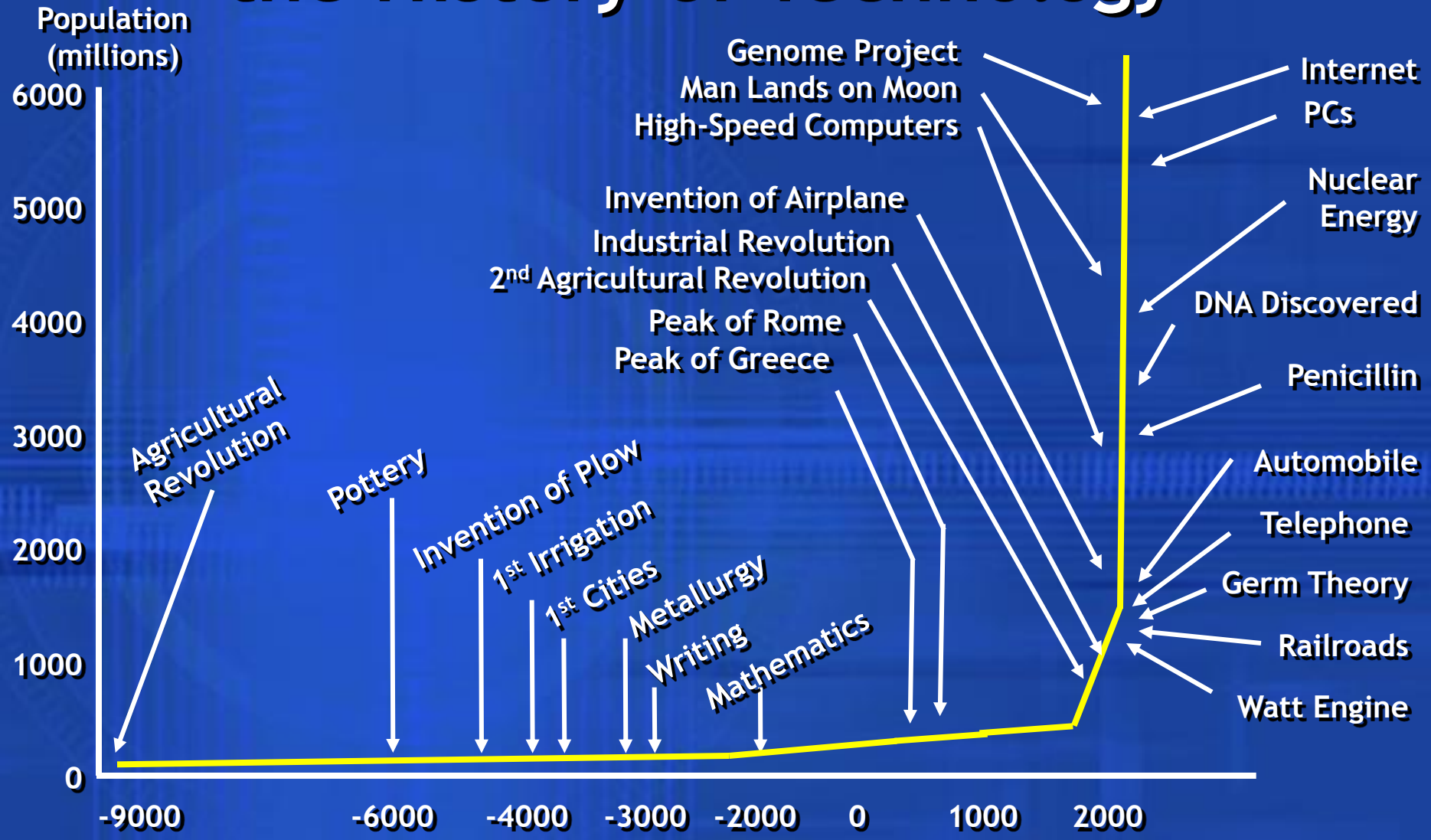
Photos from the Briefing

(4) The speakers: pictured from left to right, foreground to background: Ross DeVol, Harold Varmus, Francis Collins (speaking at the lectern), Bill Nelson, Steven Spielberg, and Margaret Anderson. (5) Harold Varmus discusses the vital work of the National Cancer Institute. (6) Congressional and Administration staff members fill the Kennedy Caucus room.

Photos from the Briefing

(7) Francis Collins discusses several “Grand Challenges” the NIH is working to address. (8) Bill Nelson answers a question from the audience; (pictured foreground to background: Steven Spielberg, Nelson, Francis Collins, Margaret Anderson. (9) Spielberg speaks with attendees after the briefing.

Growth of World Population and the History of Technology



Source: Robert Fogel/University of Chicago

Over the past two centuries

[by far the most prosperous 200 years in human history]

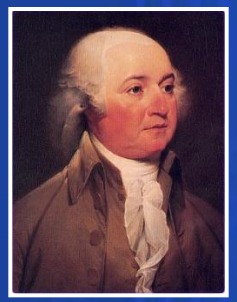
as much as

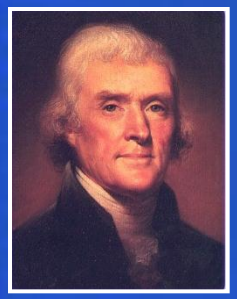
1/2 OF ALL ECONOMIC GROWTH

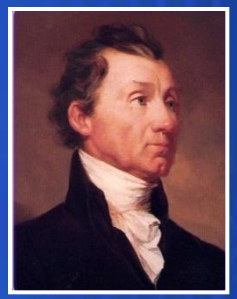
can be traced to advances in health.

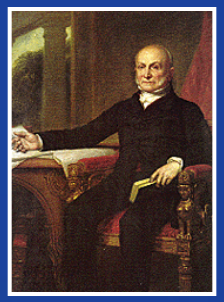
One of every five American babies born in 1900 did not live to celebrate a 5th birthday.

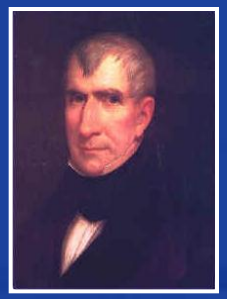
Presidents who lost a young child

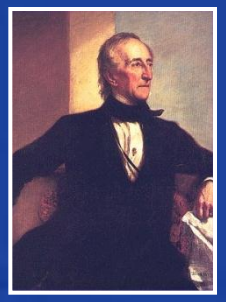

John Adams

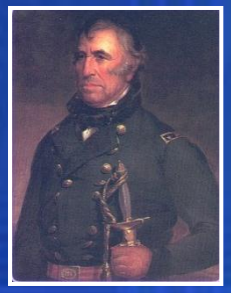

Thomas Jefferson

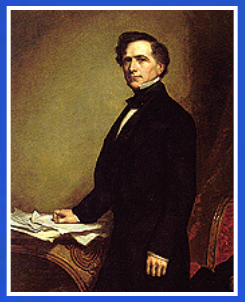

James Monroe

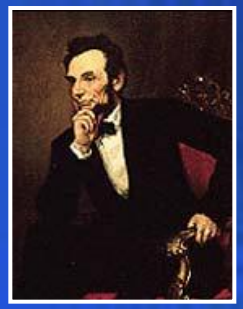

John Q. Adams

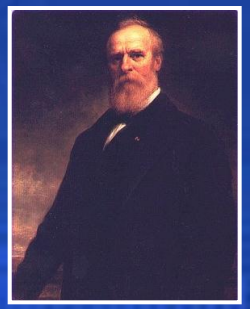

William Harrison

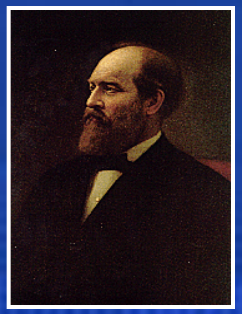

John Tyler

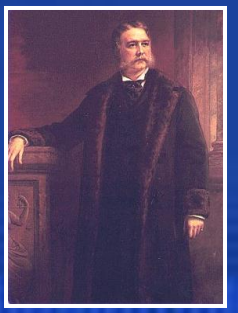

Zachary Taylor

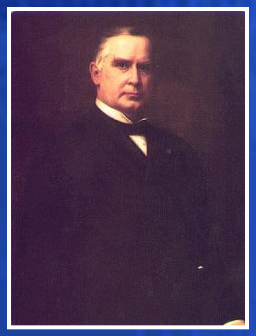

Franklin Pierce

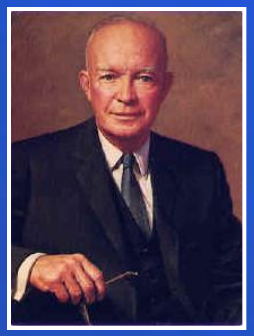

Abraham Lincoln


Rutherford Hayes


James Garfield


Chester Arthur

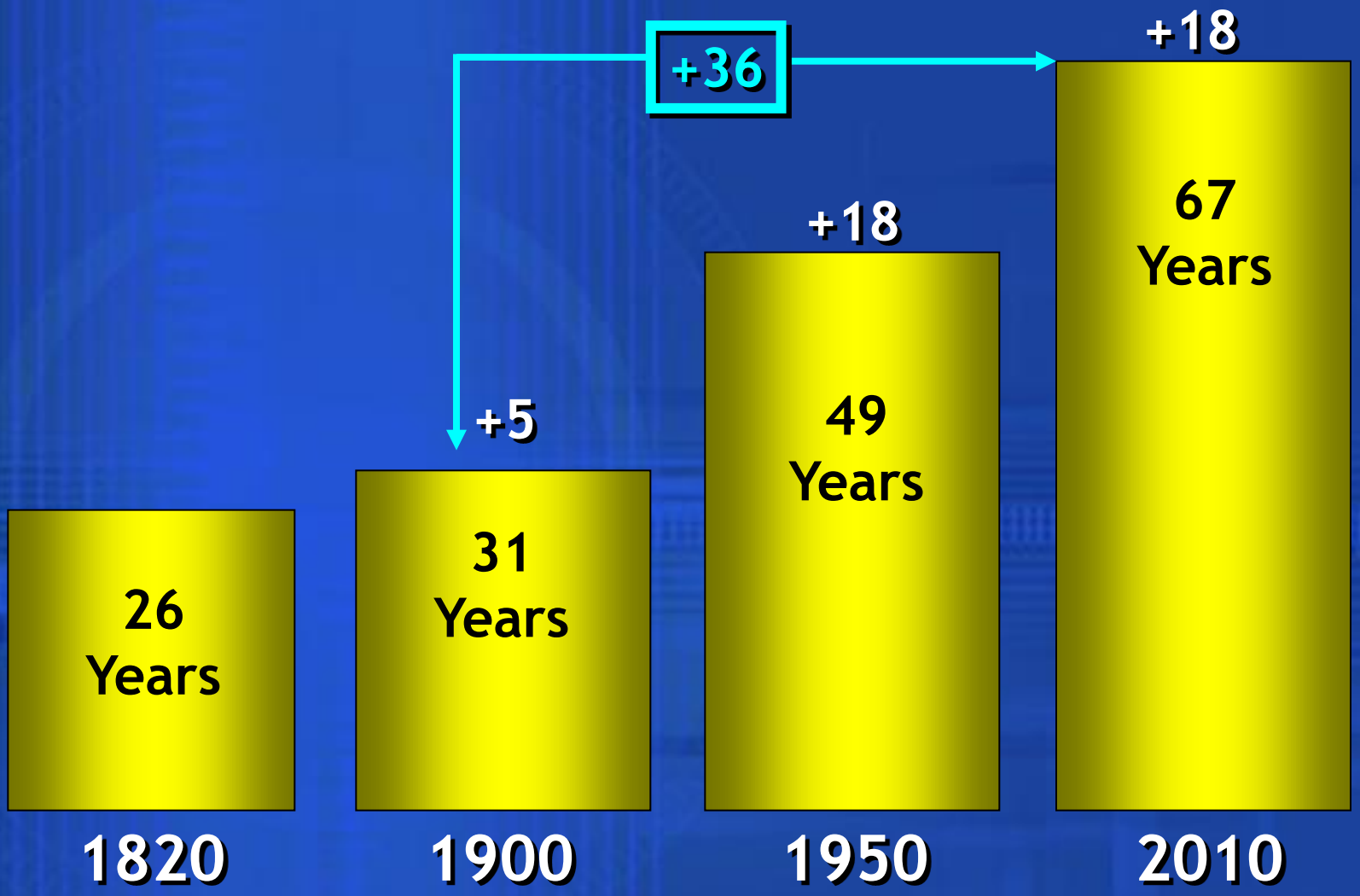

Wm. McKinley


Dwight Eisenhower


John Kennedy


George H.W. Bush

Worldwide Life Expectancy Growth

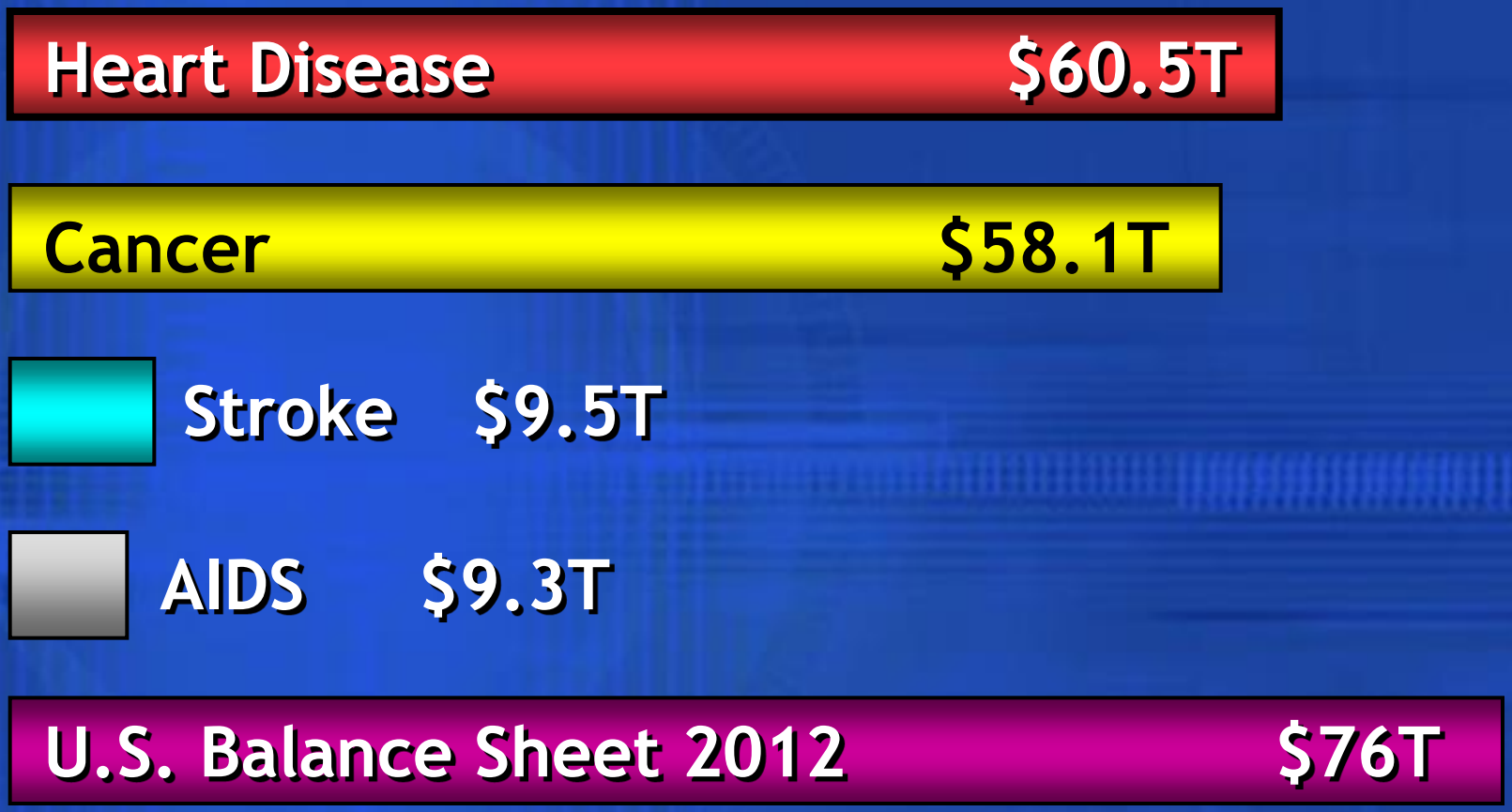


Source: United Nations Development Program

Deaths related to heart disease and stroke dropped by 40 percent between 1997 and 2006.

