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NIH Council of Councils
January 22, 2013



Behavioral and Social
Sciences Research at
NIH: Advancing Science,
Redesigning Care,
Reforming Education



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NATIONAL INSTITUTES OF HEALTH



My Personal Journey

Traditional

- Life Expectancy
- Infant Mortality
- Disability Days



Alive 1.0

Dead 0.0

Problem with Survival Analysis

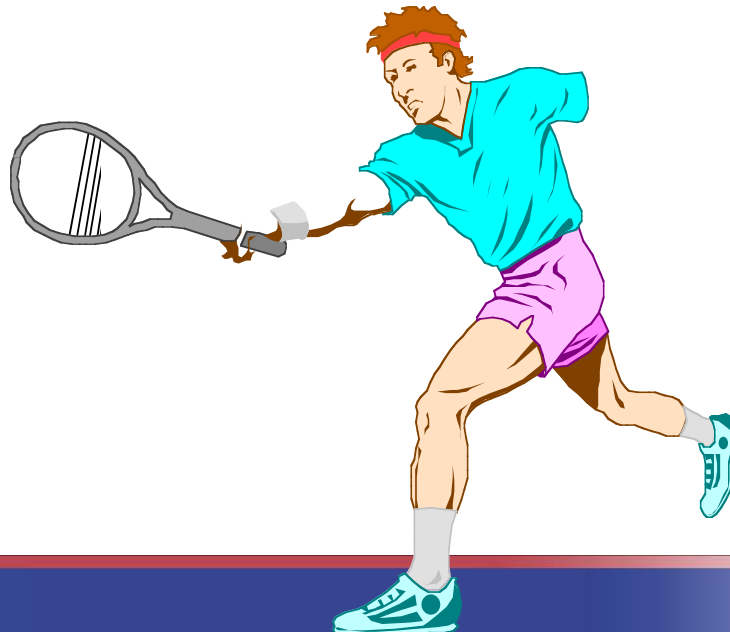


Tennis player

1.0

Man in coma

1.0



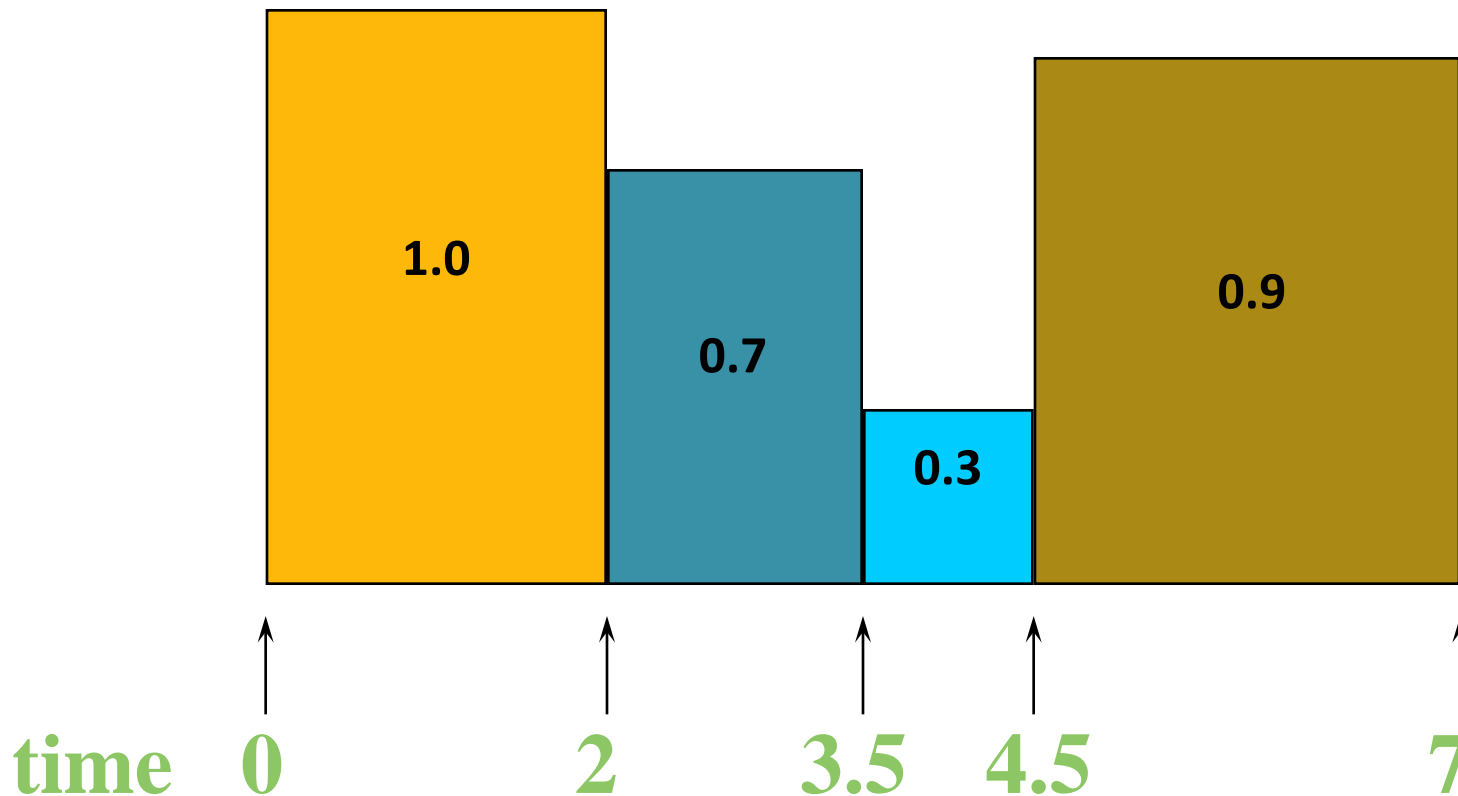


Purpose of Quality Adjusted Survival Analysis

To summarize life expectancy with adjustments for quality of life



The concept of a Quality-Adjusted Life Year (QALY)

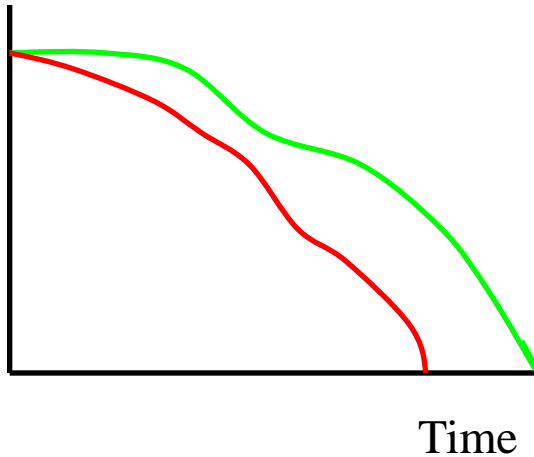


$$\text{QALYs} = 2 \times 1 + 1.5 \times 0.7 + 1 \times 0.3 + 2.5 \times 0.9 = 5.6$$



Using QALYs to measure the impact of a treatment

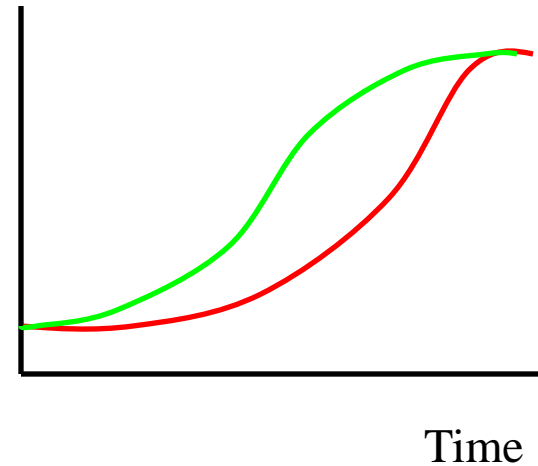
Quality
of Life



Without treatment: —

With treatment: —

Cost



From Peter Neumann, Tufts Medical Center



1972



Our Primary Goal: Improve Quality-Adjusted Life

Overall Goals of DHHS Healthy People 2000, 2010, 2020

- #1 Overall Objective for Healthy People 2000
 - To increase the span of healthy life (quality-adjusted life expectancy)
- #1 Overall Objective for Healthy People 2010
 - Increase the quality and years of life
- Healthy People 2020:
4 overall goals, including
 - Promote quality of life, healthy development, and healthy behaviors across all life stages



NIH: Steward of Medical and Behavioral Research for the Nation

“Science in pursuit of fundamental knowledge about the nature and behavior of living systems and the application of that knowledge to extend healthy life and reduce the burdens of illness and disability.”





Some New Directions for OBSSR

- Planning for the next generation of behavioral and social sciences research
 - The next generation of measurement and data
 - Delivering services in a reforming health care system
 - Training the next generation of research investigators



Theme 1: The Next Generation of Data and Analysis Methods

- mHealth
- Electronic Health Records
- Systems science
- Masses of data
- Data Visualization
- New methods for analysis





Exposomics

(from Kevin Patrick, UCSD)

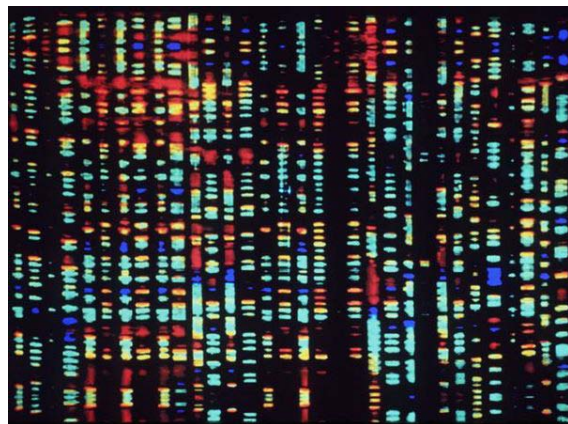
“At it's most complete, the exposome encompasses life-course environmental exposures (including lifestyle factors), from the prenatal period onwards...”

-- Christopher Paul Wild

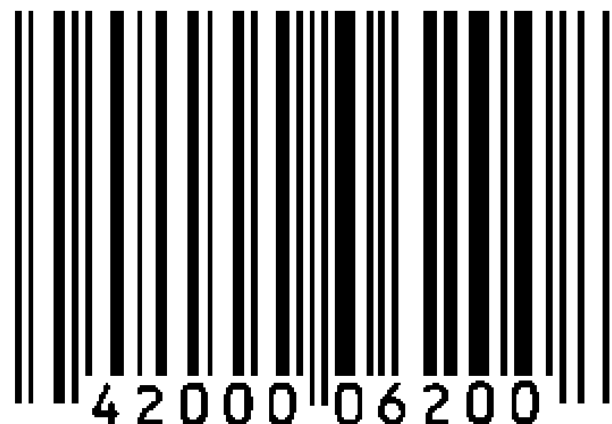




(from Kevin Patrick, UCSD)



Genome



Exposome

Together these lead to whether disease occurs or health is promoted...