Source: Diabets Care (http://www.cdc.gov/media/releases/2012/p0522_heart_disease.html)

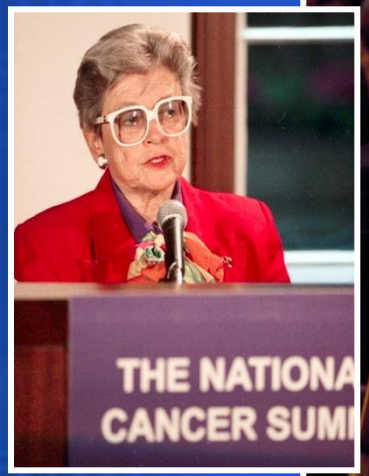
Economic Value of Eliminating Deaths

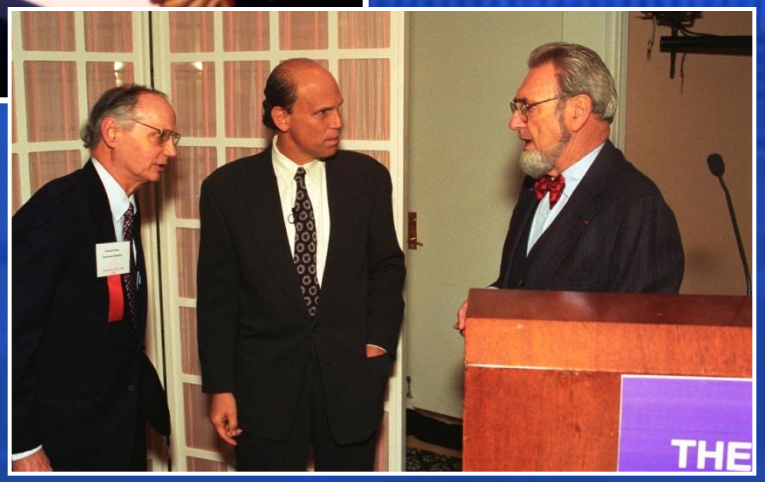


Source: Estimates base on 1999 studies by Kevin Murphy and Robert Topel/University of Chicago

FDR dedicates the NIH campus - 1940

National Cancer Summit - 1995

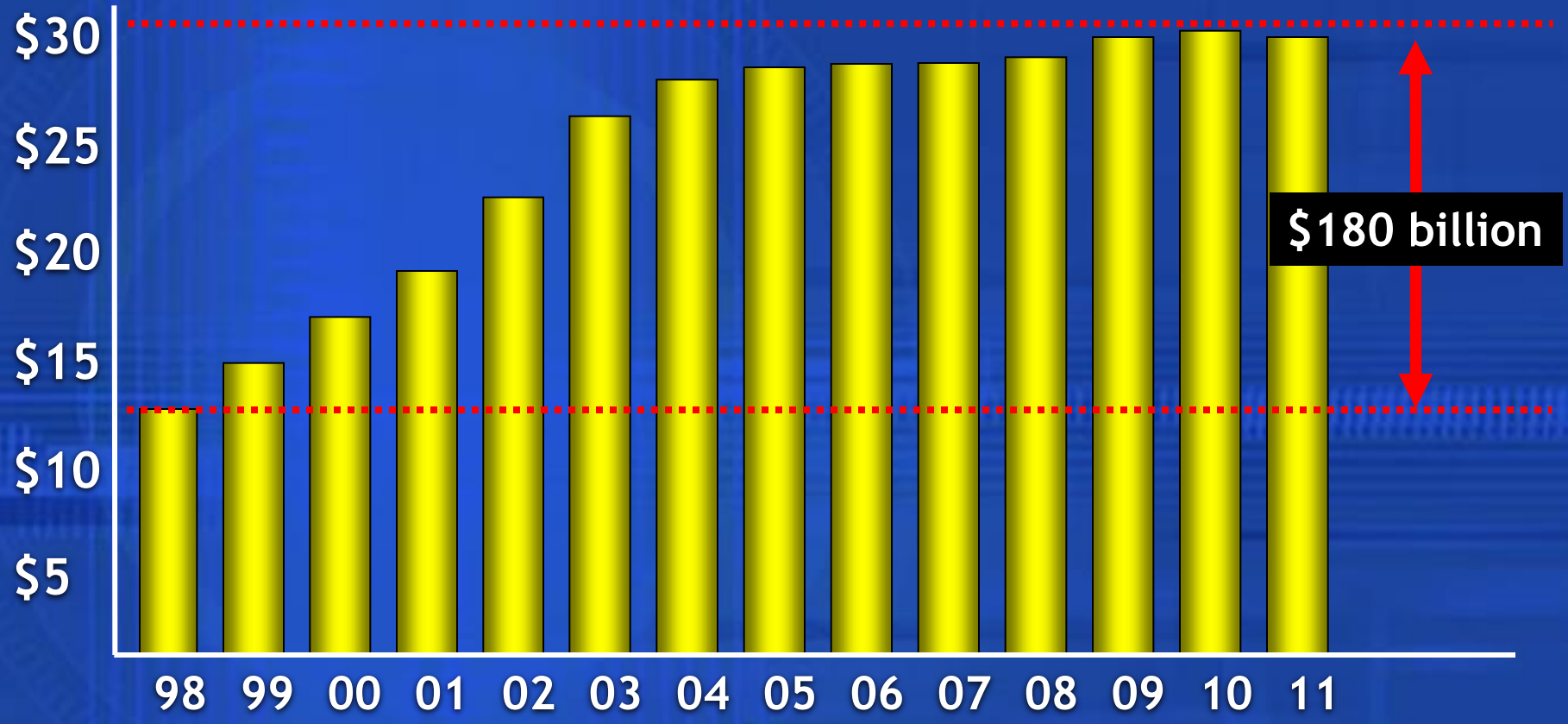




The March
September 1998

National Institutes of Health Budget

$US billions



Source: National Institutes of Health

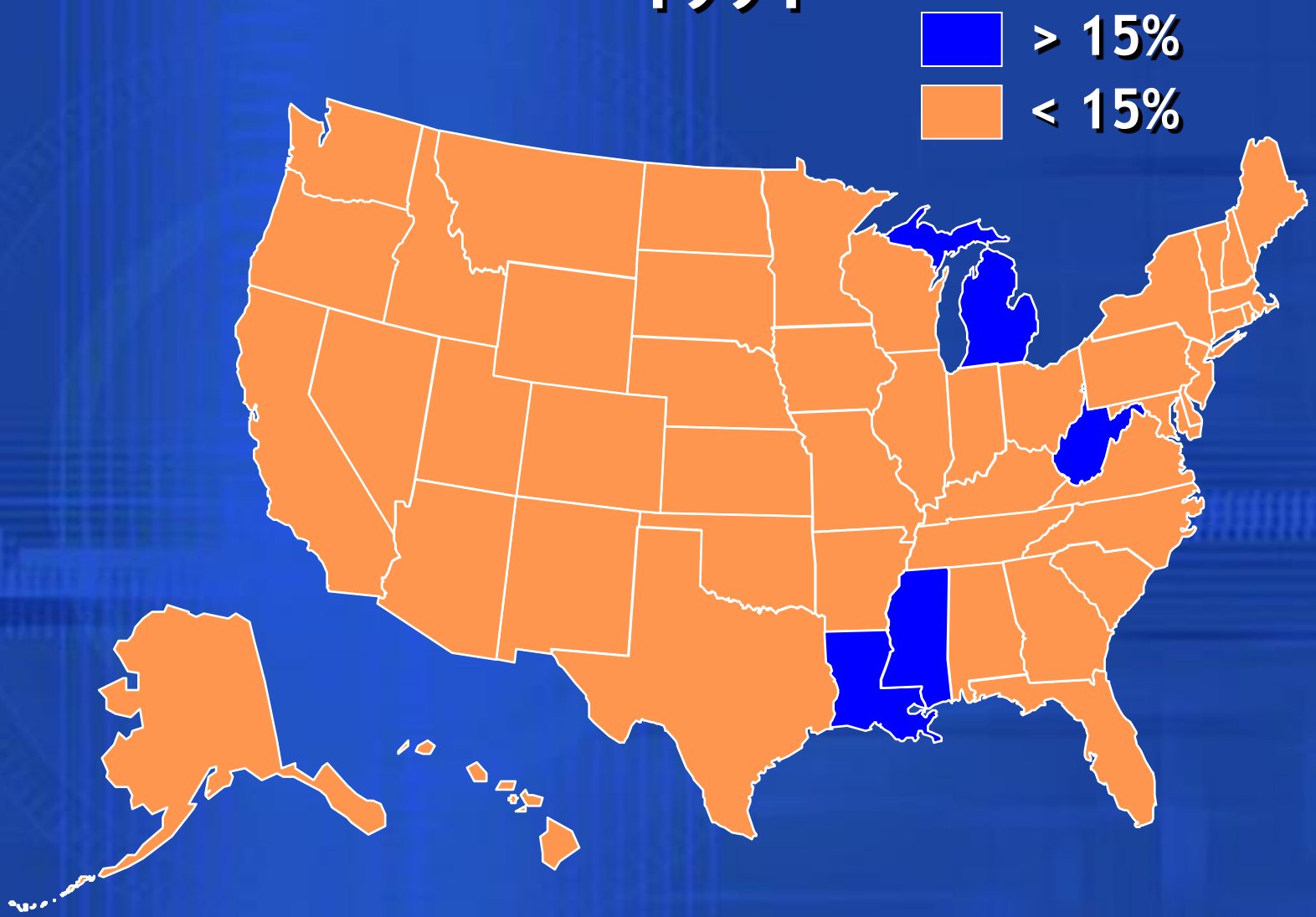
- Kick-start renewed commitment to bioscience
- Improve the health of America's people and economy

Three Solutions to Healthcare Challenges

- Prevention
- Care
- Cures

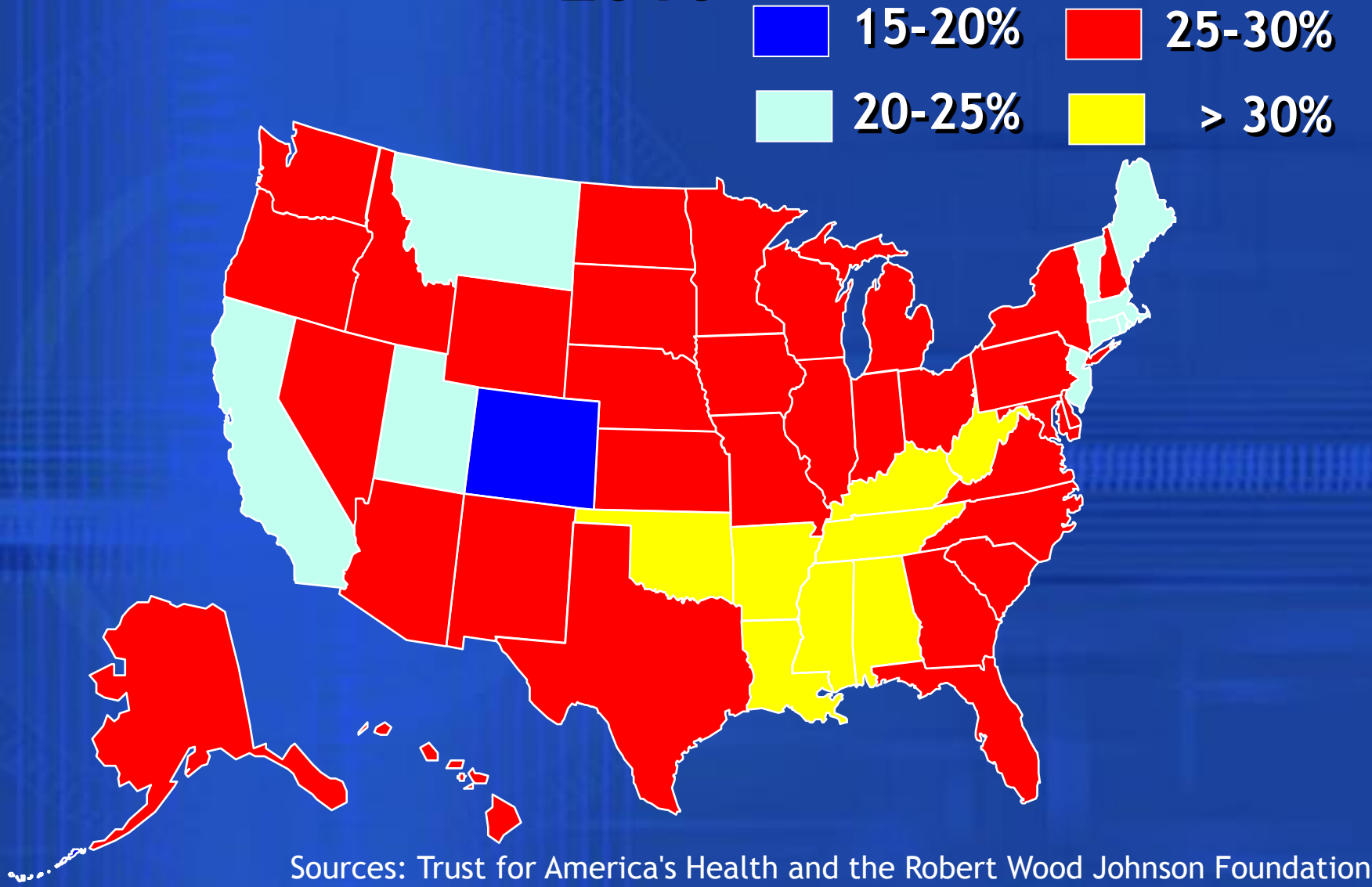
Obesity Prevalence Among U.S. Adults

1991



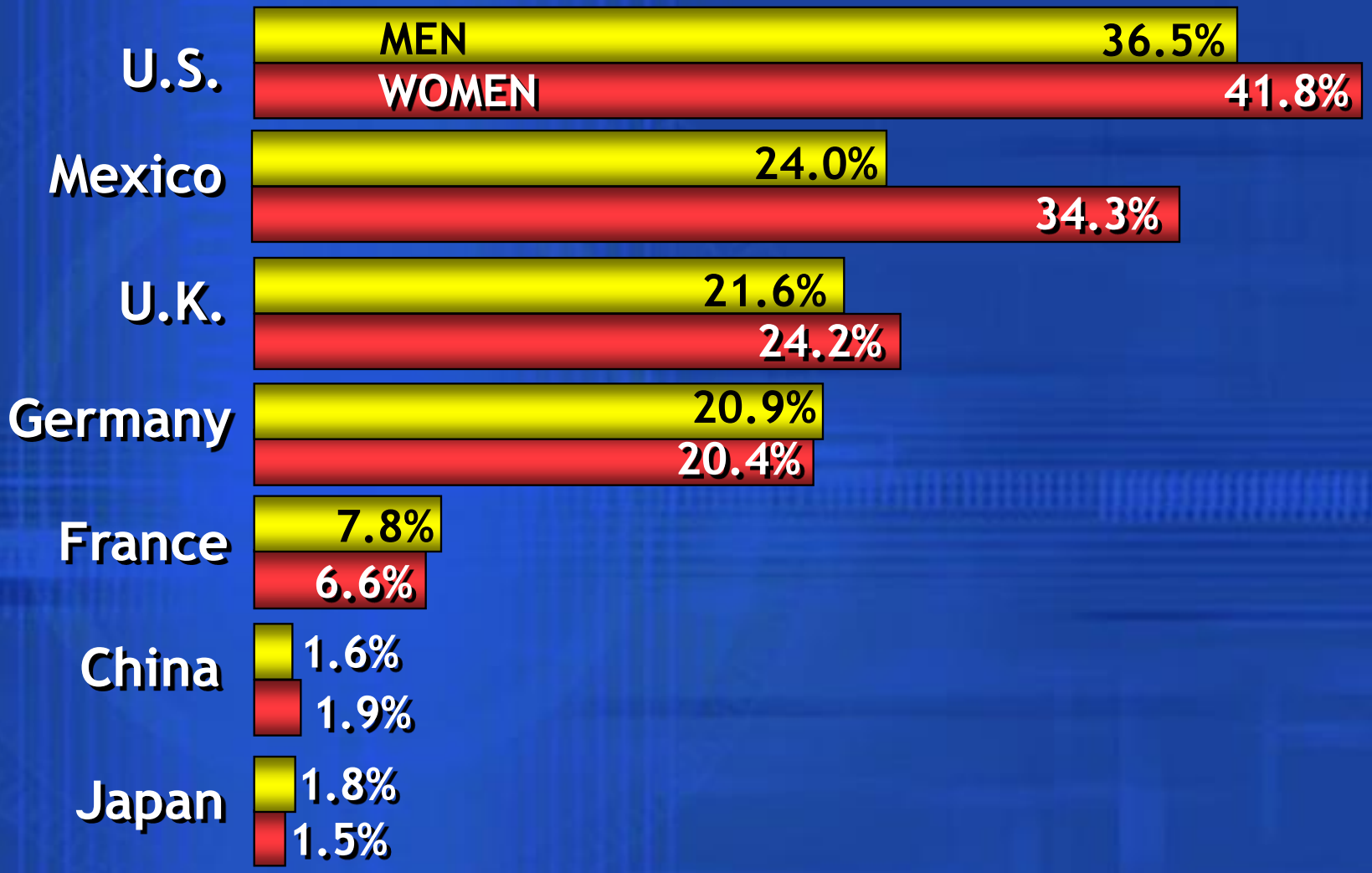
Sources: Trust for America's Health and the Robert Wood Johnson Foundation

Obesity Prevalence Among U.S. Adults
2010



Sources: Trust for America's Health and the Robert Wood Johnson Foundation

Obesity Rates: U.S. vs. World



Source: World Health Organization / Estimated obesity rates for people aged 15 years and older / 2005

World University Ranking

Life Sciences and Medicine

1. Harvard University
2. University of Cambridge
3. University of Oxford
4. Stanford University
5. Berkeley
6. University of Tokyo
7. Johns Hopkins University
8. MIT
9. Yale University
10. UCLA
11. Imperial College London
12. UC San Diego
13. National University/Singapore
14. University of Melbourne
15. University College London
16. University of Toronto
17. University of Edinburgh
18. Kyoto University
19. University of Sydney
20. University of British Columbia

Source: QS World University Rankings

Imperial College London

2000	2009
- 9,500 students	- 13,000 students
- 20% foreign	- 44% foreign
- 108 from China	- 1,650 from China

Foreign students account for 113% of student body growth.
Chinese students account for 39% of foreign-enrollment.