Billions of mobile devices
+ Billions of sensors
+ Billions using social networks

=

Unprecedented opportunities for population-level sensing

twitter





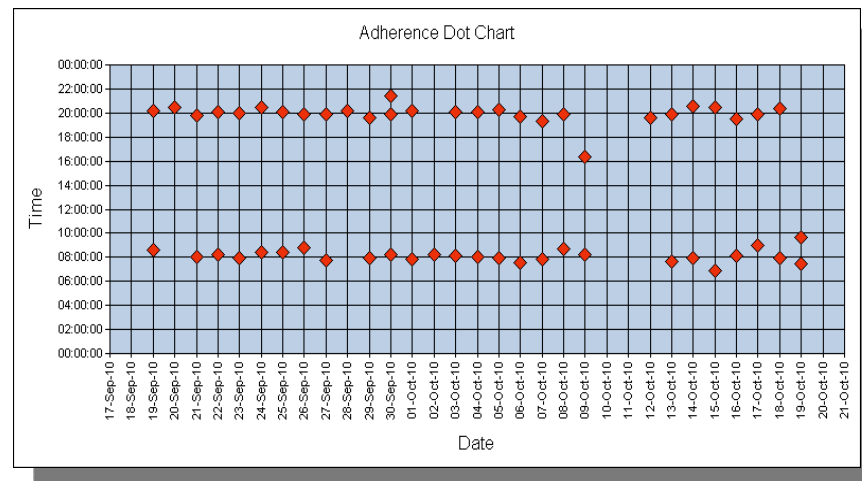
Improving Dietary Assessment Methods Using the Cell Phone and Digital Imaging

PI: Carol Boushey, Purdue University

- Uses a mobile phone as a food record
- Image processing to identify food in real time
 - Supplement with search list
 - Calculates volume to estimate portion size
- Calculates nutrient and food intake

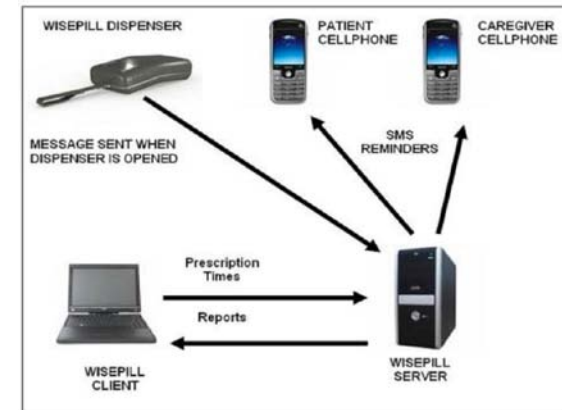


Adherence Monitoring (Uganda)



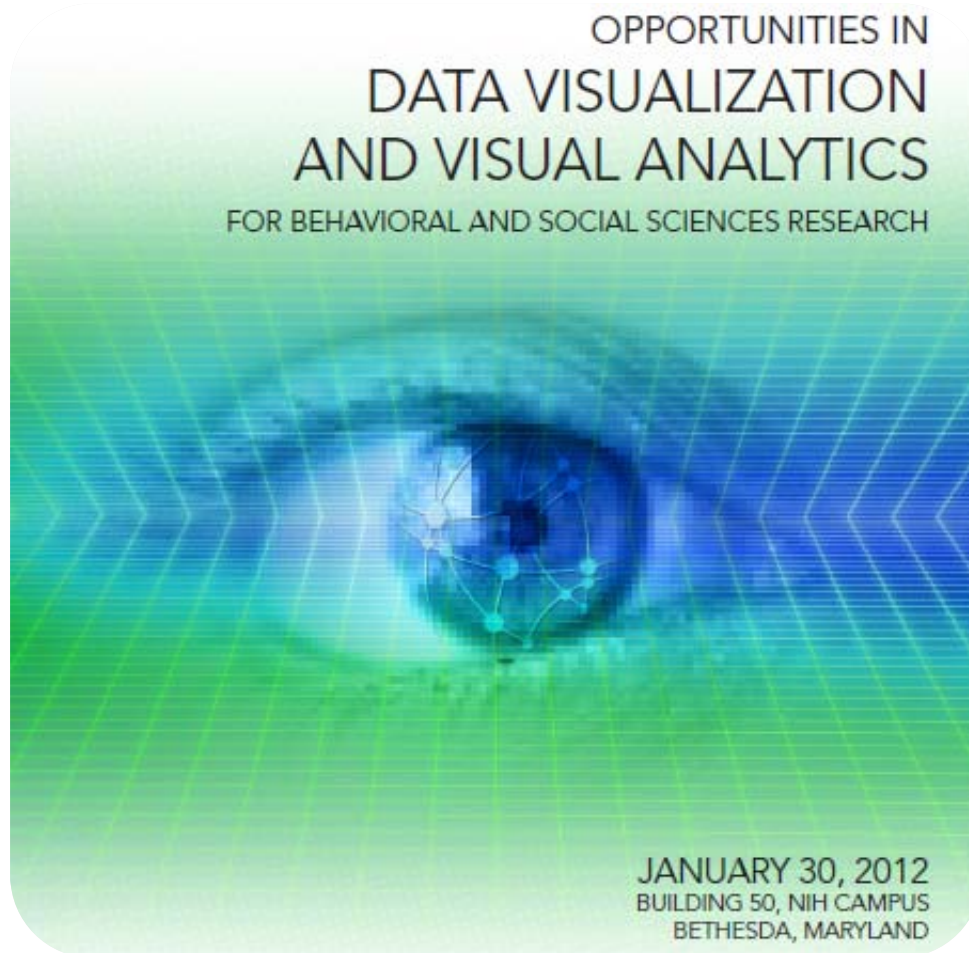
Problem: Adherence to chronic disease medications is poor. In resource-poor settings, getting people medication is only part of the solution

Solution: Wireless medication canisters that signal medication timing, transmit adherence data and allow resources to target the non-compliant





Theme 4: New Ideas



Exploring the Potential
of Visualization for BSSR
at NIH

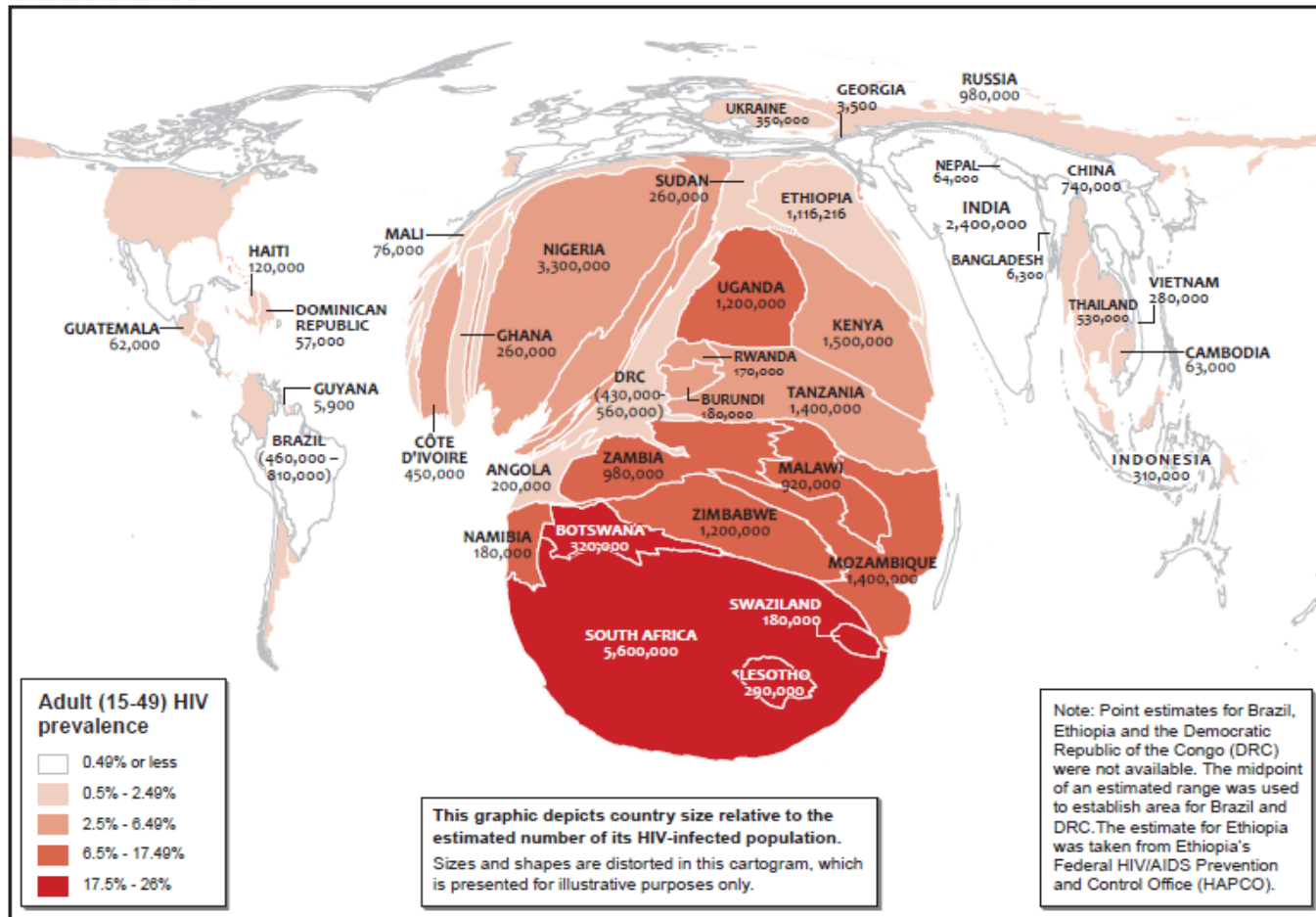


BETHESDA, MARYLAND
BUILDING 50, NIH CAMPUS
JANUARY 30, 2012





HIV Prevalence and Estimated Number of Adults and Children Infected with HIV, 2009



UNCLASSIFIED

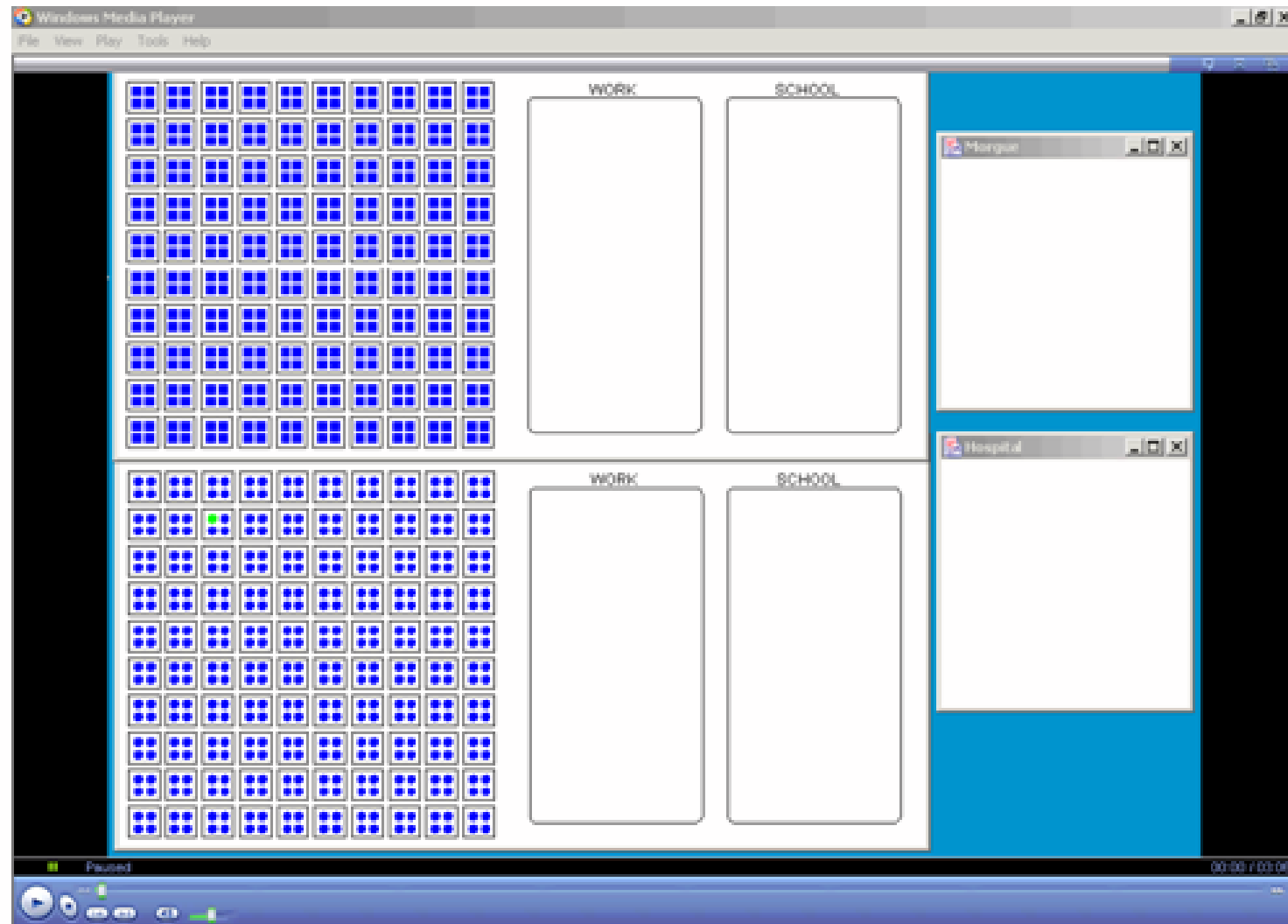
Sources: UNAIDS Report on the Global AIDS Epidemic - 2010; Ethiopia HAPCO, Report on progress towards implementation of the UN Declaration of Commitment on HIV/AIDS, March 2010.

November 10, 2011 U461 STATE (HIU)

Courtesy of Nate Heard, U.S. Department of State

Agent-Based Model of Small Pox Epidemic

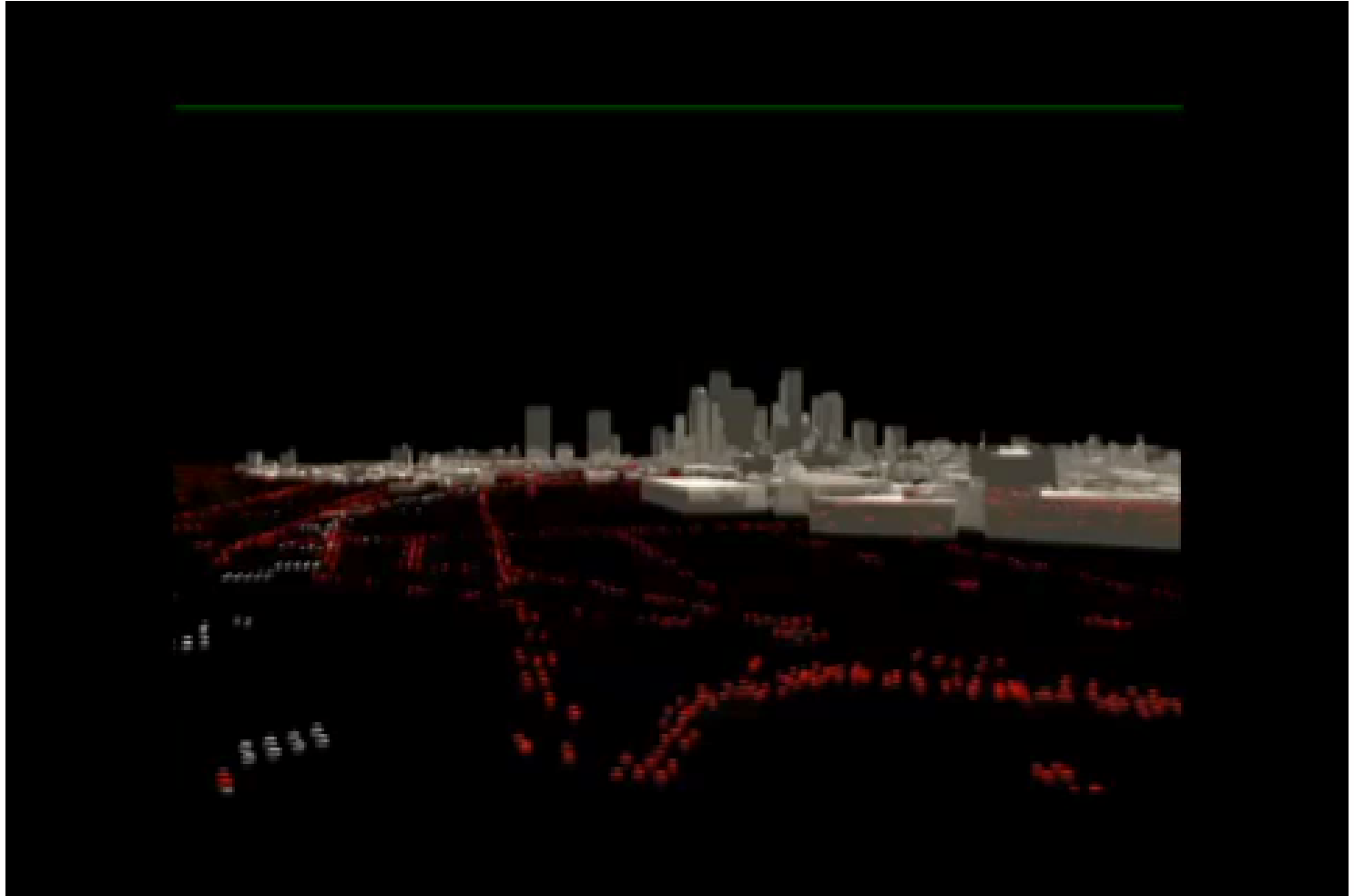
Courtesy of Josh Epstein, Johns Hopkins University



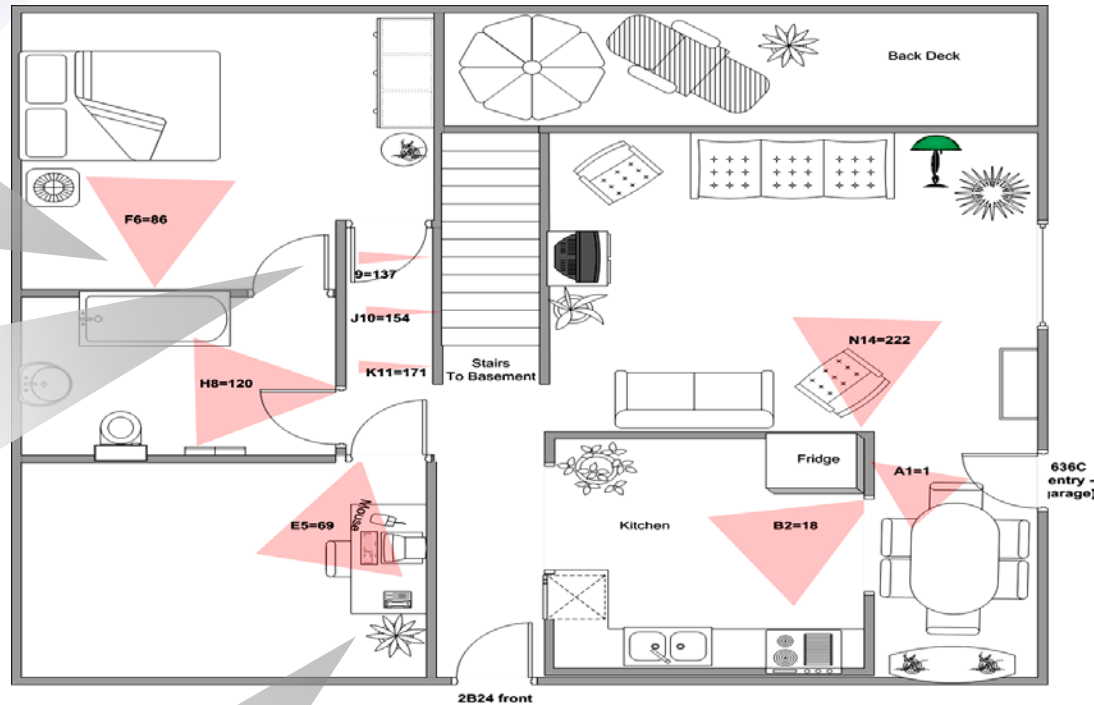
The Power of Systems Science – Patty Mabry

Los Angeles model airborne toxic pollution dynamics are modeled by Computational Fluid Dynamics (CFD) and visualized in a 3D