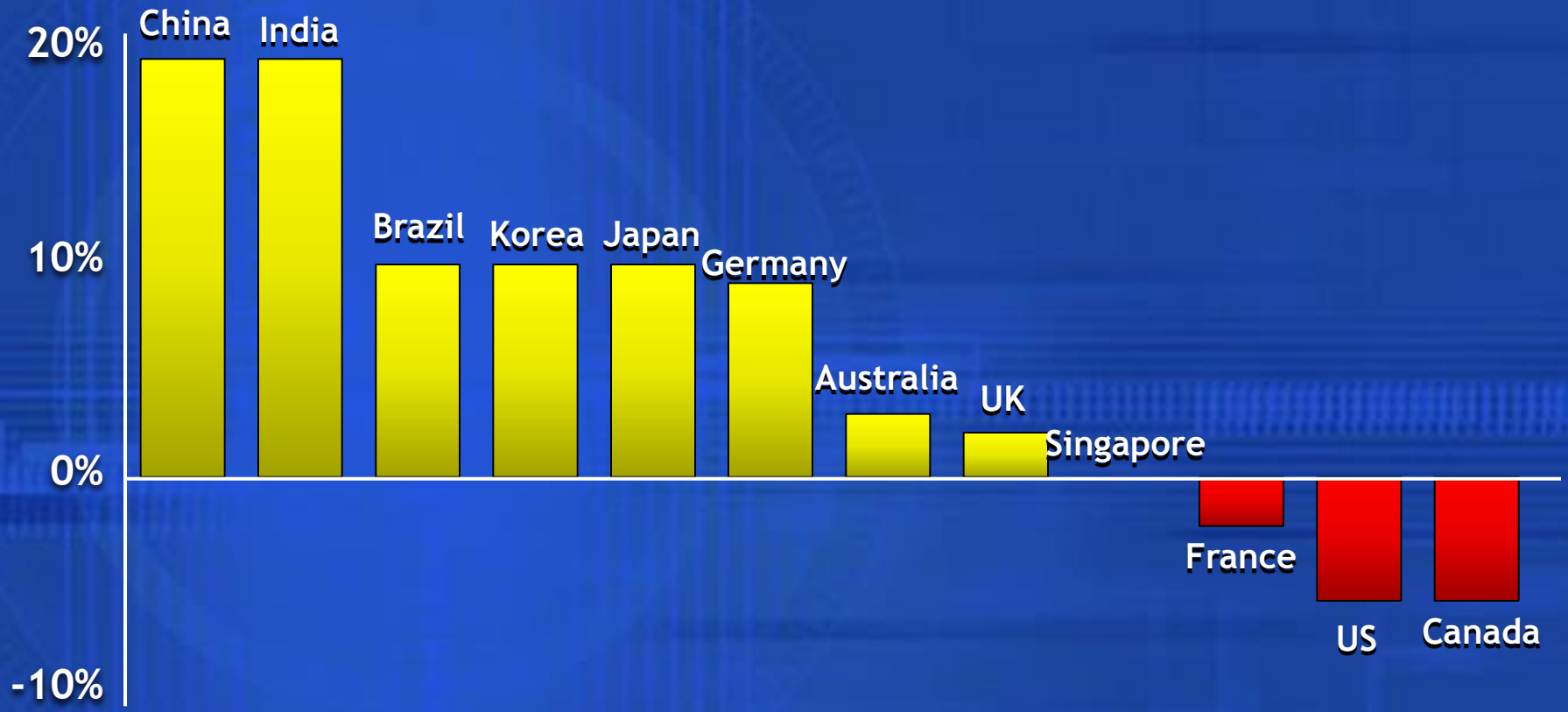
"Korea's government provides seven times more funding for pharmaceutical industry-performed research as a share of GDP than does the United States, while Singapore and Taiwan provide five and three times as much, respectively."

- Leadership in Decline report

Assessing The U.S. International Competitiveness in Biomedical Research

May 2012

Outlook for Biomedical Research Spending (2012)



Source: OECD - Government Budget Appropriations or Outlays for Research and Development (2012)

Beijing Genomics Institute

"China has the world's largest next-generation sequencing capacity."

Advancing Technology

- Cost
- Speed
- Storage
- Access

What does technology make possible?

1990	2012
13 years and $3 billion to sequence the human genome	2 hours and $1,000 to sequence a human genome

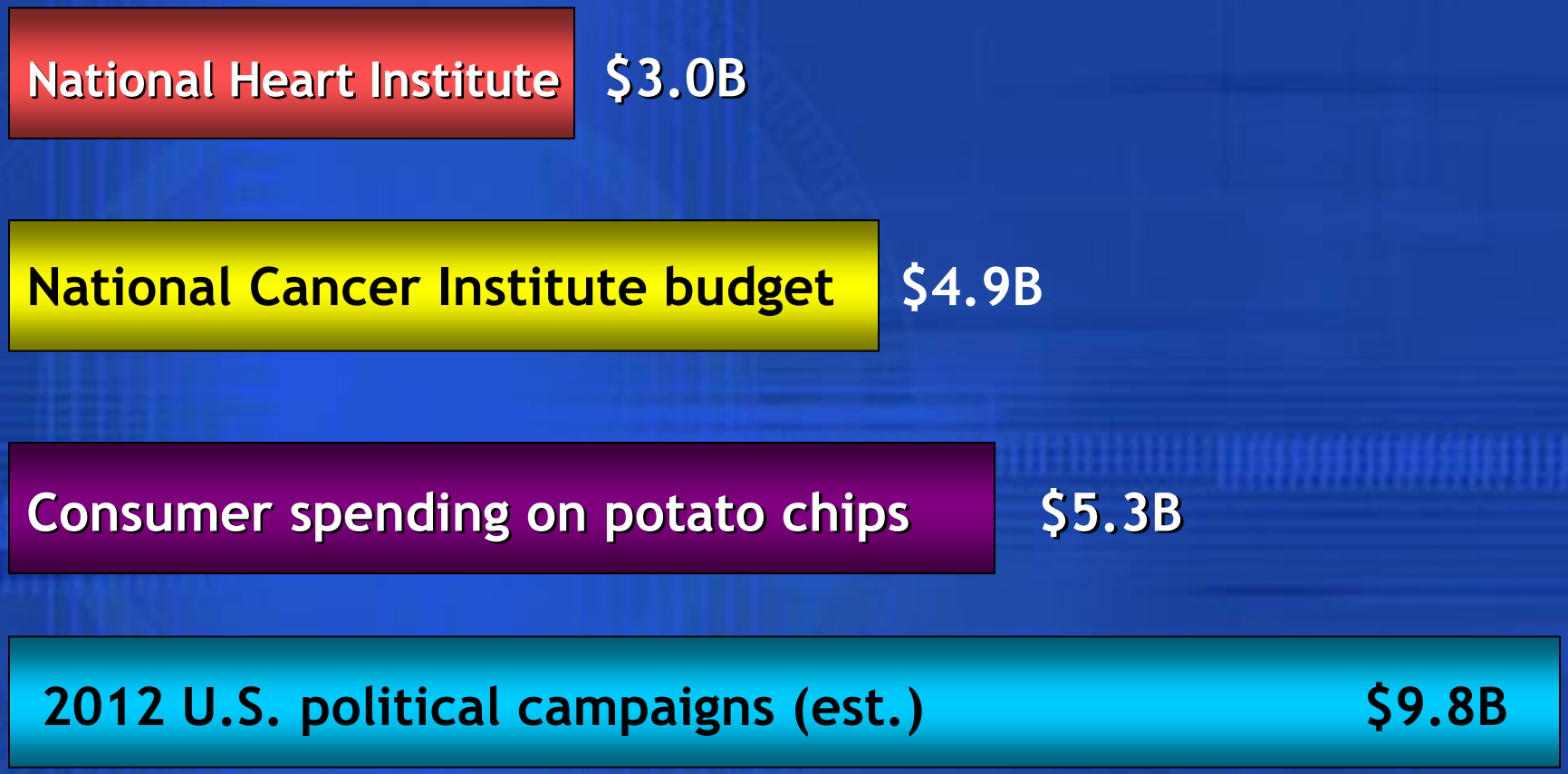
Source: John Reed, PhD, Sanford Burnham Institute

Consumer Spending

U.S.		Asia	
Housing	32.7%	Food	23%
Transportation	18.0%	Supplemental education	15%
Food	12.8%	Housing	10%
Insurance/pensions	11.2%	Clothing	8%
Healthcare	5.7%	Other	8%
Entertainment	5.1%	Transportation	6%
Apparel and services	4.1%	Healthcare	5%
Supplemental education	2.0%	Communication	5%

Source: U.S. Bureau of Labor Statistics/CLSA Mr & Mrs Asia

Major Spending Initiatives in the U.S.



Sources: Center for Responsive Politics / Borrell Associates

The NIH Impact

- 90% of Ph.D. scientists rely on NIH to support their research training.
- NIH accounts for 80% of all funding for non-profit medical research.
- 74% of pharma and biotech companies have licensed patents from NIH-funded academic research.
- 17% of FDA-approved drugs cite NIH patents as their source.
- NIH grants issued in FY2000 generated 30,477 invention disclosures, 17,341 patent applications and 6,901 patents (to date!).

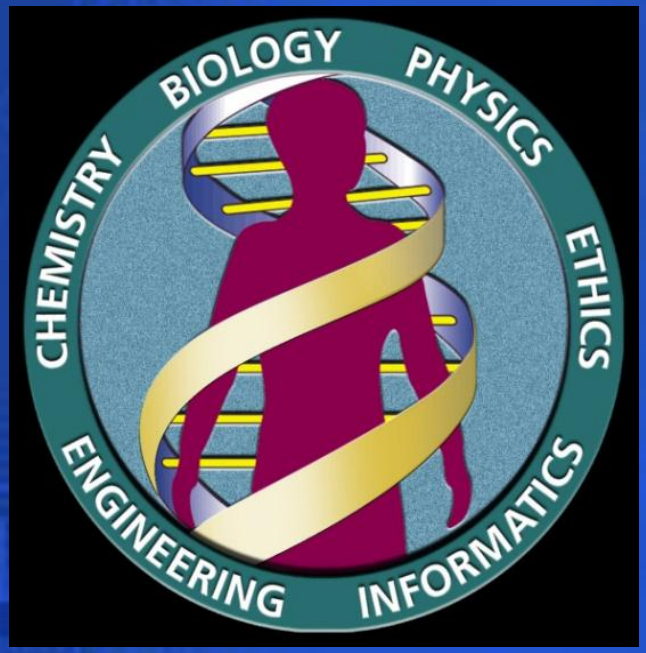
Source: John Reed, PhD, Sanford Burnham Institute

In 2011, NIH research funding led to …

- 432,094 new jobs
- $62 billion in new economic activity in the US
- 500 patent applications worldwide
- 389 patents issued
- Support of 300,000 scientists and researchers at 2,500+ universities and research institutions, and 50,000 competitive grants

Source: Dr. Everett Ehrlich, United for Medical Research (NIH's Role in Sustaining the U.S. Economy

Medical Research ROI

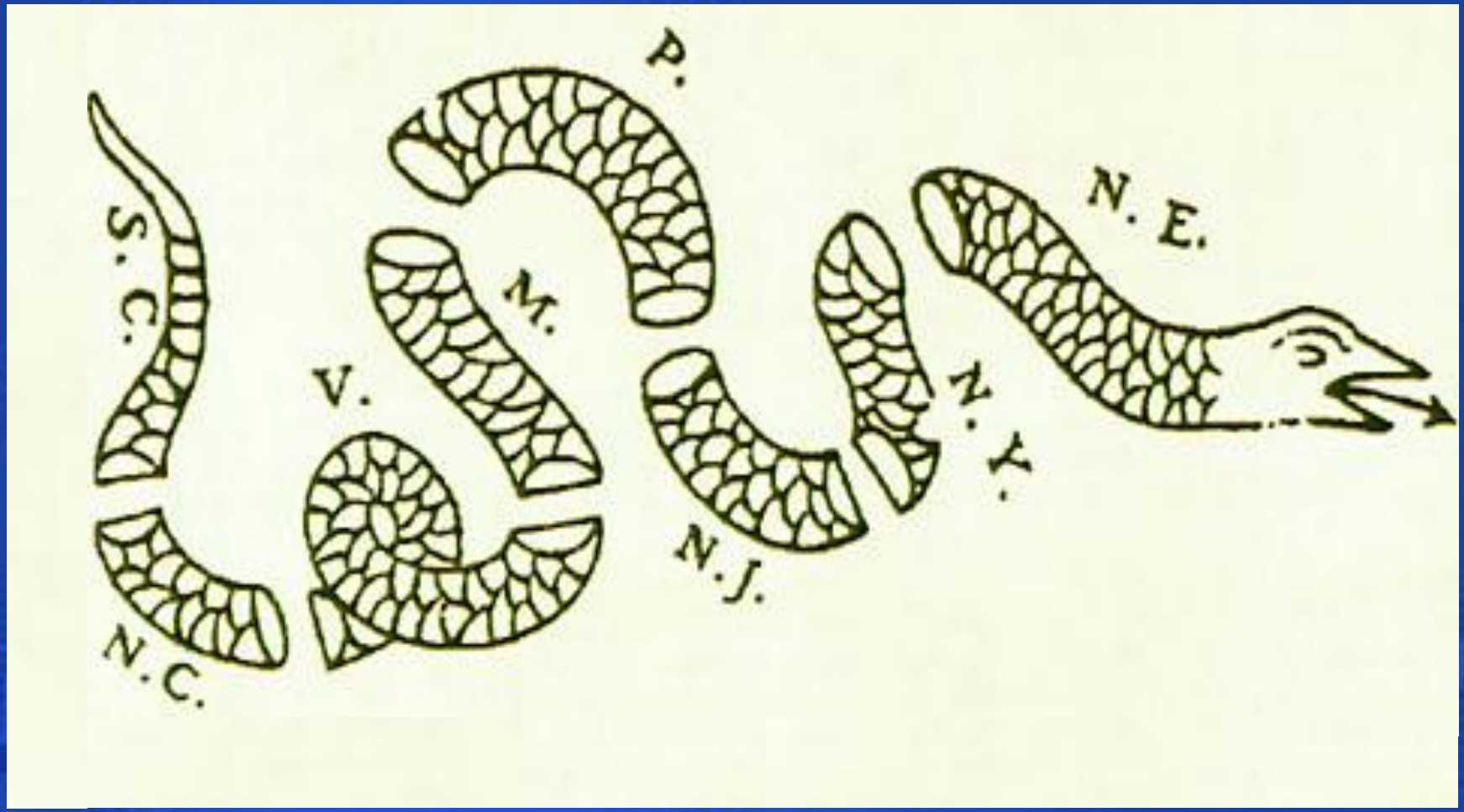


- The Federal government invested $3.8 billion in the Human Genome Project from 1990 to 2003.
- This investment generated an economic output of $796 billion and created 310,000 jobs, representing a 141:1 return on investment.