Courtesy of
Josh
Epstein
Johns
Hopkins
University



Home health based on unobtrusive, continuous monitoring

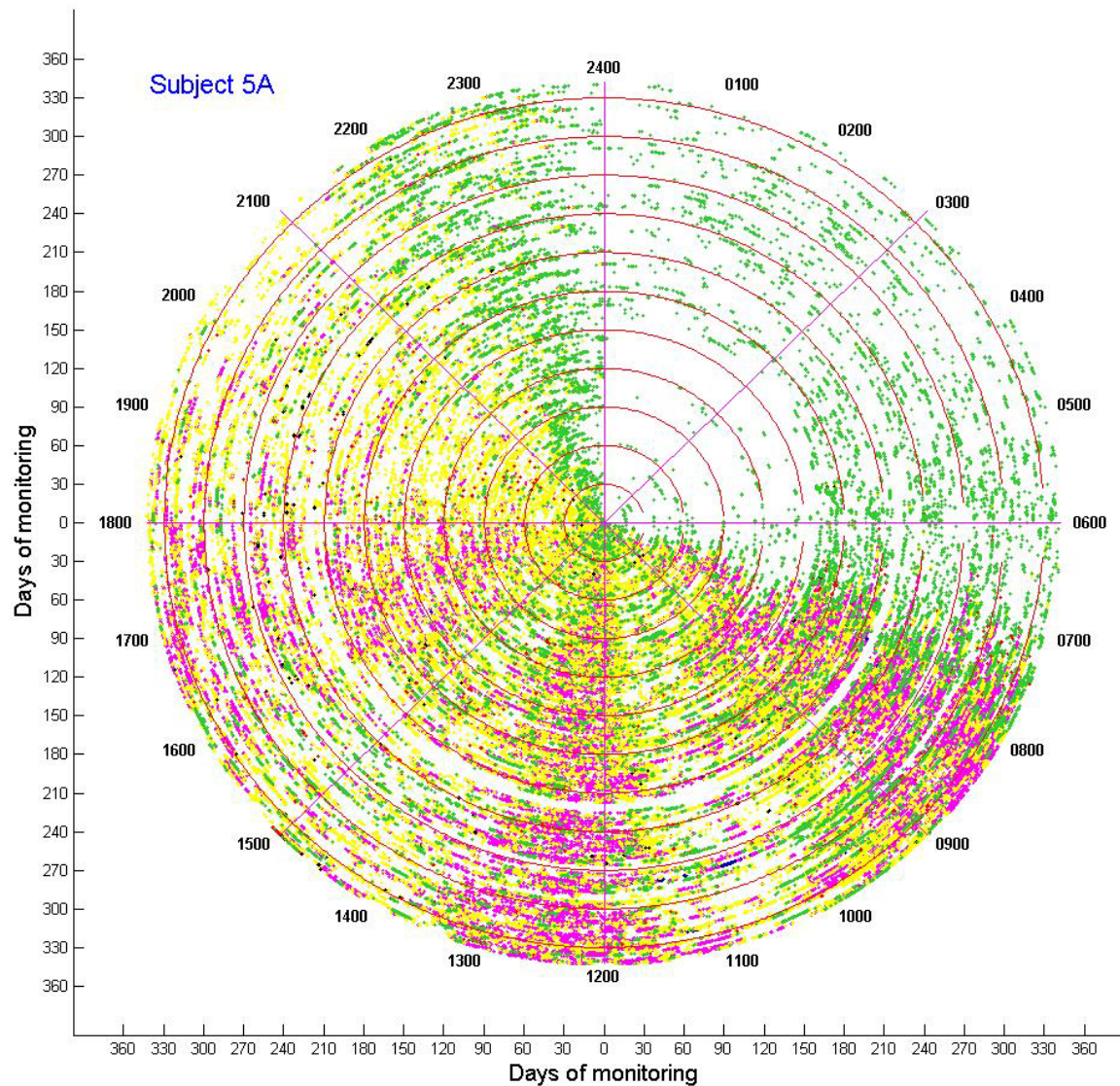


Behavioral
Markers =
Continuous
Monitoring +
Computational
Models
From
Holly Jimison
OBSSR & OHSU





Activity Monitoring in the Home (Holly Jimison)



Sensor Events Private Home

- Bedroom
- Bathroom
- Living Rm
- Front Door
- Kitchen

From Holly Jimison
OBSSR & OHSU

- Harmonization of Data
 - PROMIS
 - Toolbox
 - EHR
- New Approaches to Data Collection
 - mHealth
- New Approaches to Data Analysis
 - Visualization
 - Big Data- Data Mining



Theme 2

Understanding the Determinants of Population Health

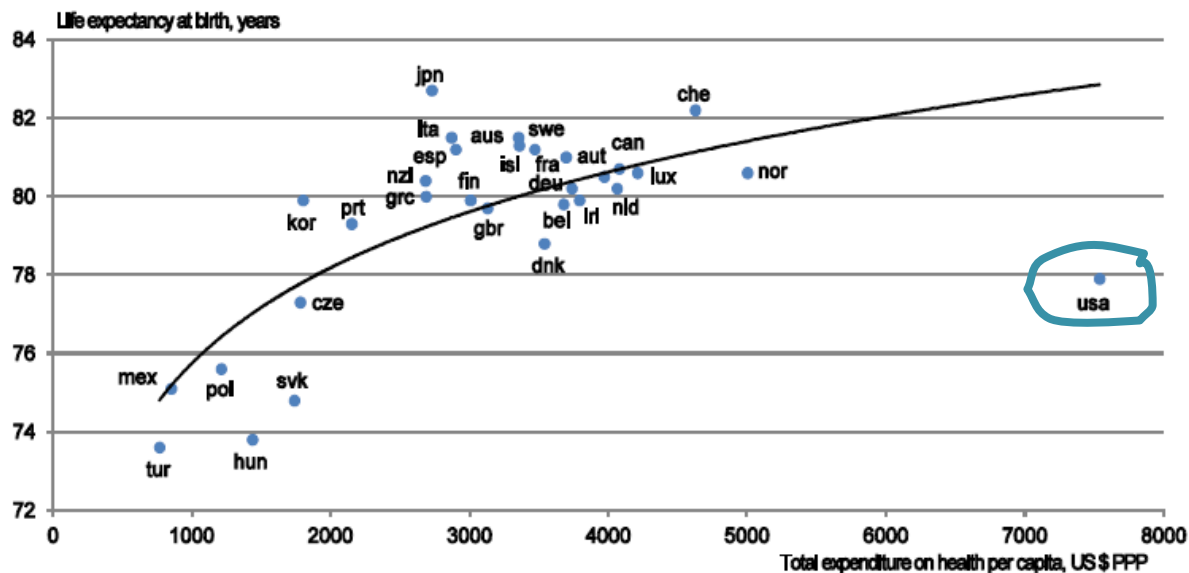


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The health of the nation: poor value for money

Figure 1. There are large differences in life expectancy and health care spending across OECD countries 2008¹



1. Or latest year available.

Source: OECD Health Data 2010.



Disease and Disadvantage in the United States and in England

James Banks, PhD

Michael Marmot, MD

Zoe Oldfield, MSc

James P. Smith, PhD

THE UNITED STATES HAS A CONSIDERABLY greater expenditure on medical care (US \$5274 per capita) than in the United Kingdom (US \$2164 adjusting for purchasing power).¹ To determine whether that expenditure translates into better health outcomes for the adult US population, data on the degree of morbidity in each country beyond the childhood years are needed.

Given the strong link between socioeconomic position and health in both countries, cross-country comparisons of morbidity should examine variation of morbidity according to comparable measures of socioeconomic position. Cross-country comparison of social differences in illness provides some insight into potential causal explanations. Access to health care is a particular case in point. Although publicly funded health care is available in both countries to citizens older than 65 years, the UK National Health Service has no age criterion for eligibility. Thus, British households are more isolated from any financial impacts of out-of-pocket medical expenses. A similar argument applies to earnings and job losses, for which the more generous UK income maintenance system should mitigate any effects of health changes on income and wealth there compared with what is available in the United States.

We compare measures of morbidity according to 2 salient measures of so-

Context The United States spends considerably more money on health care than the United Kingdom, but whether that translates to better health outcomes is unknown.

Objective To assess the relative health status of older individuals in England and the United States, especially how their health status varies by important indicators of socioeconomic position.

Design, Setting, and Participants We analyzed representative samples of residents aged 55 to 64 years from both countries using 2002 data from the US Health and Retirement Survey (n=4386) and the English Longitudinal Study of Aging (n=3681), which were designed to have directly comparable measures of health, income, and education. This analysis is supplemented by samples of those aged 40 to 70 years from the 1999-2002 waves of National Health and Nutrition Examination Survey (n=2097) and the 2003 wave of the Health Survey for England (n=5526). These surveys contain extensive and comparable biological disease markers on respondents, which are used to determine whether differential propensities to report illness can explain these health differences. To ensure that health differences are not solely due to health issues in the black or Latino populations in the United States, the analysis is limited to non-Hispanic whites in both countries.

Main Outcome Measure Self-reported prevalence rates of several chronic diseases related to diabetes and heart disease, adjusted for age and health behavior risk factors, were compared between the 2 countries and across education and income classes within each country.

Results The US population in late middle age is less healthy than the equivalent British population for diabetes, hypertension, heart disease, myocardial infarction, stroke, lung disease, and cancer. Within each country, there exists a pronounced negative socioeconomic status (SES) gradient with self-reported disease so that health disparities are largest at the bottom of the education or income variants of the SES hierarchy. This conclusion is generally robust to control for a standard set of behavioral risk factors, including smoking, overweight, obesity, and alcohol drinking, which explain very little of these health differences. These differences between countries or across SES groups within each country are not due to biases in self-reported disease because biological markers of disease exhibit exactly the same patterns. To illustrate, among those aged 55 to 64 years, diabetes prevalence is twice as high in the United States and only one fifth of this difference can be explained by a common set of risk factors. Similarly, among middle-aged adults, mean levels of C-reactive protein are 20% higher in the United States compared with England and mean high-density lipoprotein cholesterol levels are 14% lower. These differences are not solely driven by the bottom of the SES distribution. In many diseases, the top of the SES distribution is less healthy in the United States as well.

Conclusion Based on self-reported illnesses and biological markers of disease, US residents are much less healthy than their English counterparts and these differences exist at all points of the SES distribution.

JAMA. 2006;295:2037-2045

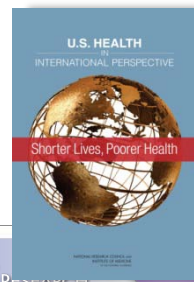
www.jama.com

cioeconomic status (SES)—education and household income—in nationally representative samples in the United States and England. One common prob-

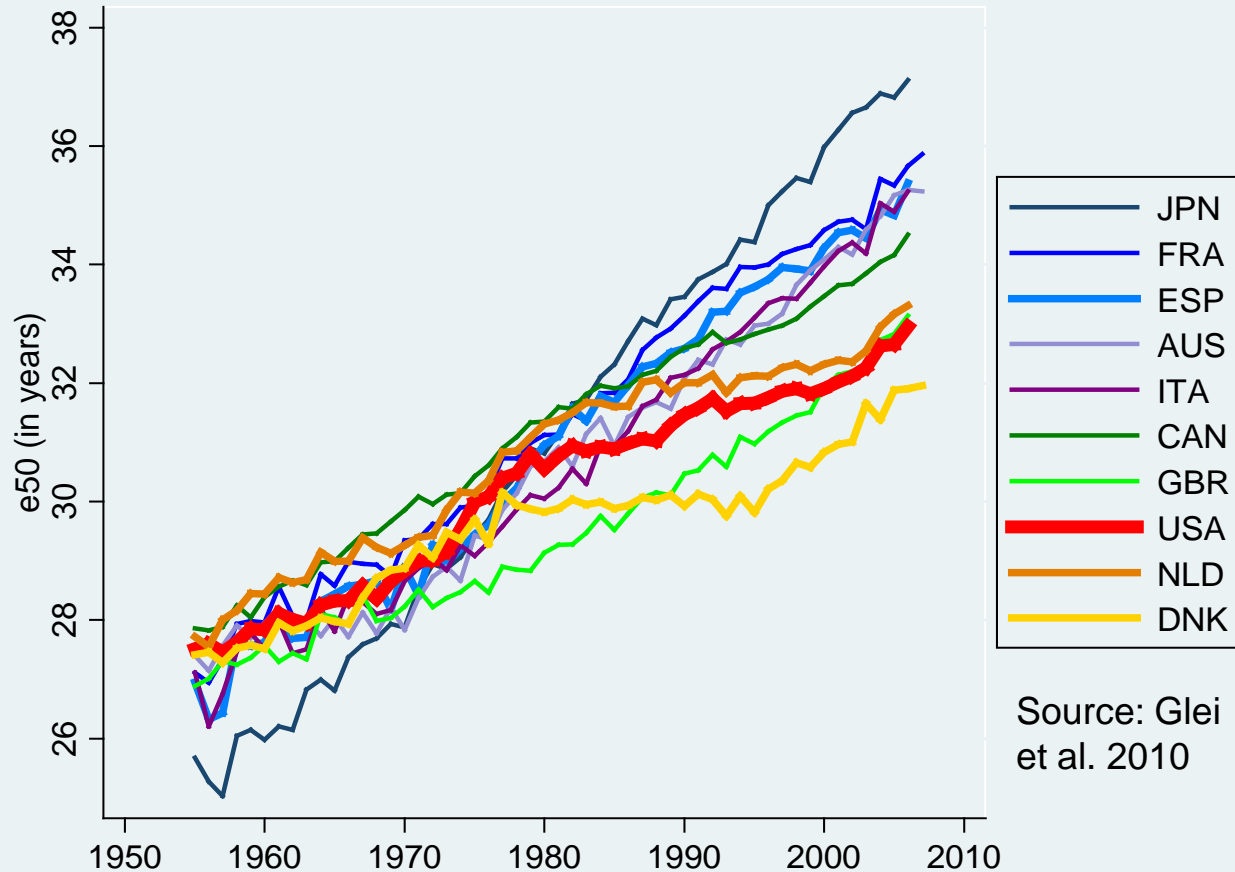
Author Affiliations are listed at the end of this article.
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(Reprinted) JAMA, May 3, 2006—Vol 295, No. 17 2037



Trends in e_{50} , Females



Source: Glei
et al. 2010

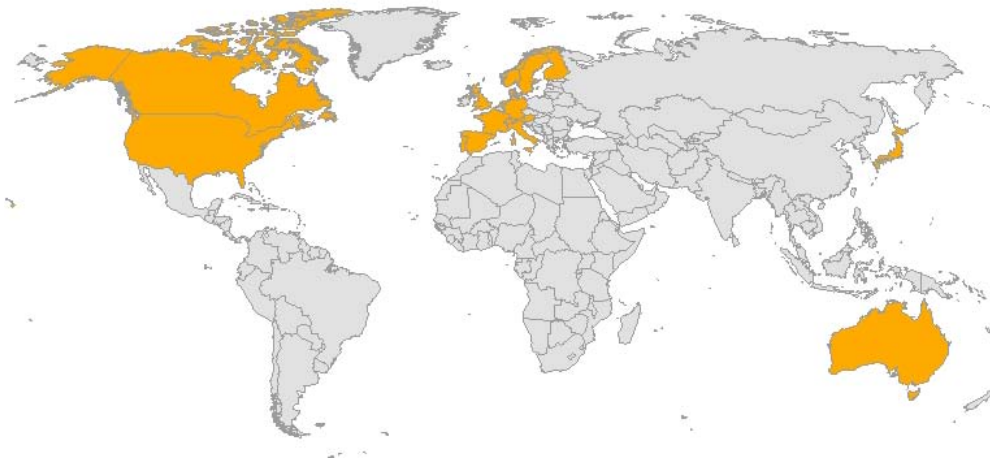
Population
Health
Mike Spittel

Source: Chapter 2, Diverging Trends in Life Expectancy at Age 50: A Look at Causes of Death, D. Glei, F. Mesle, J. Vallin

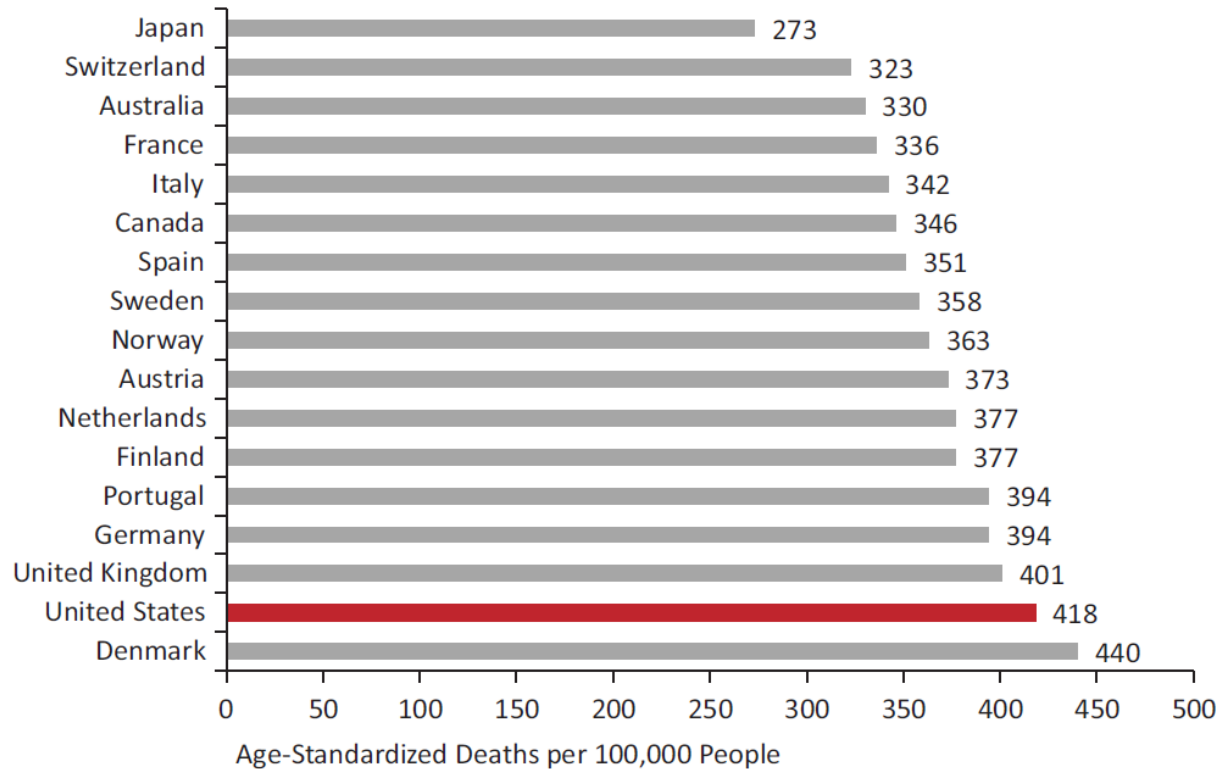
17 Peer Comparison Countries



- Australia
- Austria
- Canada
- Denmark
- Finland
- France
- Germany
- Italy
- Japan
- Norway
- Portugal
- Spain
- Sweden
- Switzerland
- The Netherlands
- United Kingdom
- United States



Mortality from Non-Communicable Diseases (NCD), 2008



Among the 17 peer countries, the US had 2nd highest NCD mortality rate in 2008 (418:100,000)

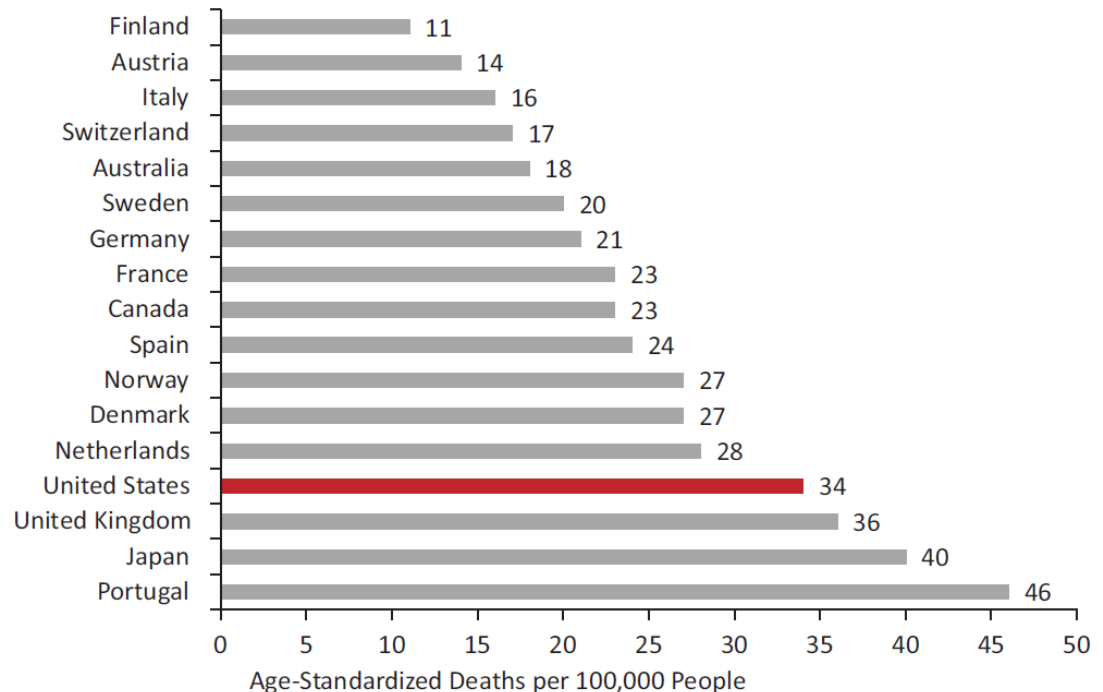


Mortality from Communicable (Infectious) Diseases, 2008



Among the 17 peer countries:

- US had 4th highest infectious disease mortality rate in 2008 (34:100,000)
- US had the highest incidence of AIDS (3rd highest in OECD, exceeded only by Brazil and South Africa).
- AIDS incidence in the US (122 per million) was almost 9 times the OECD average (14 per million).