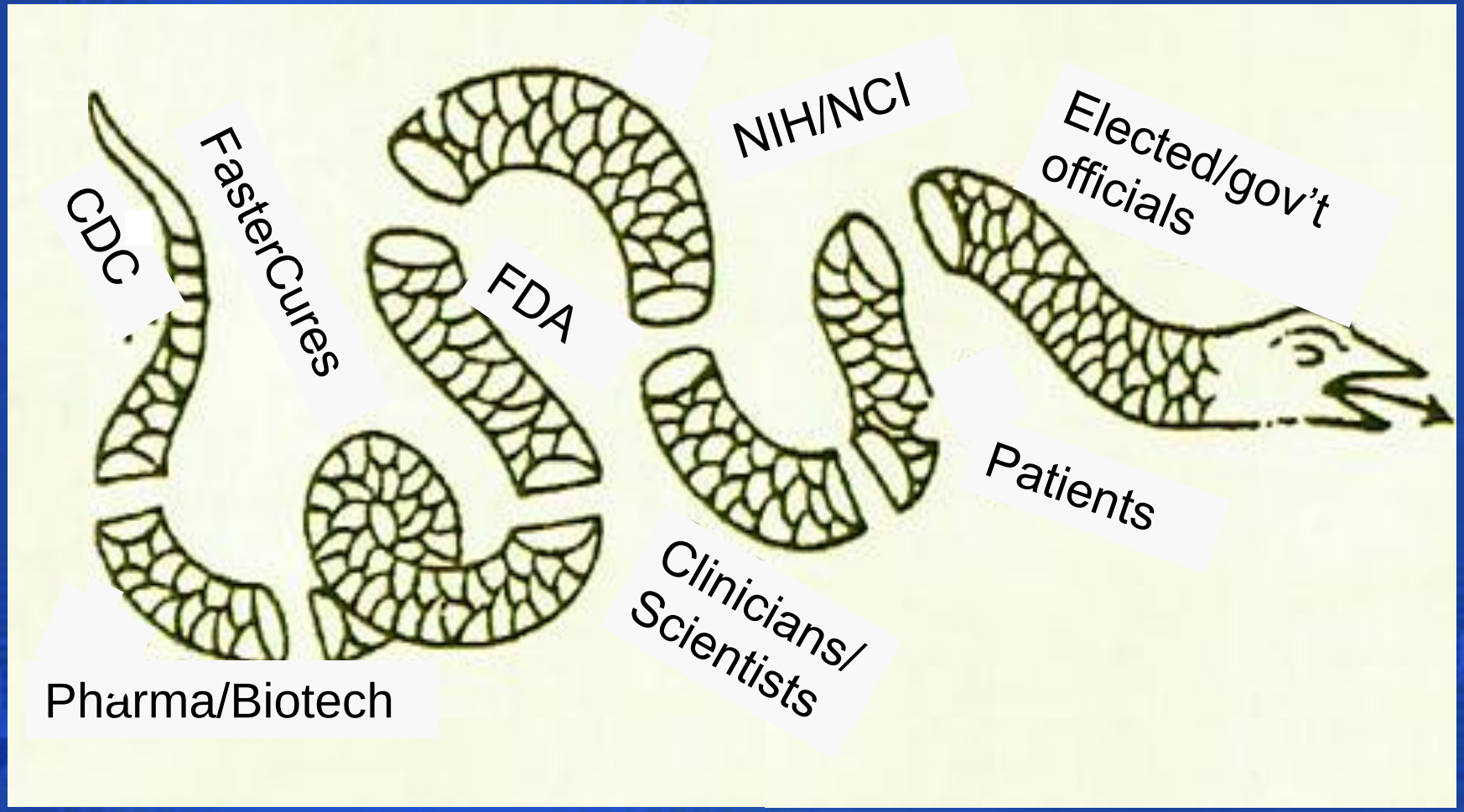
Source: Batelle (5/11/11 report)

Recent strides in understanding antibodies — the first weapons the human immune system deploys to fight an infection - make researchers optimistic that they are "on the cusp of a period of major discovery leading to [an AIDS] vaccine."

Source: Washington Post



First political cartoon in America
Ben Franklin, 1754: "Join or Die"



We need to join in public/private collaboration.

A CELEBRATION OF SCIENCE

Renewing Our Commitment to the Future

Washington, DC • September 7-9, 2012

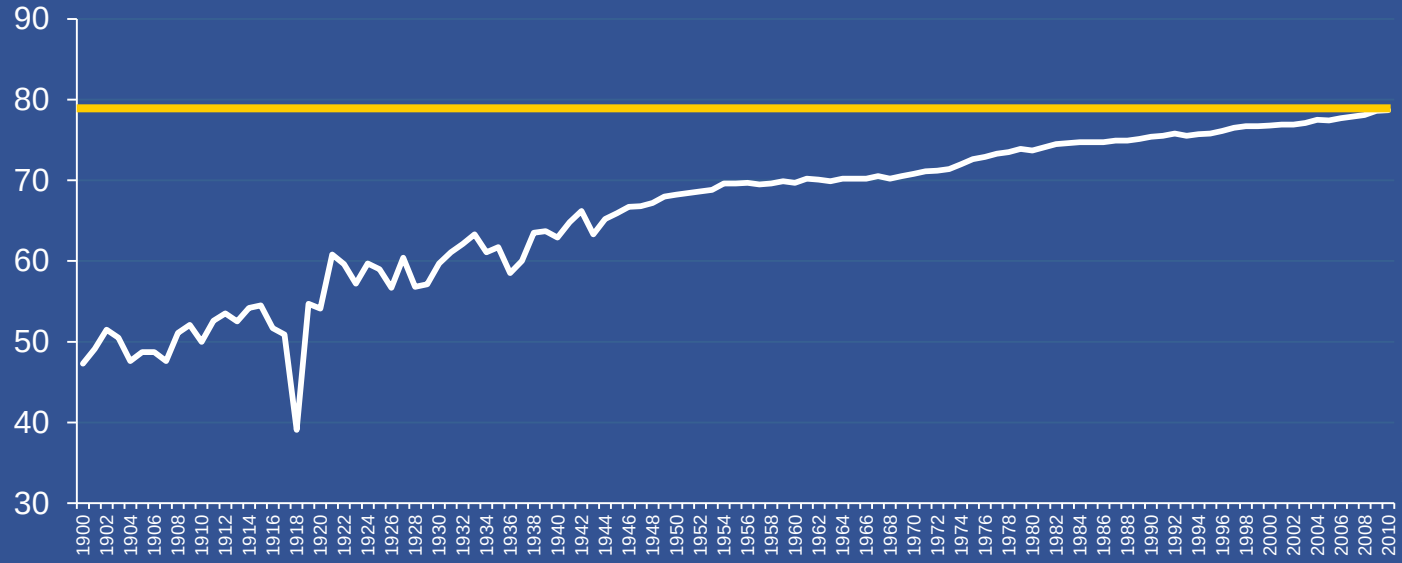
Renewing America's Commitment to Bioscience

Francis S. Collins, M.D., Ph.D.
Director, National Institutes of Health

Congressional Briefing
July 25, 2012

NIH's Impact on U.S. Health and Medicine

U.S. Life Expectancy



Life expectancy has risen from 48 to 79; these gains are worth ~$3.2 trillion annually

NIH Accomplishments

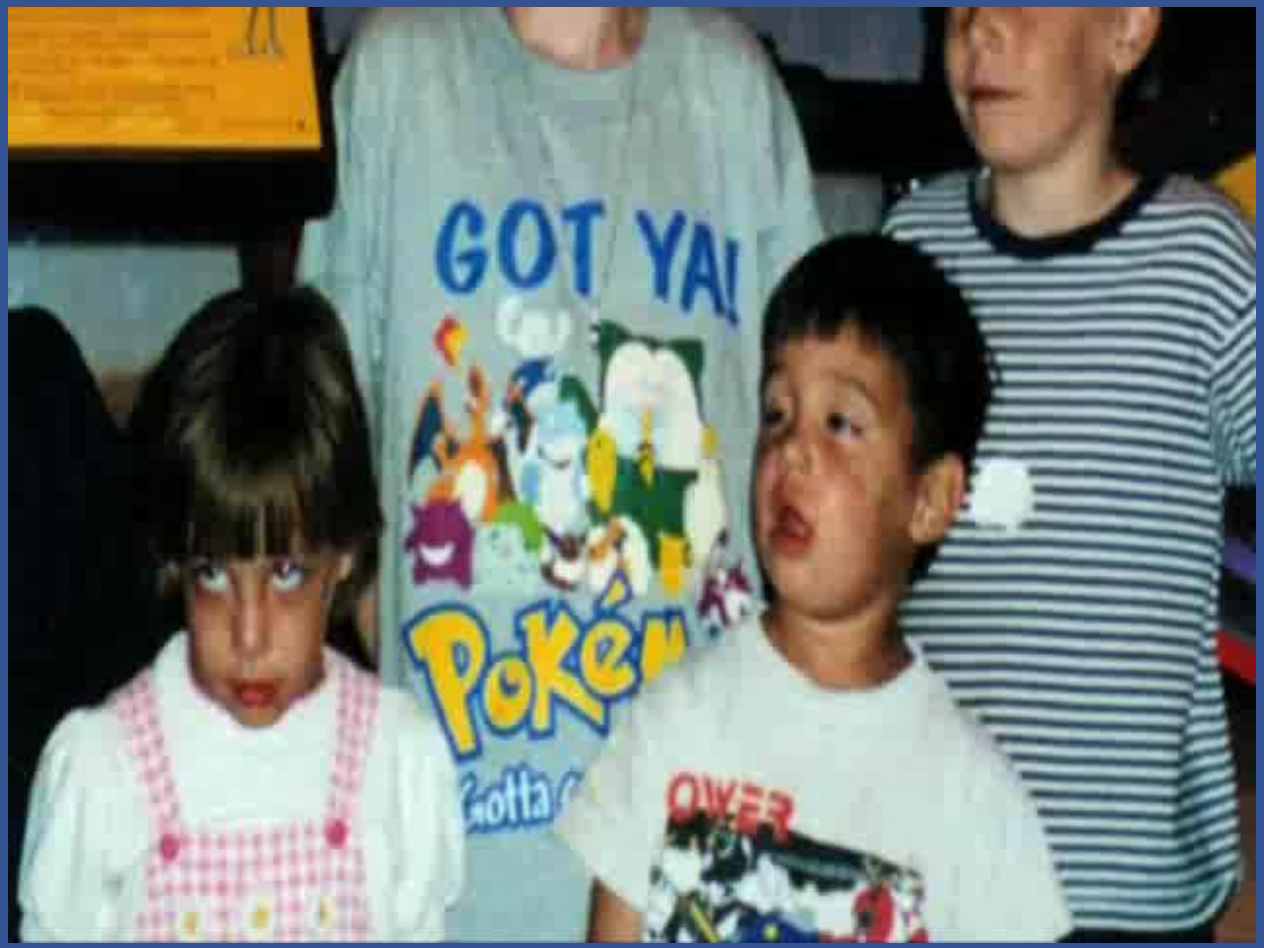
- **Cardiovascular disease:** Death rates for heart disease and stroke have fallen by ~70% over the last 50 years
- **Infant mortality:** 40% reduction over the past two decades
- **Cancer:** Death rates falling ~1% per year, saving ~$500 billion annually
- **Diabetes:** Between 1997–2006, deaths among people with diabetes from all causes fell 23%; from heart disease, 40%
- **HIV:** Treatments enable people diagnosed in their 20s to live past 70

Cost of Sequencing a Human Genome
2001–2011

$100,000,000
$10,000,000
$1,000,000
$100,000
$10,000
$1,000

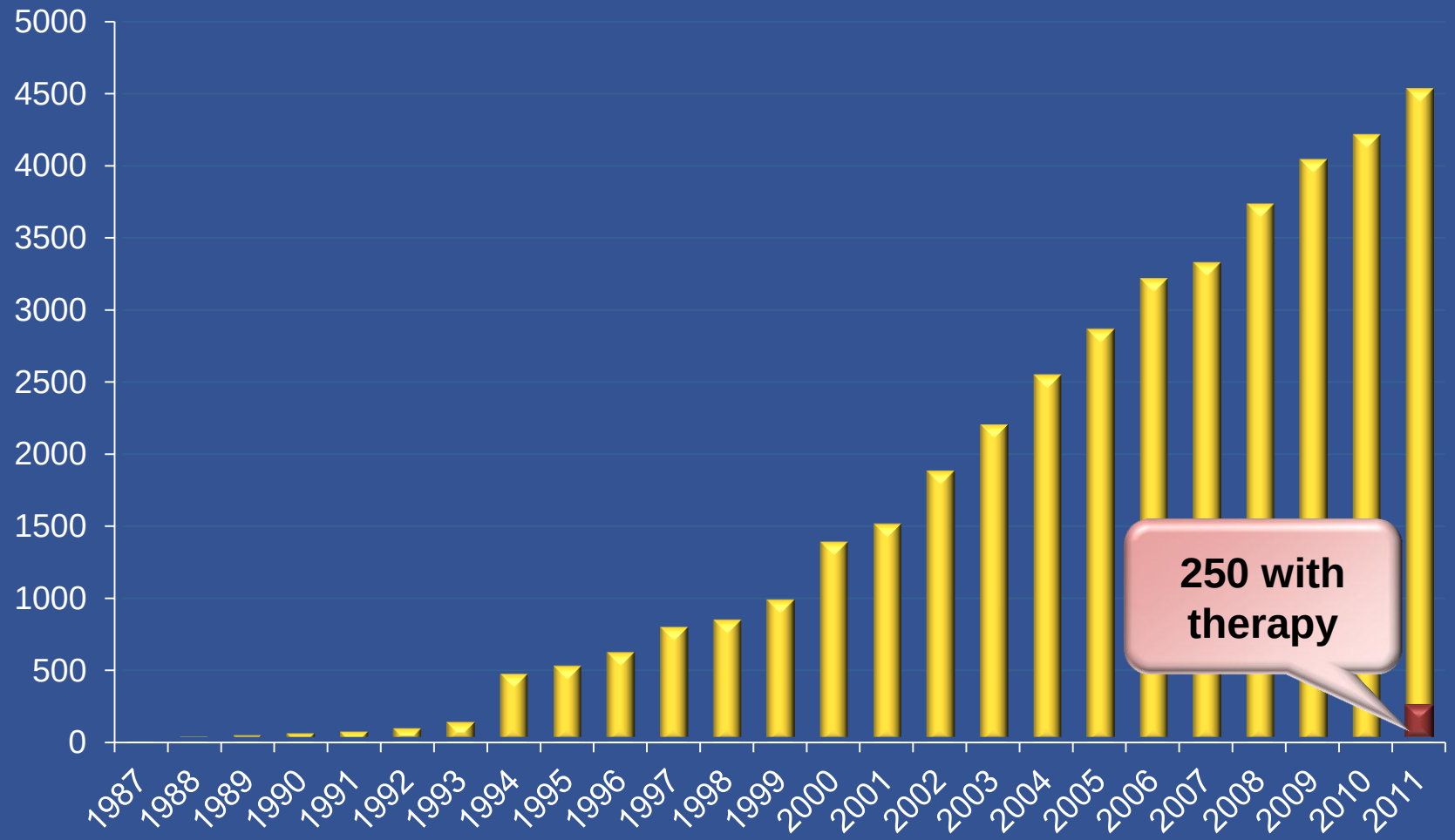
9/01 12/01 3/02 6/02 9/02 12/02 3/03 6/03 9/03 12/03 3/04 6/04 9/04 12/04 3/05 6/05 9/05 12/05 3/06 6/06 9/06 12/06 3/07 6/07 9/07 12/07 3/08 6/08 9/08 12/08 3/09 6/09 9/09 12/09 3/10 6/10 9/10 12/10 3/11 6/11 9/11

Success Story: Noah and Alexis Beery



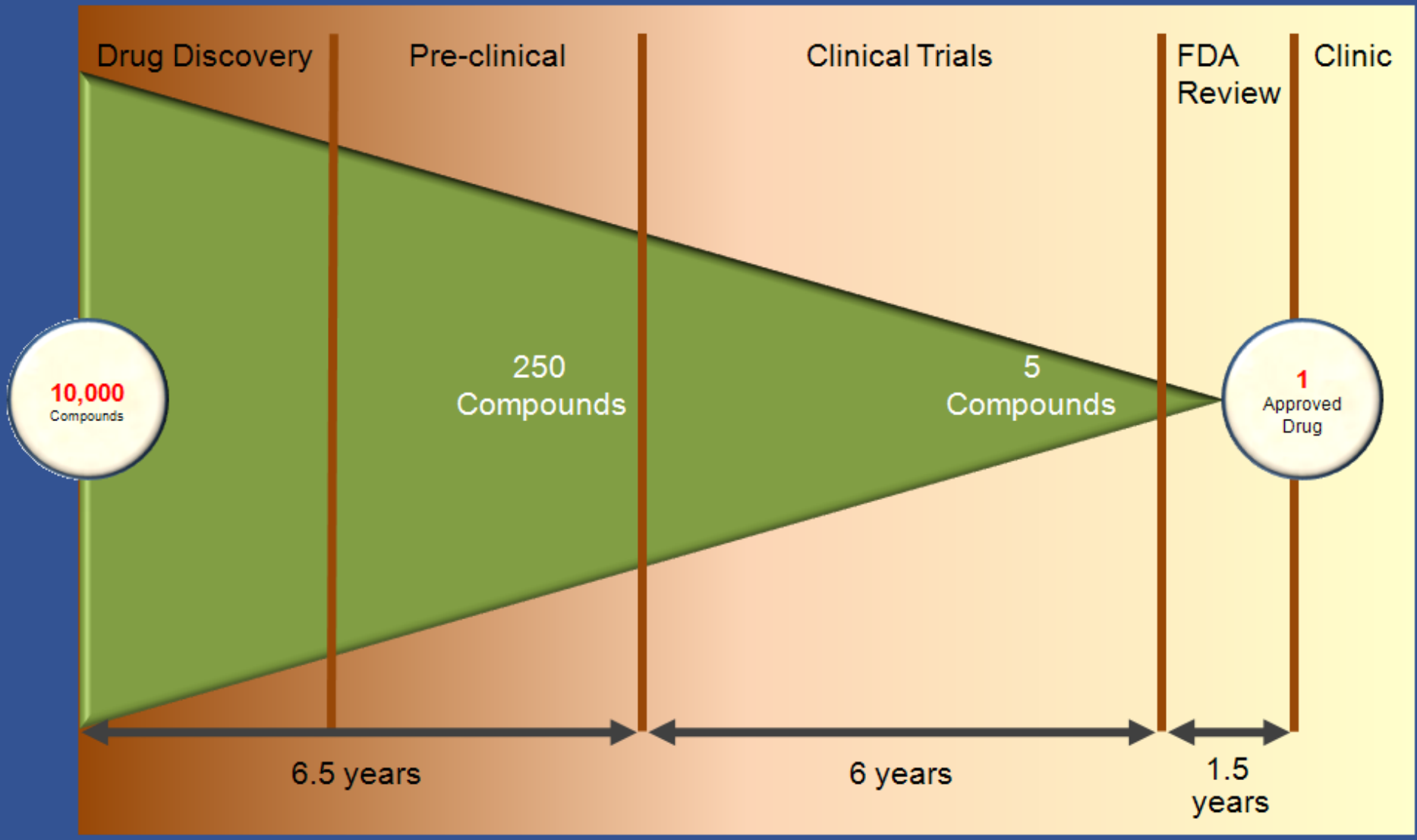
Success Story: Noah and Alexis Beery

Disorders with Known Molecular Basis



Source: Online *Mendelian Inheritance in Man*, Morbid Anatomy of the Human Genome