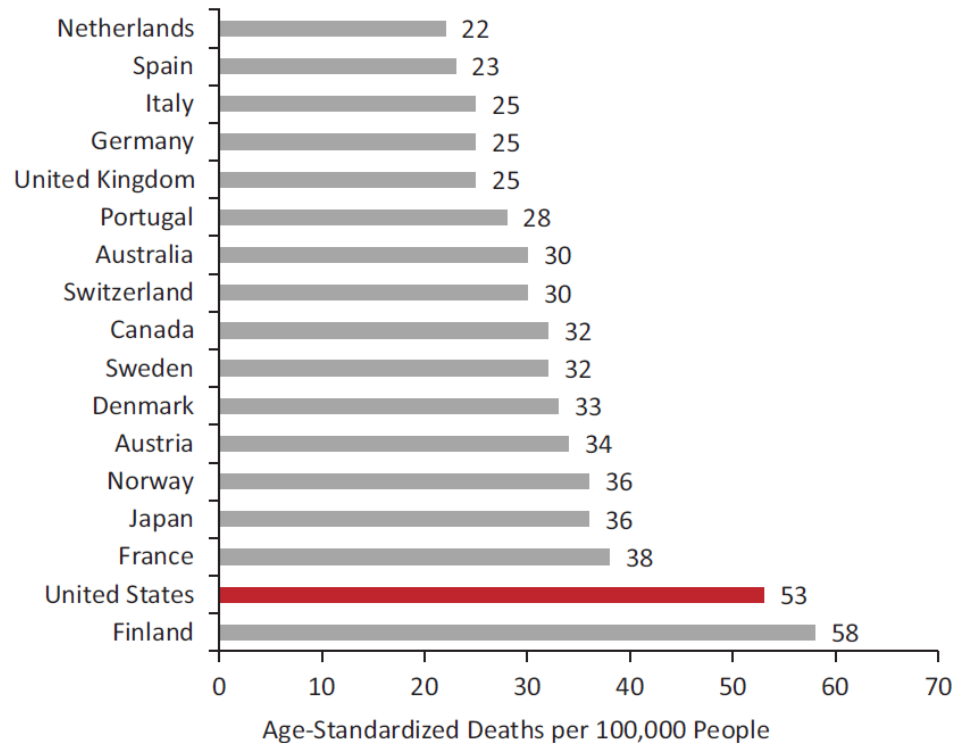




Mortality from Injuries

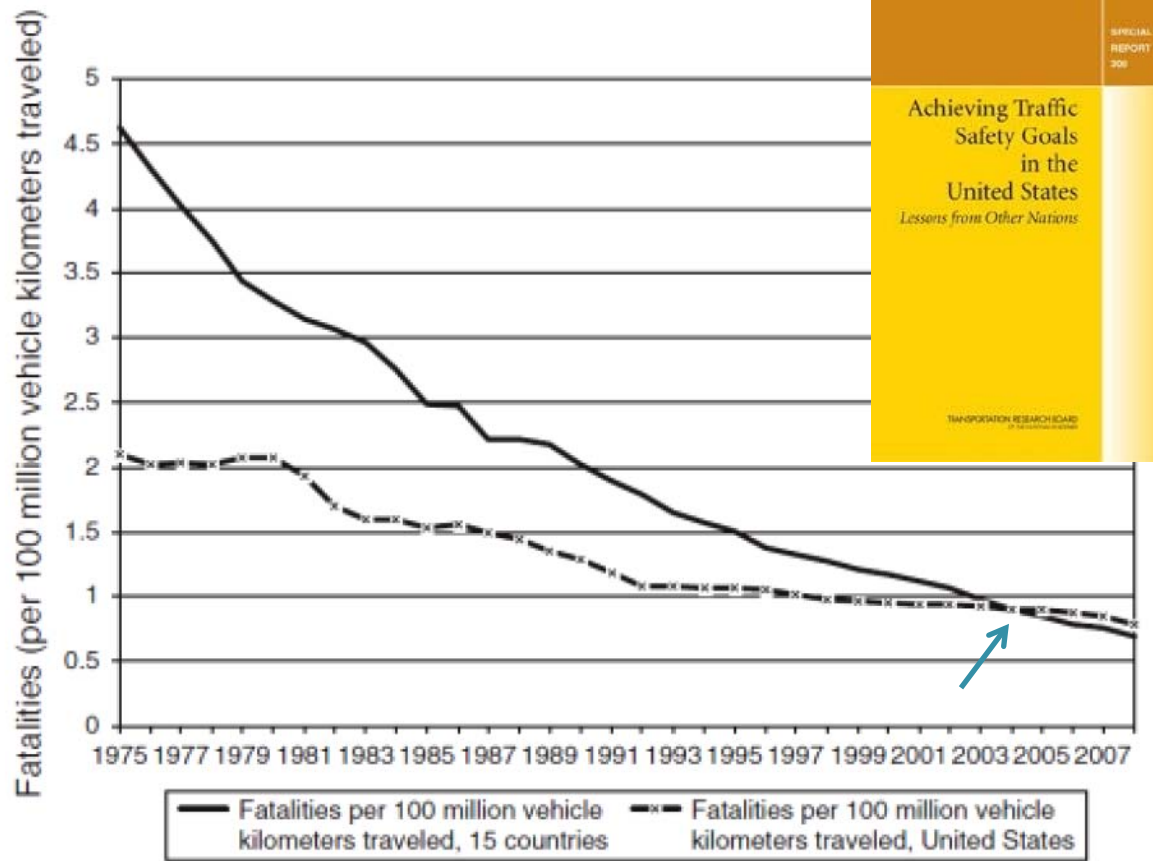


- Among the 17 peer countries, the US had the 2nd highest injury mortality rate in 2008 (53:100,000).
- US had the highest death rate from transport accidents in 2009 (3rd highest in OECD, behind Mexico and the Russian Federation).





Mortality from Transport Accidents



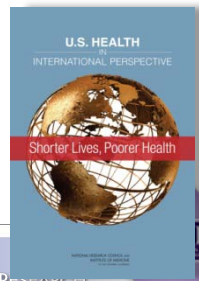
Among the 17 peer countries, mortality from transport accidents decreased by 42% in the OECD between 1995 and 2009, but by only 11% in the US (OECD, 2011).





Mortality from Violent Injuries

- In 2007, 69% of US homicides (73% of homicides before age 50) involved firearms, compared with 26% in peer countries.
- A 2003 study found that the US homicide rate was 7 times higher (the rate of firearm homicides was 20 times higher) than in 22 OECD countries.
- Although US suicide rates were lower than in those countries, firearm suicide rates were 6 times higher.



Life Expectancy at Birth, 2007



Males			Females		
Country	LE	Rank	Country	LE	Rank
Switzerland	79.33	1	Japan	85.98	1
Australia	79.27	2	France	84.43	2
Japan	79.20	3	Switzerland	84.09	3
Sweden	78.92	4	Italy	84.09	3
Italy	78.82	5	Spain	84.03	5
Canada	78.35	6	Australia	83.78	6
Norway	78.25	7	Canada	82.95	7
Netherlands	78.01	8	Sweden	82.95	7
Spain	77.62	9	Austria	82.86	9
United Kingdom	77.43	10	Finland	82.86	9
France	77.41	11	Norway	82.68	11
Austria	77.33	12	Germany	82.44	12
Germany	77.11	13	Netherlands	82.31	13
Denmark	76.13	14	Portugal	82.19	14
Portugal	75.87	15	United Kingdom	81.68	15
Finland	75.86	16	United States	80.78	16
United States	75.64	17	Denmark	80.53	17

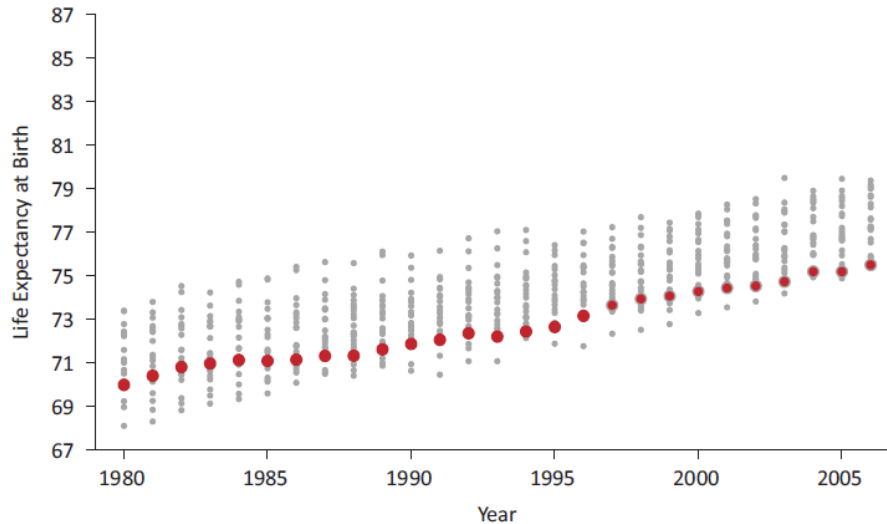
- US life expectancy ranked last among males (75.6 years) and next to last among females (80.8 years)
- Difference from top-performing country = 3.7 (males), 5.2 years (females)



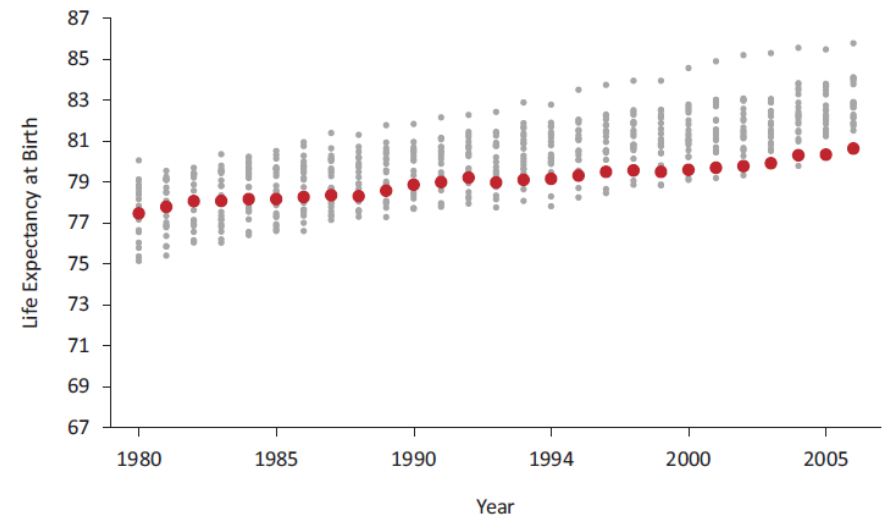


Life Expectancy at Birth in 21 High-Income Countries, 1980-2006

Males



Females



Explaining Divergent Levels of Longevity in High-Income Countries

The problem is longstanding and worsening.