Drug Development Pipeline



National Center for Advancing Translational Sciences

- Biochip for Drug Safety Screening to develop chip to screen for safe, effective drugs
  - NIH, DARPA contribute $70M over 5 years; FDA provides guidance
  - Awards announced July 24, 2012
- Rescuing and Repurposing
  - June, 2012: NIH partners with eight pharmaceutical companies
  - Program matches 58 pharma compounds already proven safe in humans with NIH-funded scientists' ideas for new uses
  - Features template legal agreements to:
    - Reduce time, cost, effort
    - Provide roadmap for handling intellectual property

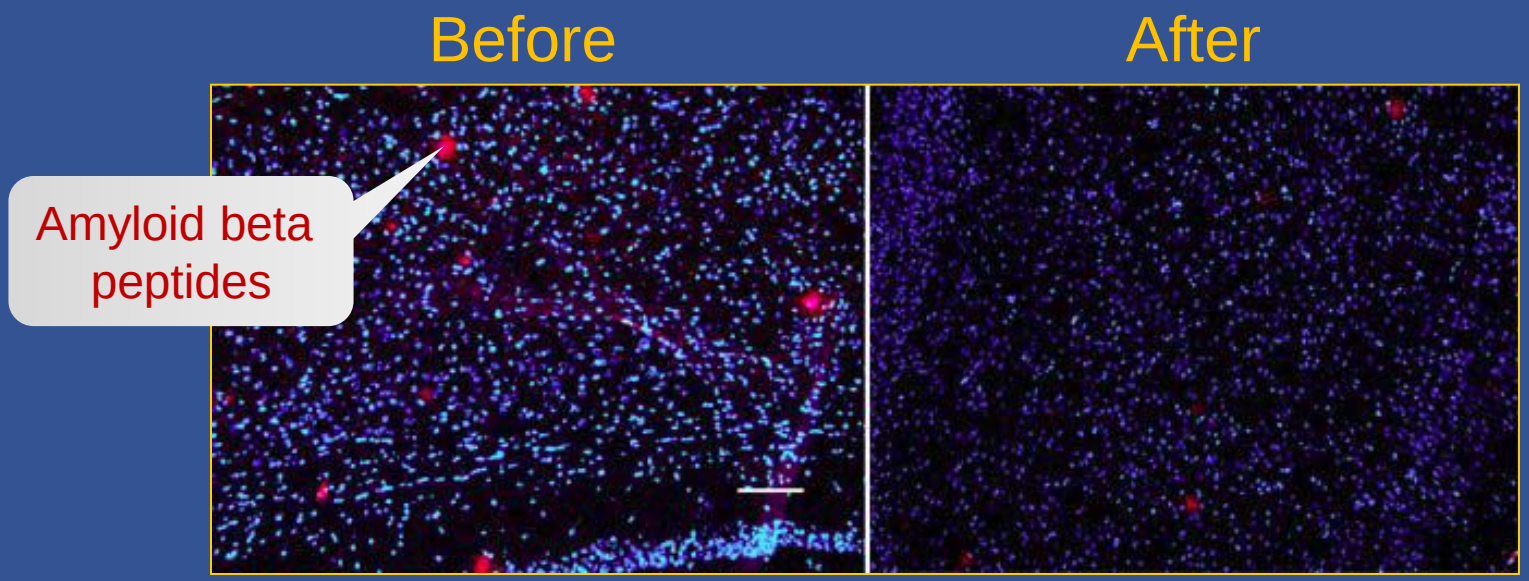
Drug Rescue and Repurposing: Alzheimer's Disease and Bexarotene

Sciencexpress Report

9 February 2012

ApoE-Directed Therapeutics Rapidly Clear β-Amyloid and Reverse Deficits in AD Mouse Models

Paige E. Cramer,[1] John R. Cirrito,[2] Daniel W. Wesson,[1,3] C. Y. Daniel Lee,[1] J. Colleen Karlo,[1] Adriana E. Zinn,[1] Brad T. Casali,[1] Jessica L. Restivo,[2] Whitney D. Goebel,[2] Michael J. James,[4] Kurt R. Brunden,[4] Donald A. Wilson,[3] Gary E. Landreth[1*]

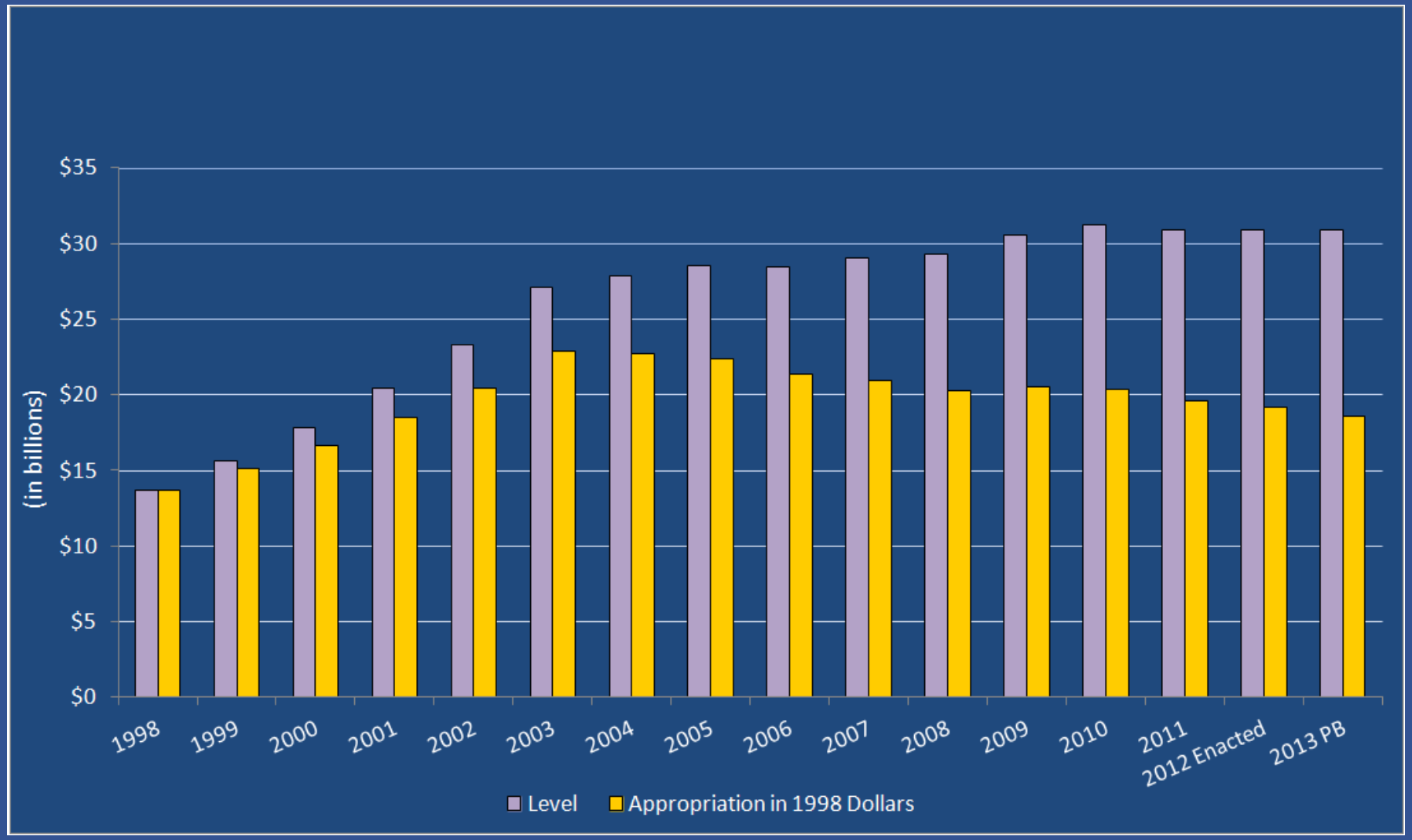


NIH's Grand Challenges That Can Be Met
Some Examples

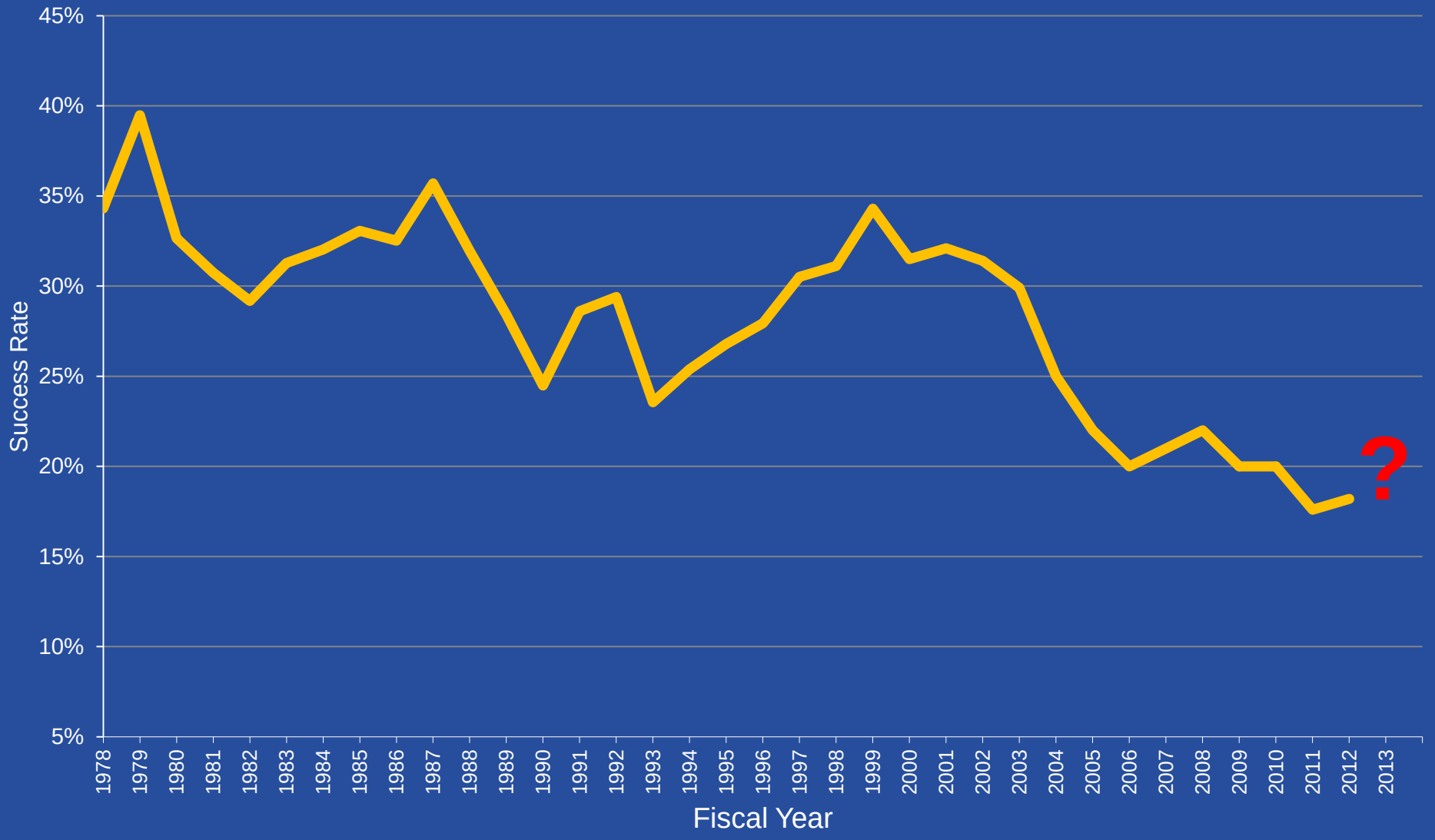
- Win the Battle Against Alzheimer's Disease
- Secure an AIDS-free Generation
- Reverse the National Epidemic of Obesity
- Develop a Universal Influenza Vaccine
- Apply Precision Medicine to Cancer

The Effects of Inflationary Growth on Purchasing Power: NIH Appropriation vs. Appropriation in 1998 Dollars

FY 2013 President's Budget Request



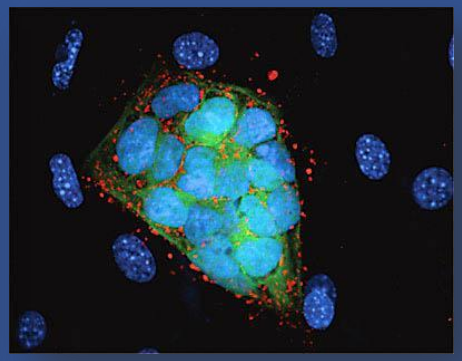
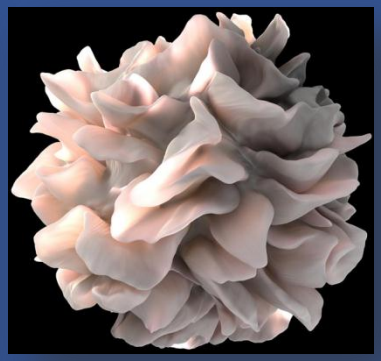
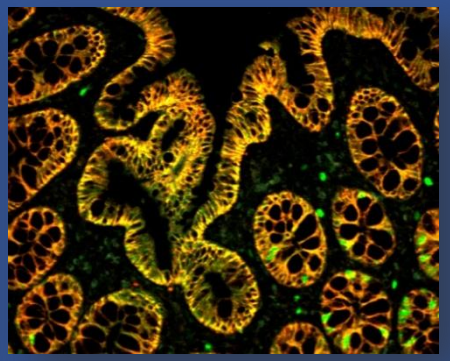
Grant Success Rates
FY 1978-2013






NIH...

Turning Discovery Into Health™

WHY SUSTAINED INVESTMENTS IN RESEARCH BENEFIT THE USA AND THE WORLD

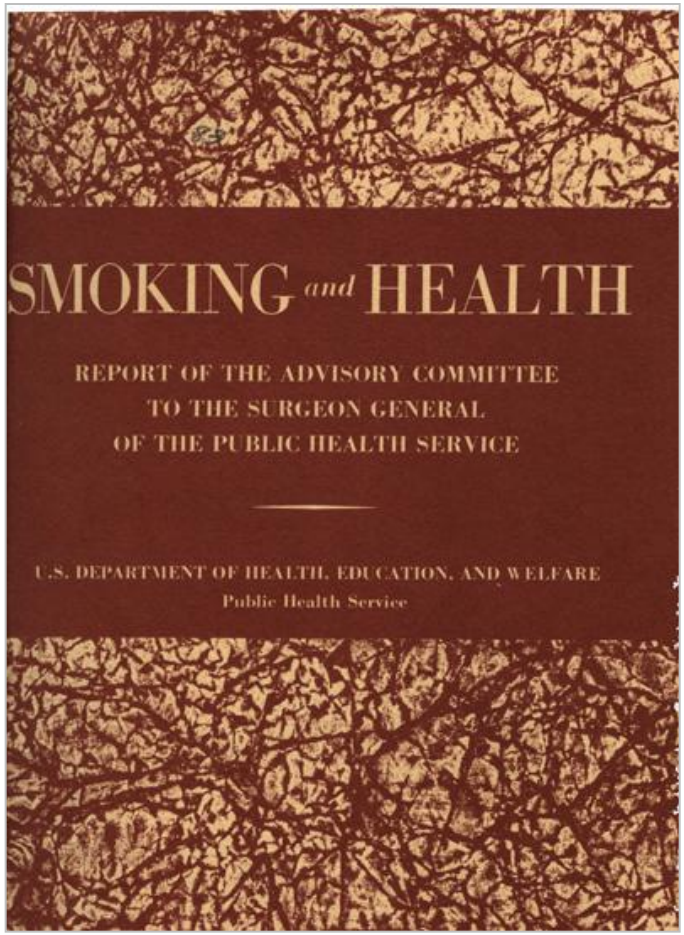
Harold Varmus

Director, NCI

July 25, 2012

1971: NIXON SIGNS THE NATIONAL CANCER ACT

ADVANCES IN CANCER CONTROL CIRCA 1971



1964: SURGEON-GENERAL'S REPORT

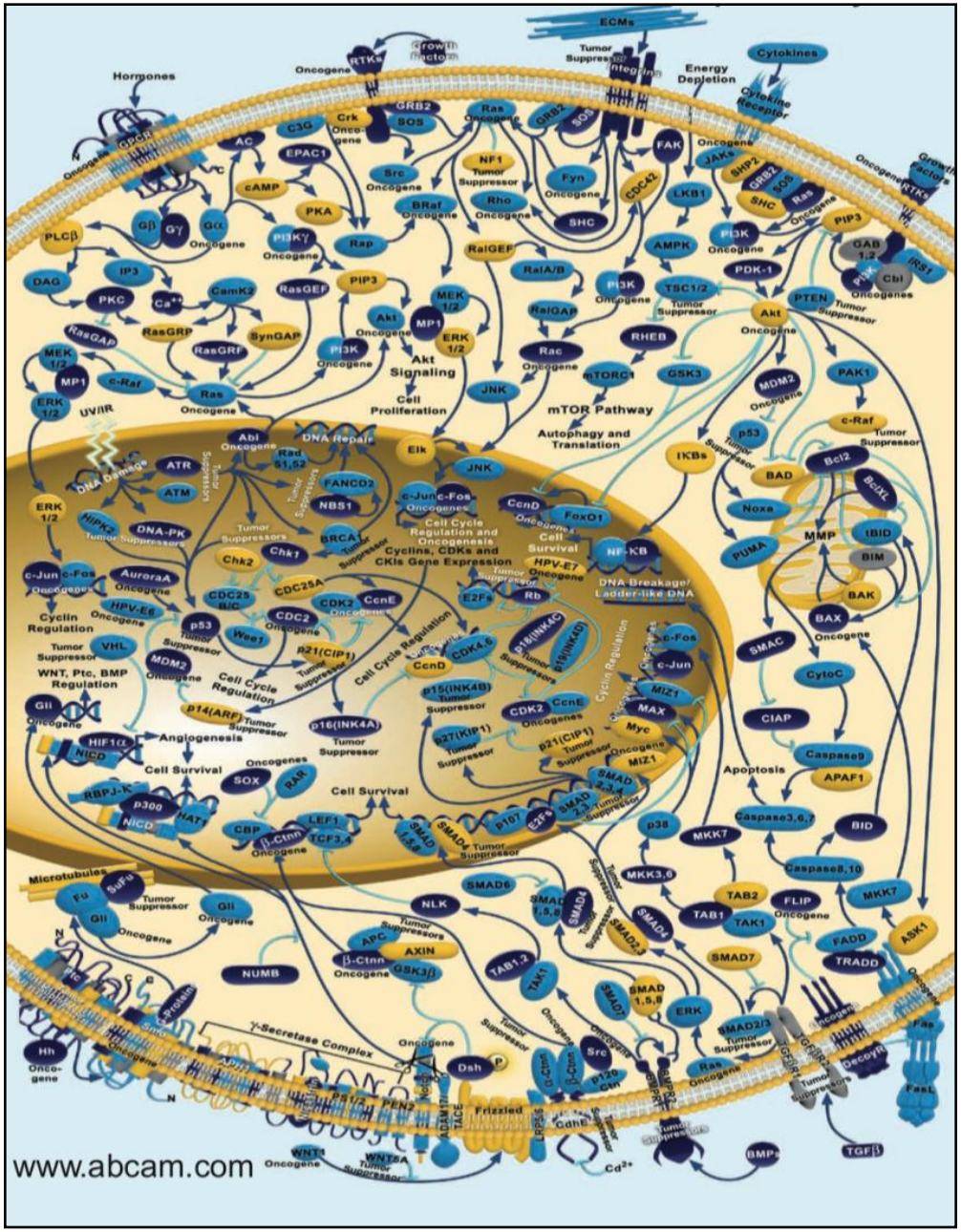
CHEMOTHERAPY FOR CHILDHOOD LEUKEMIA

OVER THE NEXT FEW DECADES, INVESTMENTS IN BASIC RESEARCH--CANCER VIRUSES, CELL BIOLOGY, GENETICS-- PRODUCED AT LEAST THREE MAJOR ADVANCES….

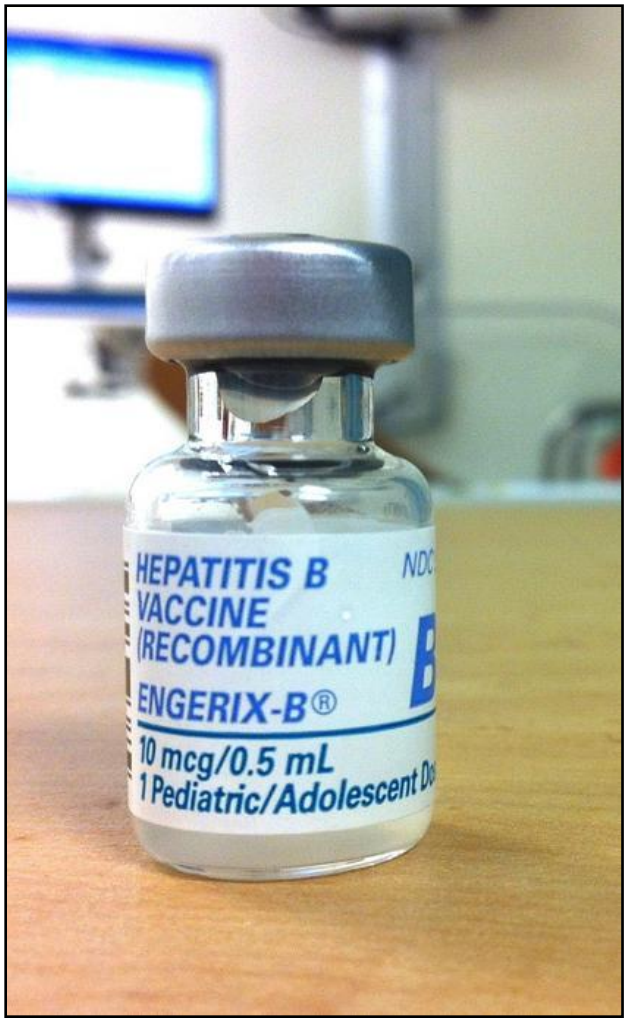
(1)CANCER GENES

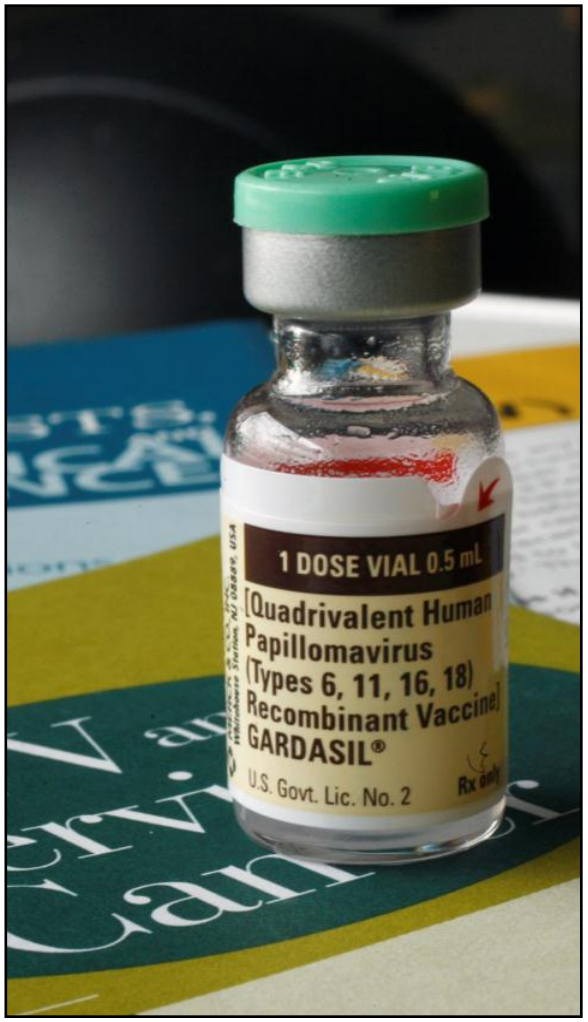
Many cell genes and proteins produce cancers cells when damaged… they are targets for diagnosis and therapy….

CANCERS ARE A COMPLEX SET OF DISEASES CAUSED BY GENETIC CHANGE



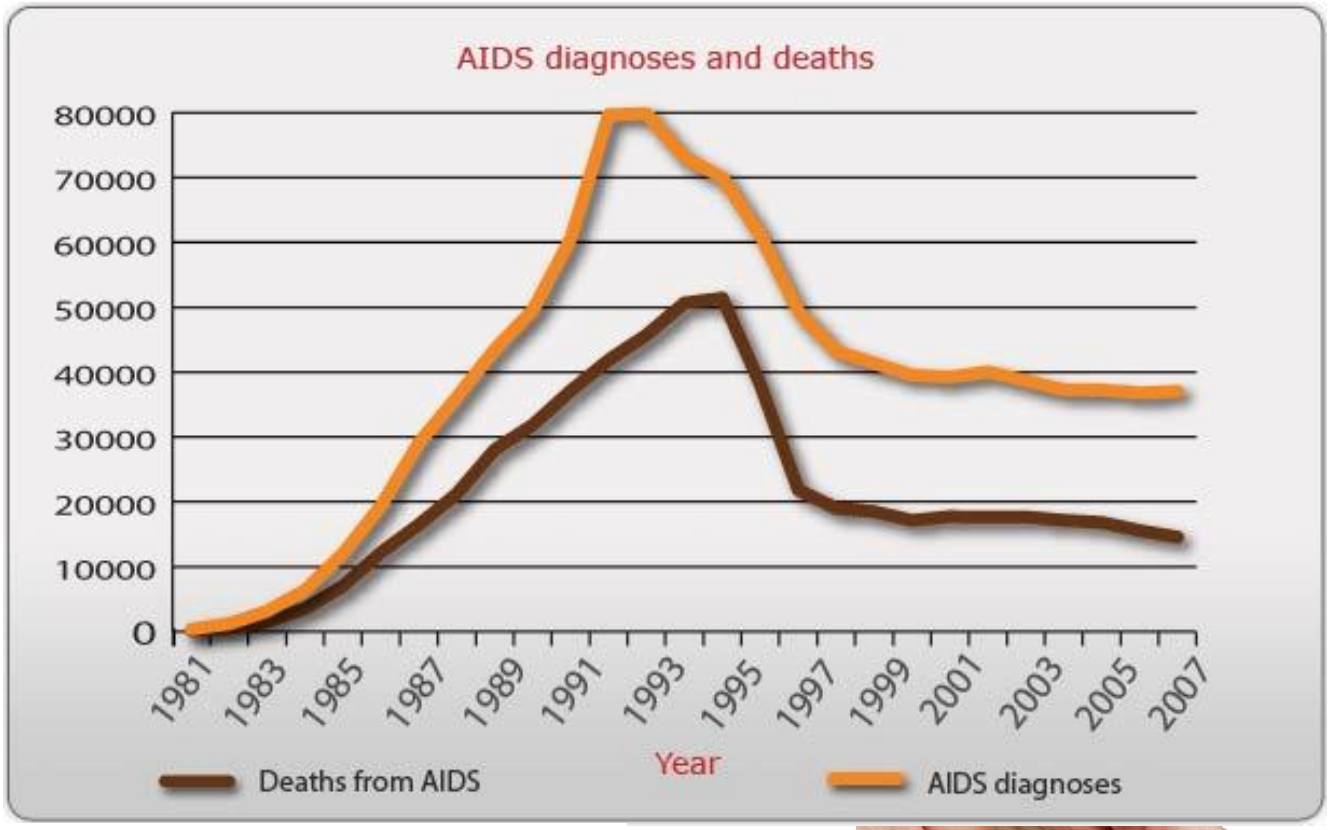
(2) ANTI-CANCER VACCINES

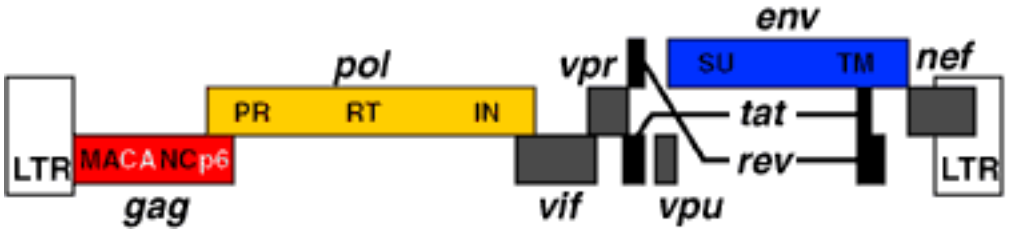




Vaccines against hepatitis B and papilloma viruses protect millions against hepatoma, cervical cancer, etc.

(3) Progress against AIDS, which depended on understanding retroviruses, the most closely studied cancer viruses.





HIV genome

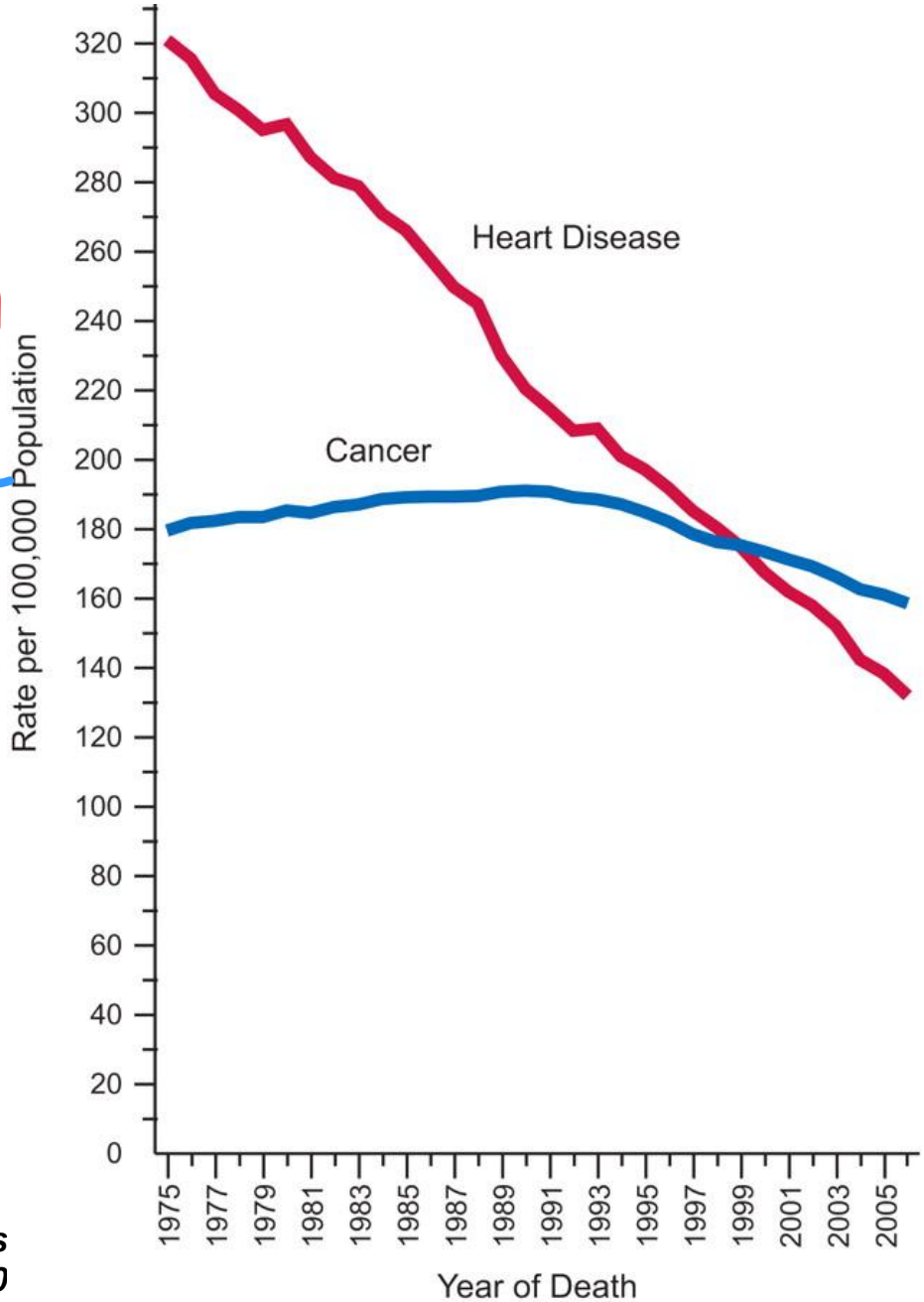
40+ YEARS AFTER THE NATIONAL CANCER ACT,
THE OPPORTUNITIES ARE VAST, BUT….

IRONICALLY AND SADLY, BUDGETS ARE SHRINKING….