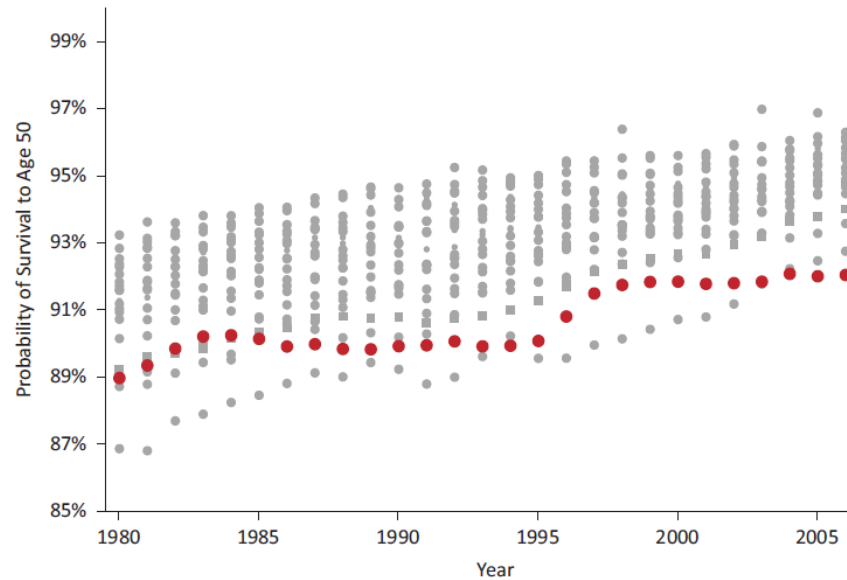
In 1980, US life expectancy among females was about average, and was near the bottom for males, but by 2006 US life expectancy for both sexes had fallen to the bottom ranks.



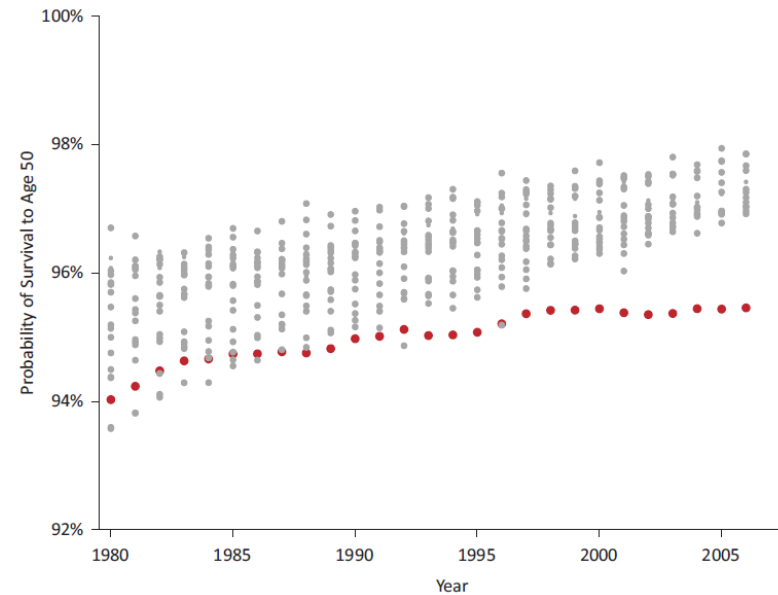
Probability of Survival to Age 50 in 21 High-Income Countries, 1980-2006



Males



Females



Explaining Divergent
Levels of Longevity
in High-Income
Countries

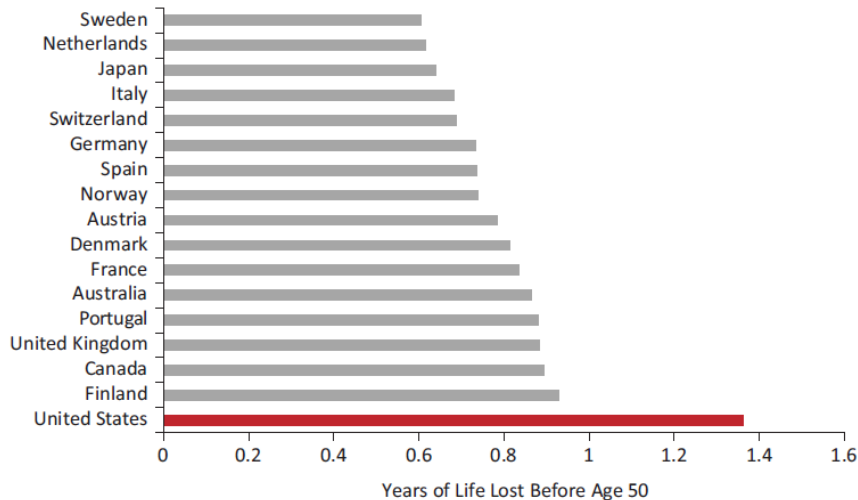
For decades, American youth have been less likely to survive to age 50 than people in other rich nations.



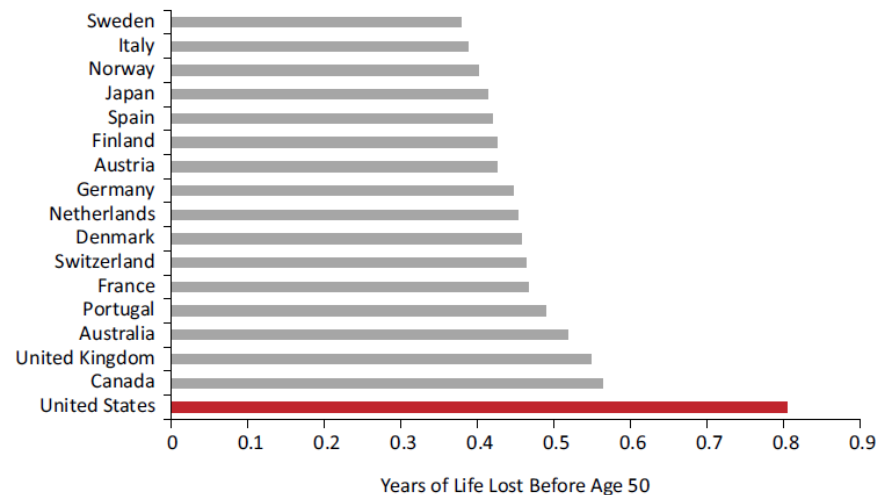


Years of Life Lost Before Age 50, 2006-2008

Males



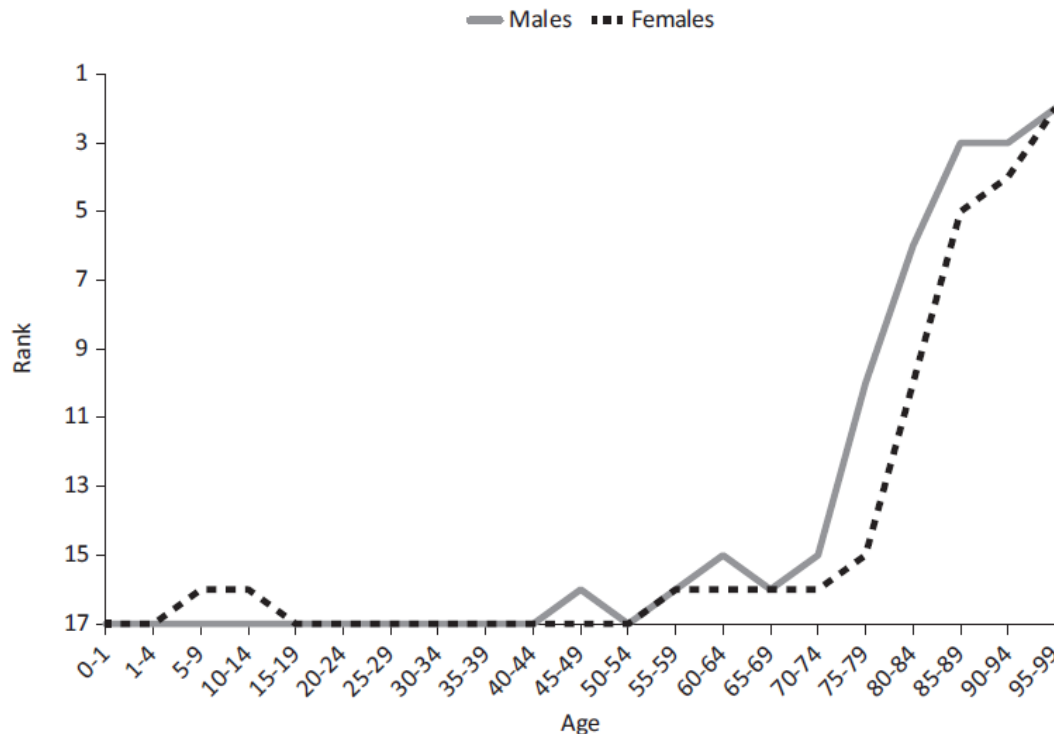
Females



- US male and female newborns can expect to lose about 1.4 years and 0.8 years of life, respectively, before age 50.
- The US losses before age 50 are double those of Sweden, the best performing country.



Ranking of US Mortality Rates by Age Group in 17 Peer Countries, 2006-2008



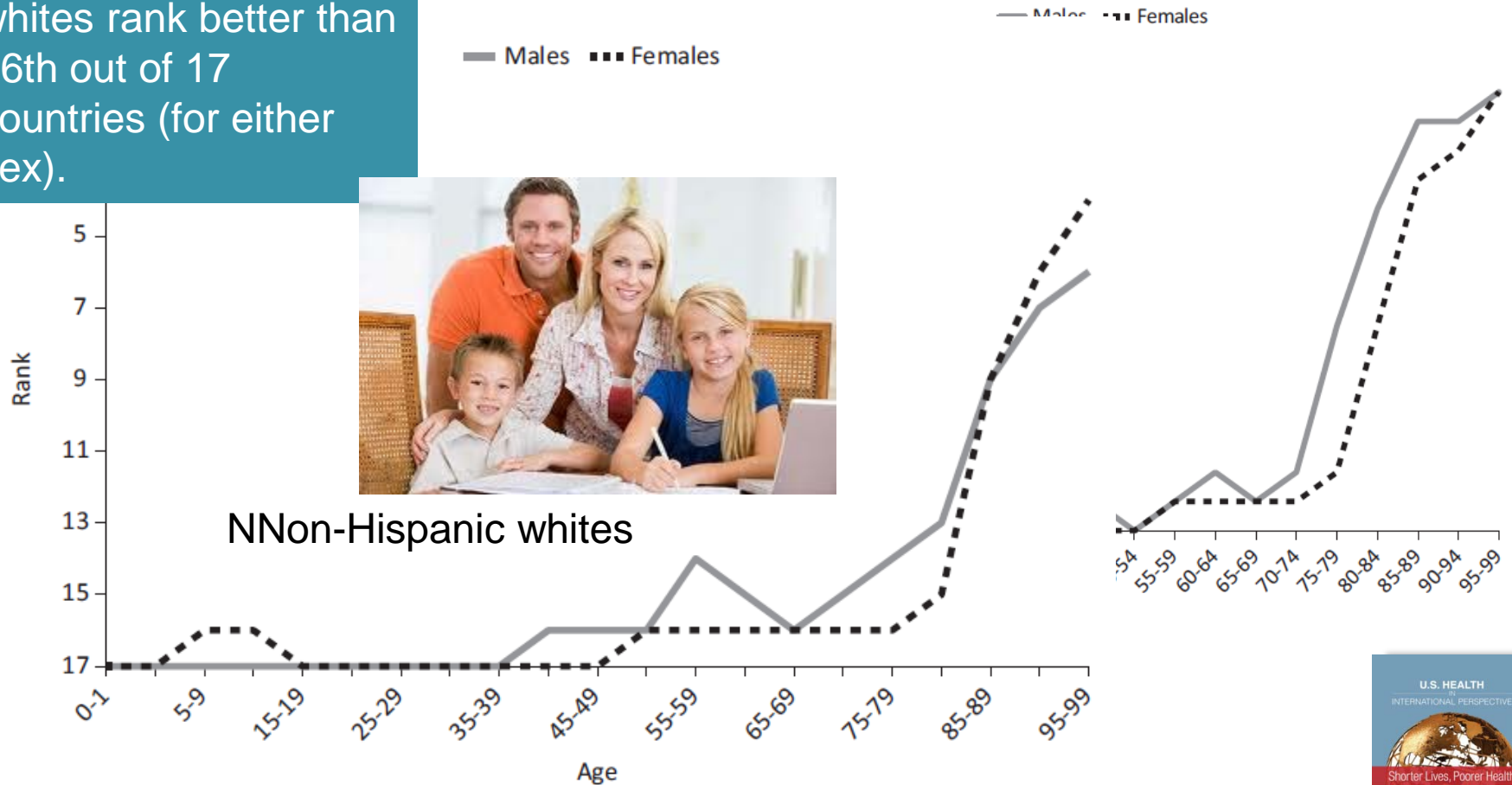
- US life expectancy is low at every age.
- In either sex, the US rank is never better than 15th out of 17 until age 75.