MANY REASONS TO BE OPTIMISTIC ABOUT
DELIVERY ON SCIENTIFIC PROMISES…

Death Rates for Cancer and Heart Disease for Ages Younger than 85 Years: United States, 1975 to 2006

CANCER DEATH RATES HAVE BEEN FALLING OVERALL (BUT NOT FOR ALL CANCERS) SINCE AROUND 1990



From Jemal, A. et al., Cancer statistics 2010 CA Cancer J Clin 2010;60:277-30

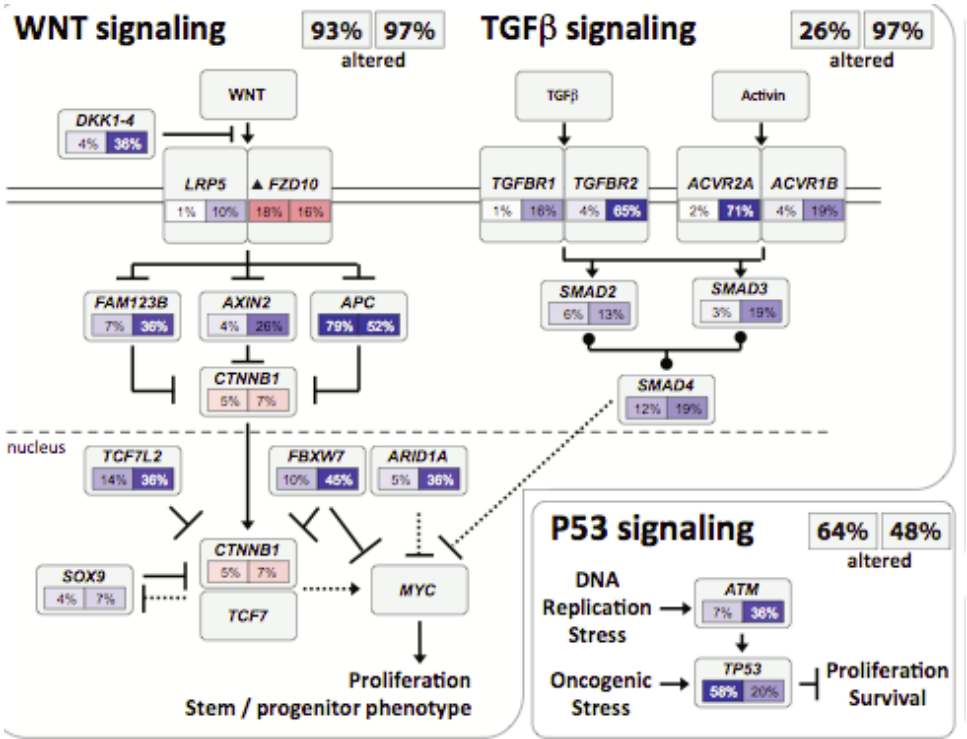
NEW KNOWLEDGE IS ACCRUING SWIFTLY

The New York Times

Genetic Aberrations Seen as Path to Stop Colon Cancer

By GINA KOLATA
Published: July 18, 2012

THE CANCER GENOME ATLAS PUBLISHES ITS LATEST REPORT---ON COLO-RECTAL CANCER



NEW CANCER DRUGS TARGETED AGAINST DAMAGED PROTEINS CONTROL DISEASE

GLEEVEC BLOCKS AN ONCOGENIC ENZYME AND KILLS CANCER CELLS (199^`

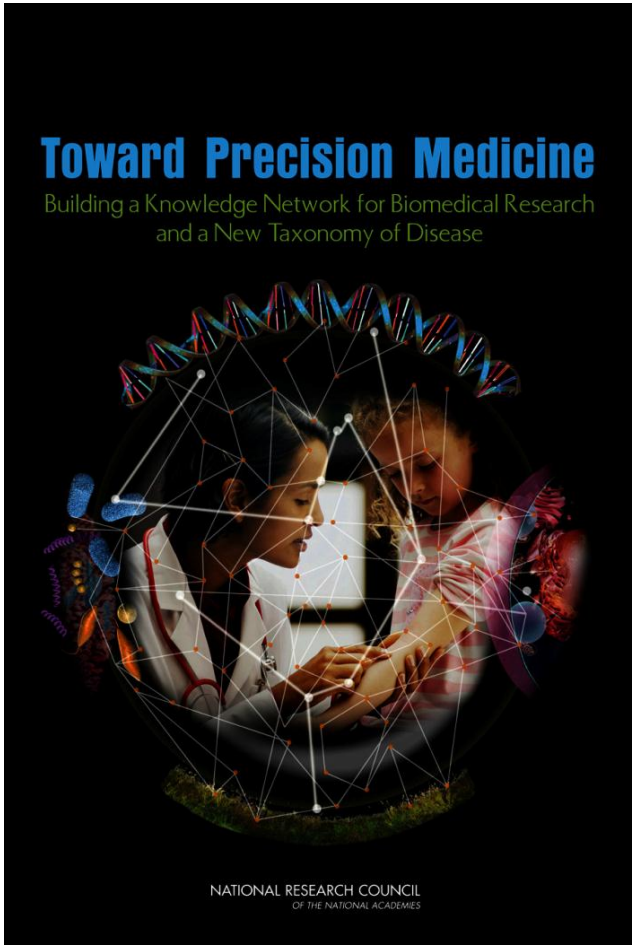
APPROVED BY FDA IN 2001 TO TREAT AN ADULT LEUKEMIA (CML); ACTIVE ORALLY, FEW SIDE-EFFECTS

EFFECTIVE IN SEVERAL HUMAN CANCERS

Drug in active site of target protein

RESTORES NORMAL LIFE EXPECTANCY IN CML PATIENTS

NEW MEDICAL PRACTICES ARE BEING ADOPTED



Accurate diagnosis based on genetic characteristics

Choice of therapy based on knowledge of targets

Prediction of outcome based on complex information specific to each patient

The New York Times

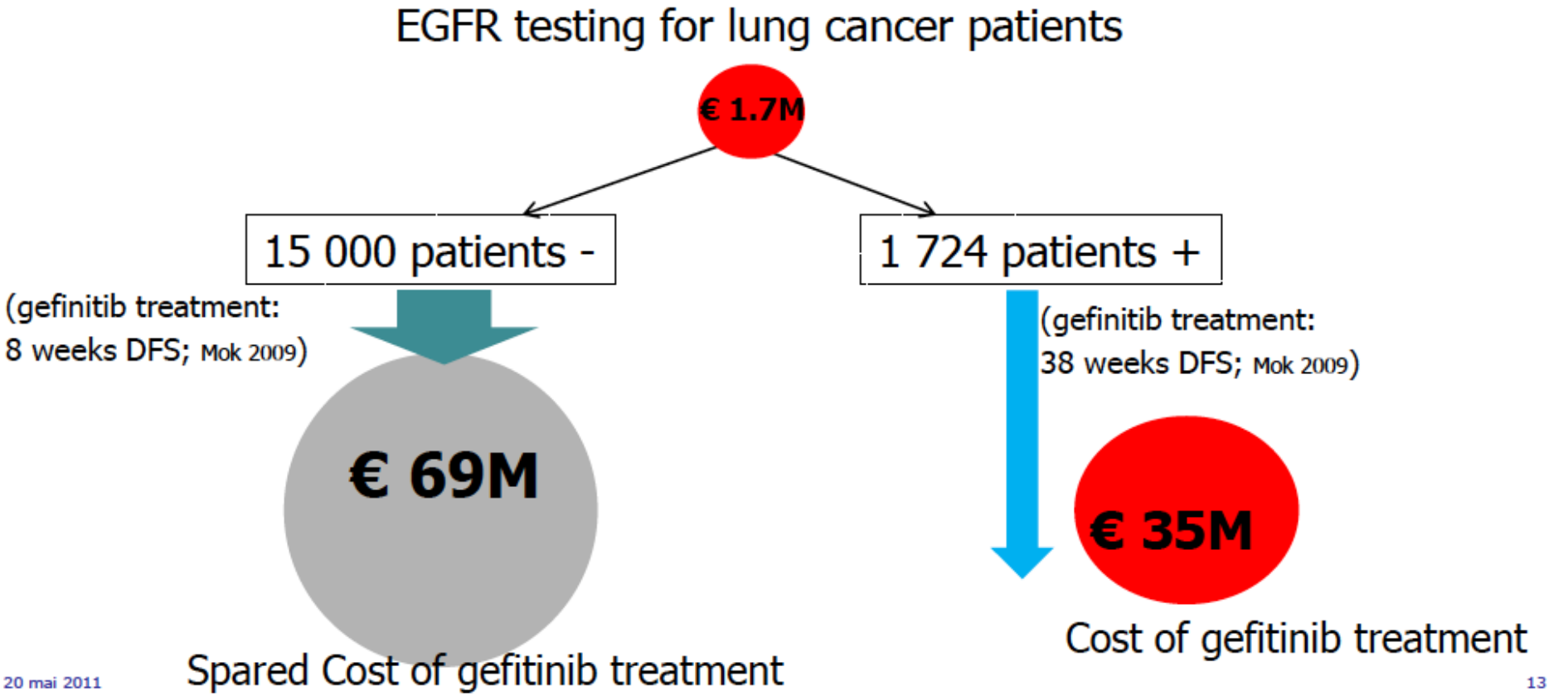
A Life-Death Predictor Adds to a Cancer's Strain

By GINA KOLATA
Published: July 18, 2012

… AND (AS FRANCE HAS SHOWN) IT CAN SAVE MONEY!

INSTITUT NATIONAL DU CANCER

Example of gefitinib treatment : €69M spared cost for the health insurance



Testing for mutations in lung cancer allows cost-efficient use of new and effective targeted therapies

WITH TALENT AND IDEAS, TIME (DECADES), AND RESOURCES,

THIS STRUGGLE CAN BE WON!

KIMMEL CANCER CENTER

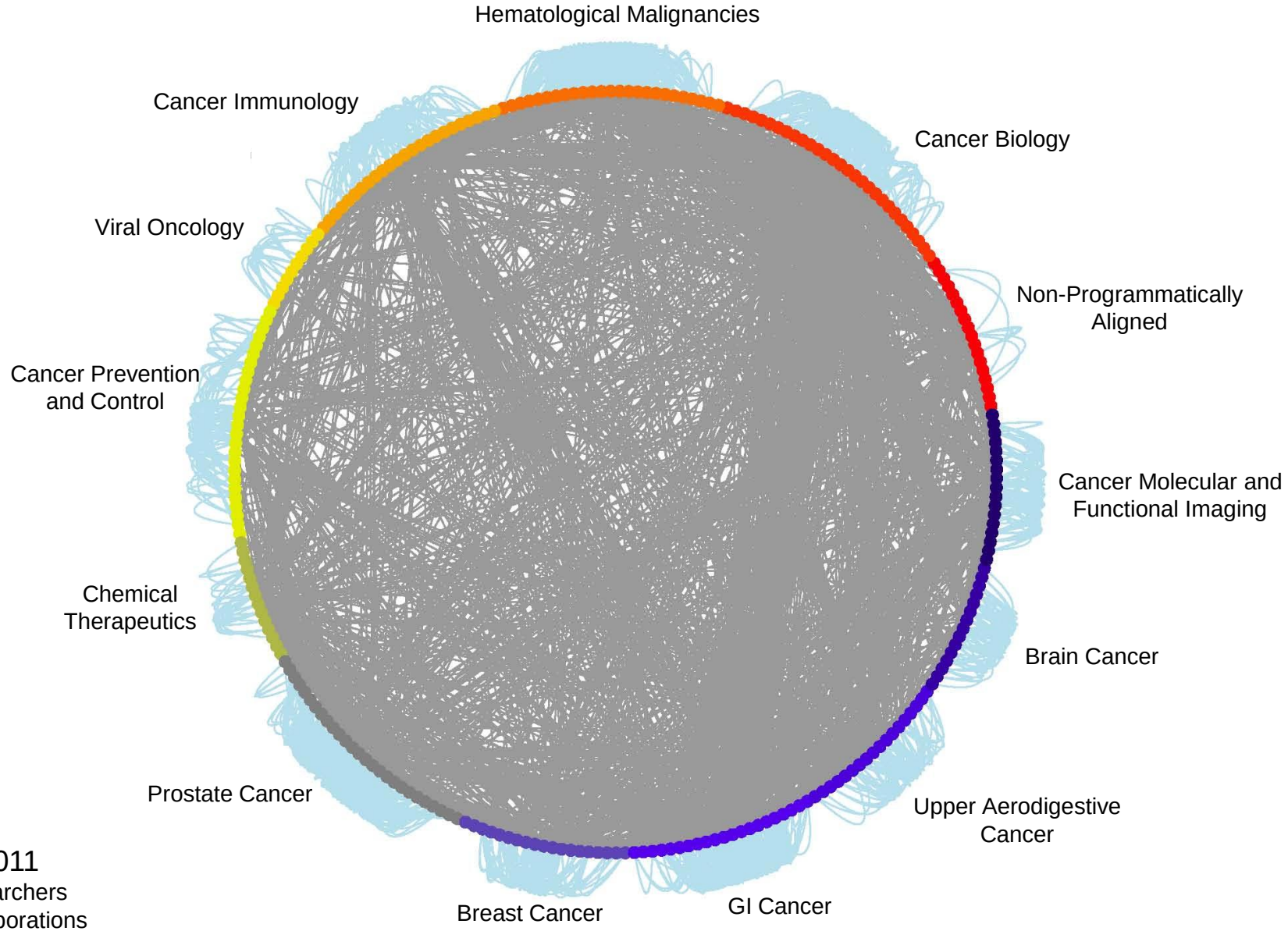
Cancer Research and Cancer Care from the "Frontline" of Cancer Medicine

William G. Nelson, M.D., Ph.D.

Director, Sidney Kimmel Comprehensive Cancer Center (SKCCC)

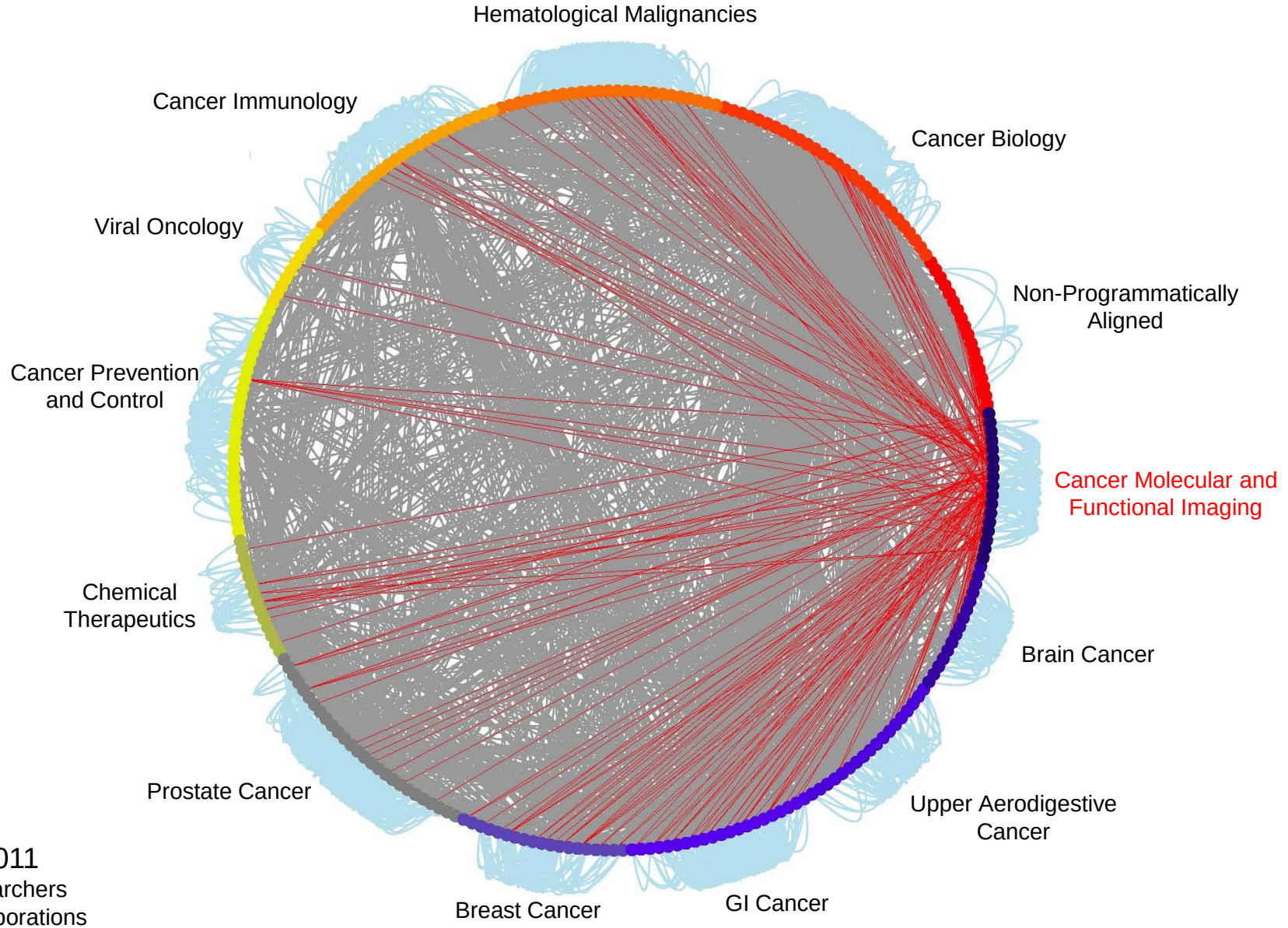
JOHNS HOPKINS MEDICINE

NIH/NCI-Funds to SKCCC Promote Team Science



2006-2011
263 researchers
2032 collborations
643 intra-Programmatic
1389 inter-Programmatic

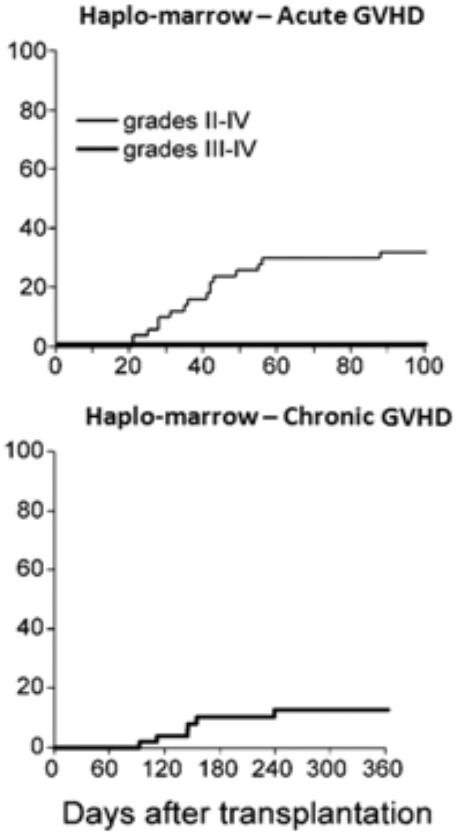
NIH/NCI-Funds to SKCCC Promote Team Science



2006-2011
263 researchers
2032 collborations
643 intra-Programmatic
1389 inter-Programmatic

NIH/NCI-Funded Research at SKCCC Helps Eliminate Disparities in Cancer Treatment*

Opportunity: Allogenic bone marrow transplantation (alloBMT) has proven benefit in the treatment of hematological malignancies and inherited bone marrow disorders.

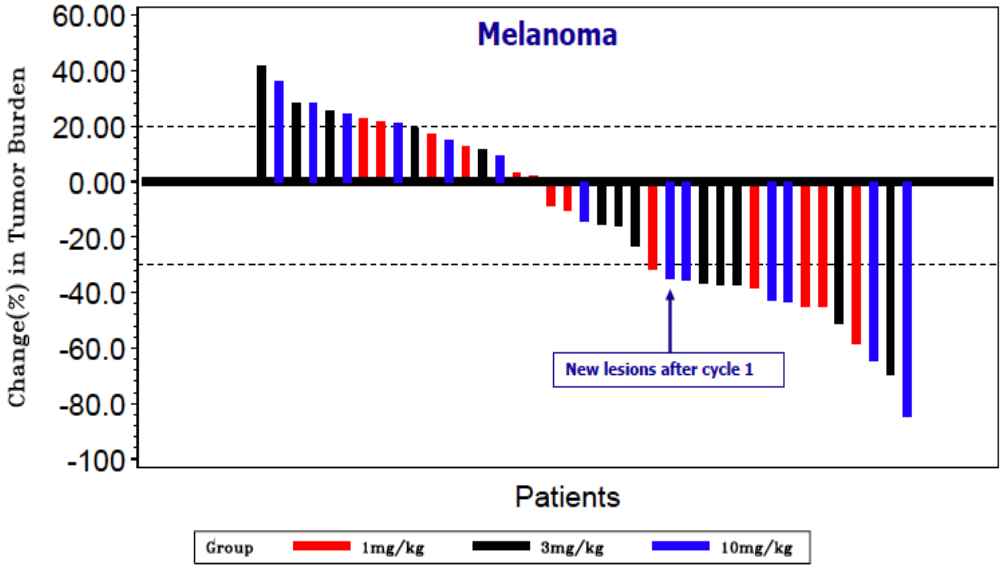


Challenge: HLA-matched bone marrow donors are under-represented among African-American and other minority populations.

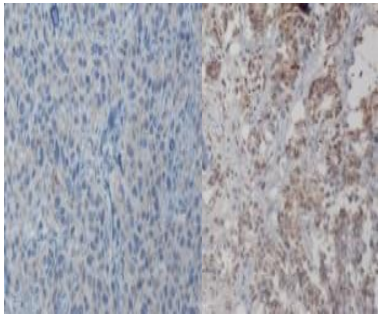
Solution: Innovative strategy for establishing immune tolerance in bone marrow allografts reduces graft-versus-host disease (GVHD) and making alloBMT more accessible to minority patients.

*Brunstein CG *et al.* Blood *118:* 282-288 (2011)

Heterogeneous Responses to Anti-PD-1*

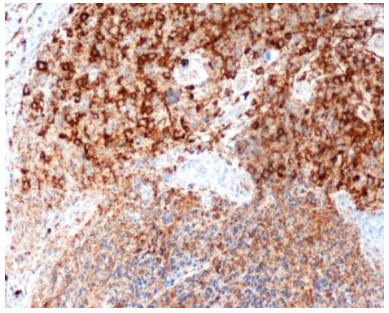


cytoplasmic or absent B7-H1 expression (14 cases)



0/14 responses

membranous B7-H1 expression (16 cases)



11/16 responses

pretreatment biopsies from subjects (n = 30) with melanoma treated with an anti-PD-1 antibody

*Brahmer JR *et al.* J Clin Oncol *28:* 3167-75 (2010); Topalian SL *et al.* New Engl J Med *366*: 2443-54 (2012)

Translational Development of Molecular Biomarkers at SKCCC and Elsewhere: What are the Challenges?

Biomarker Discoveries

germline DNA variants
somatic DNA mutations, translocations, etc.
somatic DNA somatic methylation changes
RNA expression changes, splice variants
protein expression changes

Biomarker Assay Platforms

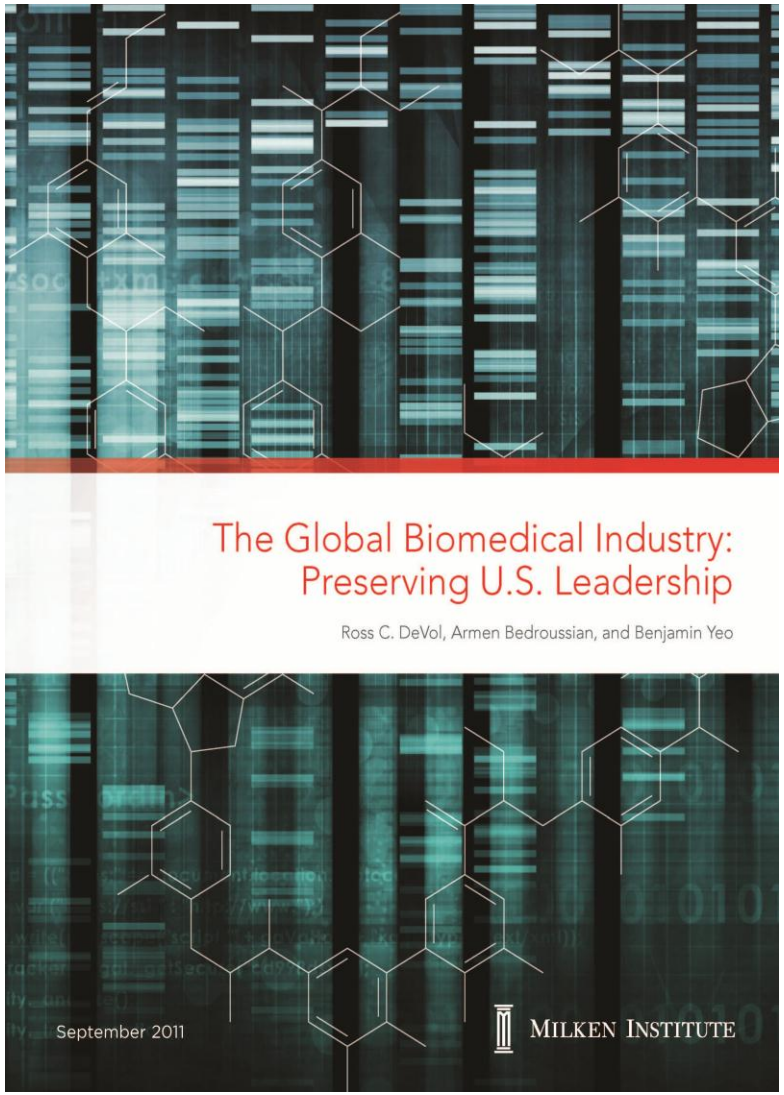
DNA Beaming, PARE, MSP, nanoMSP, MOB, COMPARE, GEMINI

Regulatory/Systems Considerations

CLIA, biospecimen collection/ archiving, HIPAA, health record information technology

Integration into Clinical Practice

Test	Marker	Specimen	Company	Disease	Indication
PCA3	RNA	urine	Dianon	prostate cancer	predicts prostate biopsy outcome
MGMT methylation	DNA	tissue	MDxHealth	glioblastoma	predicts response to temozolomide
GSTP1 methylation	DNA	urine tissue	LabCorp MDxHealth	prostate cancer	predicts prostate biopsy outcome
AMACR	protein	tissue	many	prostate cancer	diagnosis aid



Congressional Staff Hill Briefing
Washington, D.C.
July 25, 2012

Ross DeVol
Chief Research Officer
Milken Institute

Size of biomedical industry

2009

MILKEN INSTITUTE

Industry	Employment	Wages, US$B	Output, US$B
Biopharmaceuticals	283,700	$29.0	$82.4
Medical devices and equipment	409,200	$26.5	$59.4
Research, testing and medical labs	526,300	$40.3	$64.5
Total Biomedical	1,219,200	$95.9	$213.2

Sources: Bureau of Labor Statistics, Moody's Analytics, Milken Institute.

Four largest European countries comprised more than half of all NCEs produced during 1970s….

MILKEN INSTITUTE

NCEs =New chemical entities by headquarter country of inventing firm

	1971-1980	
Country	**NCEs**	**% total**
U.S.	157	31
France	98	19
Germany	96	20
Japan	75	15
Switzerland	53	10
U.K.	29	6
Total NCEs	508	

Sources: Arthur Daemmrich, "Where Is the Pharmacy to the World? International Variation and Pharmaceutical Industry Location," Harvard Business School Working Paper, 2009; Milken Institute.

….but in the previous decade, the U.S. Share jumped to 57 percent

MILKEN INSTITUTE

NCEs =New chemical entities by headquarter country of inventing firm

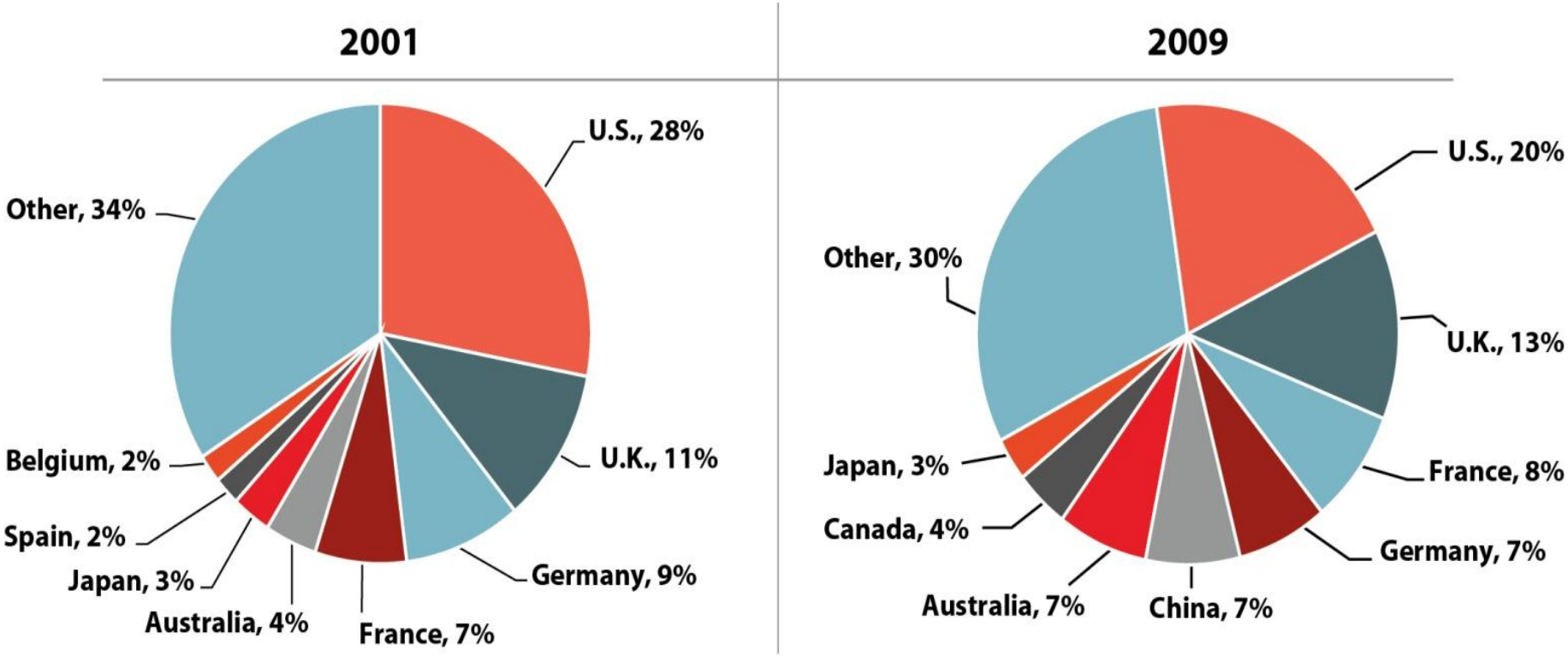
	2001-2010	
Country	**NCEs**	**% total**
U.S.	111	57
France	11	6
Germany	12	6
Japan	18	9
Switzerland	26	13
U.K.	16	8
Total NCEs	194	

Sources: Arthur Daemmrich, "Where Is the Pharmacy to the World? International Variation and Pharmaceutical Industry Location," Harvard Business School Working Paper, 2009; Milken Institute.

U.S. share of foreign students declining

Global destinations for international students at the post secondary level

MILKEN INSTITUTE



Sources: OECD; Atlas of Student Mobility, Institute of International Education.

Singapore: Innovation as a national priority

MILKEN INSTITUTE

Recommendations on how U.S can retain and bolster its biomedical innovation leadership

MILKEN INSTITUTE

- Increase R&D tax incentives and make them permanent
- Cut corporate tax rates to match the OECD average
- Extend support for emerging biomedical research fields
- Provide adequate resources for the FDA and the NIH to expedite regulatory reviews and clinical trials
- Leverage existing strengths in medical devices
- Build human capital for biomedical innovation
- Promote and expand role of universities by adopting best practices in tech transfer and commercialization

Margaret Anderson

Executive Director

IT TAKES TOO LONG.

DISEASE WON'T WAIT.

TIME=LIVES

1 OF EVERY 10,000

SCIENTIFIC DISCOVERIES MAKE IT TO MARKET.

80-90%

OF DRUG DEVELOPMENT PROJECTS FAIL BEFORE THEY GET TESTED IN HUMANS.

15 YEARS

THAT'S HOW LONG IT TAKES TO TURN A SCIENTIFIC DISCOVERY INTO A NEW MEDICAL SOLUTION THAT COULD IMPROVE AND SAVE LIVES.

We Can't Wait 15 Years.

15 YEARS

$1 BILLION

1 IN 3

AMERICANS

NO TIME TO WASTE

1 IN 3 AMERICANS

LIVES WITH A DEADLY OR DEBILITATING DISEASE FOR WHICH THERE ARE NO CURES, AND

Few Meaningful Treatment Options.

Every...

68 SECONDS

SOMEONE DEVELOPS ALZHEIMER'S DISEASE.

24 SECONDS

SOMEONE IS DIAGNOSED WITH CANCER.

18 SECONDS

SOMEONE IS DIAGNOSED WITH DIABETES.

And, the List Goes On...

IT COSTS TOO MUCH.

$100 BILLION

PER YEAR SPENT ON R&D.

And Yet, Only 35 New Drugs Approved in 2011.

ONLY 5¢

OF EVERY U.S. HEALTH DOLLAR GOES TO MEDICAL RESEARCH.

>$1 BILLION

TO BRING ONE NEW THERAPY FROM LAB TO MARKET.

IT'S ABOUT SAVING LIVES.

WE ALL KNOW SOMEONE

WHO COULD USE A

Faster Cure.

TO SAVE LIVES, WE NEED TO

SAVE TIME.

timeequalslives.org

Q&A slides

NIH funding increasingly goes to older researchers.

In 1980, nearly 10% of all NIH grants went to "young researchers" - between age 31 and 33.

In 2006, young researchers accounted for 1%.

In 2007, more grants were given to 70-year-old researchers than those under age 30.

Source: The Wall Street Journal 2/20/10

Job "Opportunities" in the Sciences

- Since 2000, U.S. drug firms have slashed 300,000 jobs.
- 14% of biology and life-science PhDs land a coveted academic position within five years
- Unemployment among chemists is 4.6% - the highest in 40 years.
- 38 percent of new PhD chemists were employed in 2011.
- $10 billion in federal stimulus funds to the NIH in 2009 "created or retained" 50,000 science jobs – many of which are now at risk.

Source: Dr. Everett Ehrlich, United for Medical Research (NIH's Role in Sustaining the U.S. Economy)

The NIH Grant-Funding Process

- Only 25% percent of NIH grantees are "young investigators," down from 29% in 1990.
- The average age of a first-time NIH-funded researcher has jumped from 39 years to 43 years since 1990.
- Only 18% of first-time applicants receive awards (2007).

Source: Dr. Everett Ehrlich, United for Medical Research (NIH's Role in Sustaining the U.S. Economy)

- The Chinese Academy of Sciences approved the applications of 477 senior foreign scientists and 179 young fellows to come to China for research collaboration (2010 and 2011).
- China's goal is to raise the proportion of research input to above 2.5% of GDP by 2020.

Source: China Daily 6/10/11

- The number of peer-reviewed papers published by Chinese researchers rose 64-fold over the past 30 years.
- China is second to the US in terms of academic papers published, and will take first place by 2020.

Source: The Telegraph 1/25/10