Ranking of Mortality of non-Hispanic Whites by Age Group in 17 Peer Countries, 2006-2008



At no age below 55 do US non-Hispanic whites rank better than 16th out of 17 countries (for either sex).



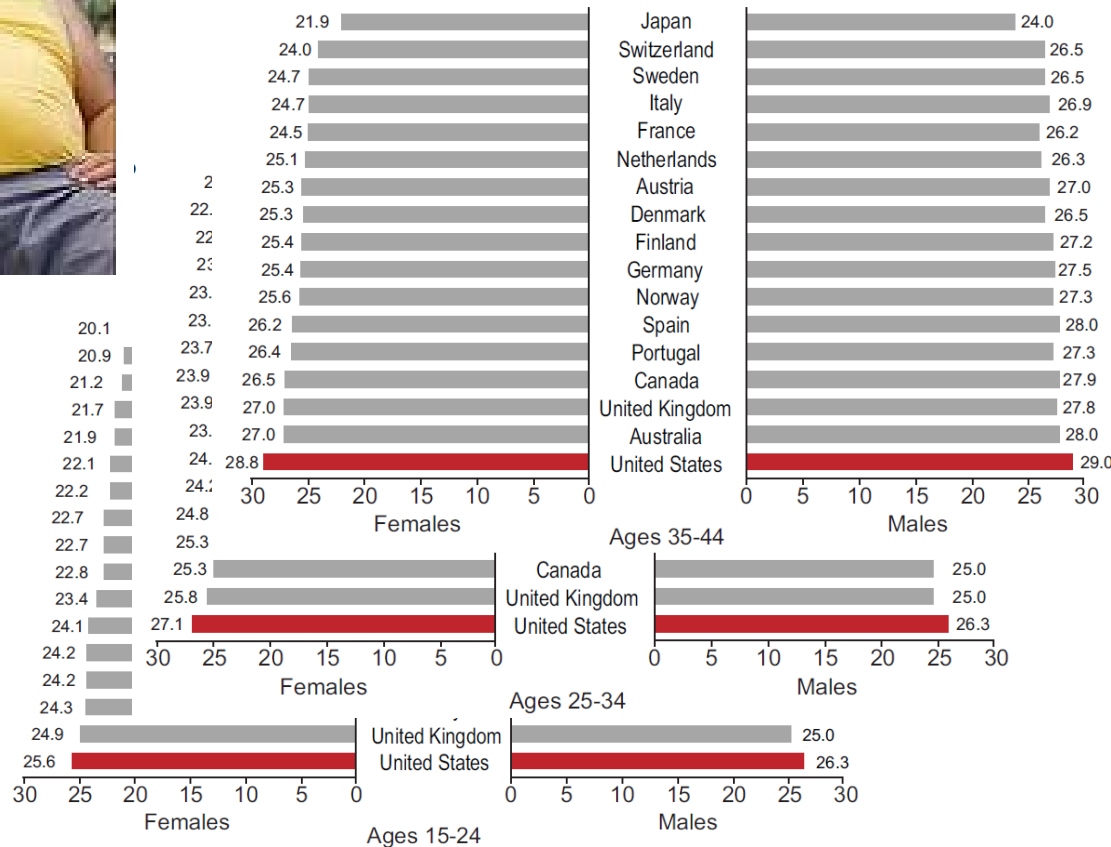
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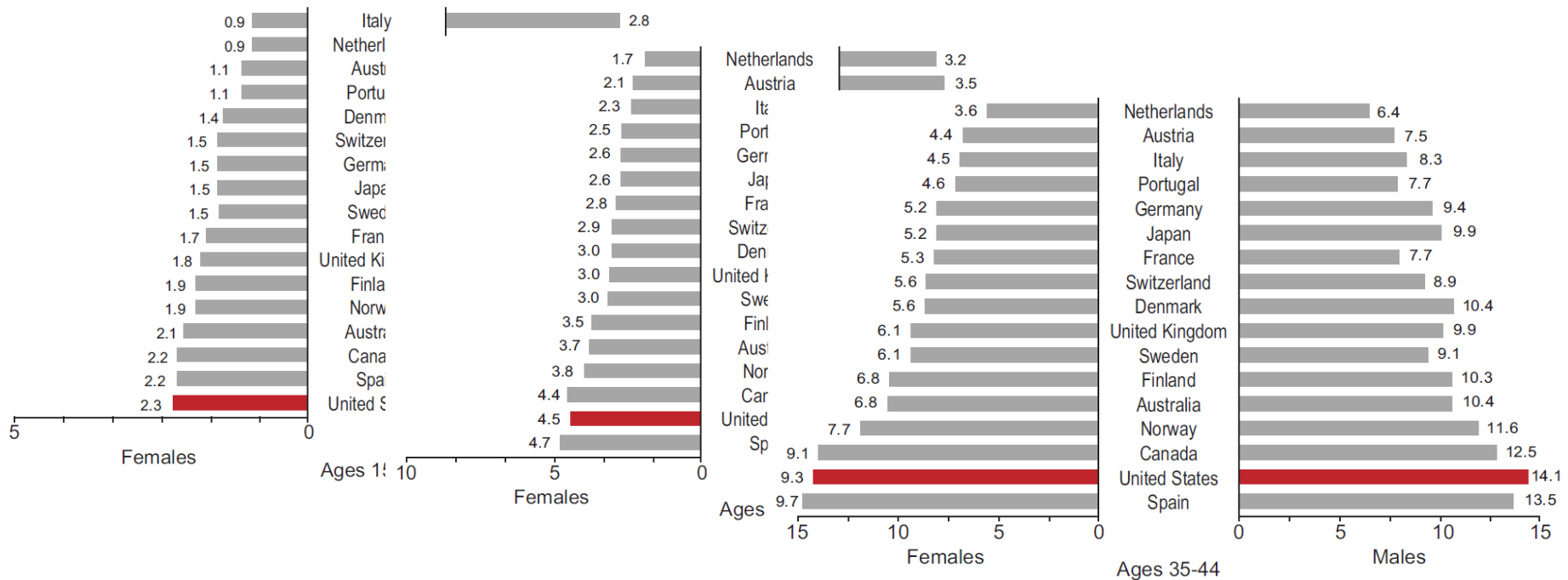
Obesity: Average BMI in 17 Peer Countries, 2008



- The US has the highest prevalence of adult obesity among the 17 peer countries (and all other OECD countries)
...a position it has held for decades.
- As of 2009, the prevalence of obesity in the US (34%) was twice the OECD average (17%).



Diabetes: Self-Reported Prevalence in 17 Peer Countries, 2008



As of 2010, the US had the highest prevalence of diabetes (among adults aged 20-79) across all 17 peer countries (and all OECD countries except Mexico).



US Adolescent Health Disadvantage

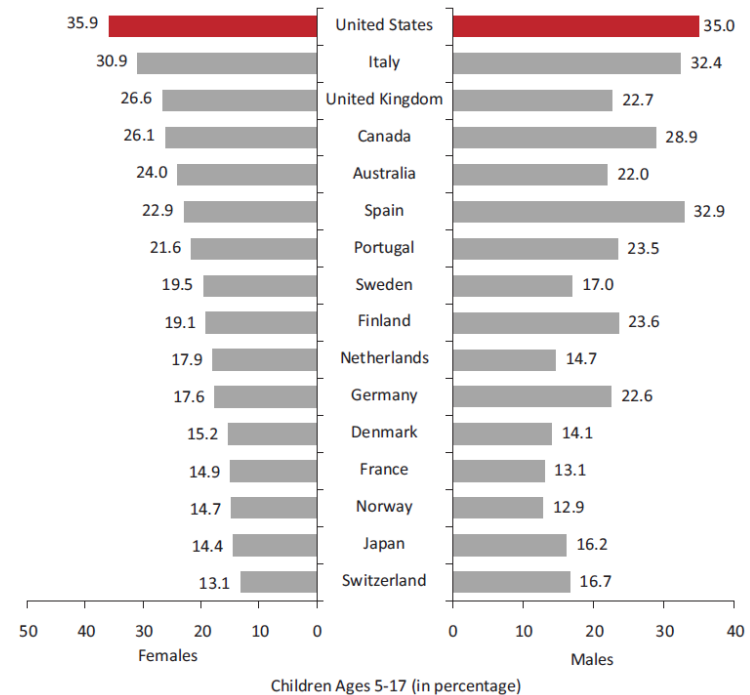
Among teens aged 15-19 in 2005, the US had the highest all-cause mortality rate among peer countries.

- Pattern is decades old: US mortality rates at ages 15-24 have been higher than the OECD mean since the 1950s for males and since the 1970s for females.

As of 2005, the prevalence of obesity among US teens aged 12-17 was more than twice the OECD mean:

- By 2011, one third of US children aged 5-17 were overweight/obese, the highest rate among peer countries.
- Obesity among US non-Hispanic whites aged 5-13 was higher than the OECD average for ages 5-19.

Among the 17 peer countries in 2010, the US had the 5th highest prevalence of diabetes among children ages 0-14.



Prevalence of overweight (including obese) children in 17 peer countries





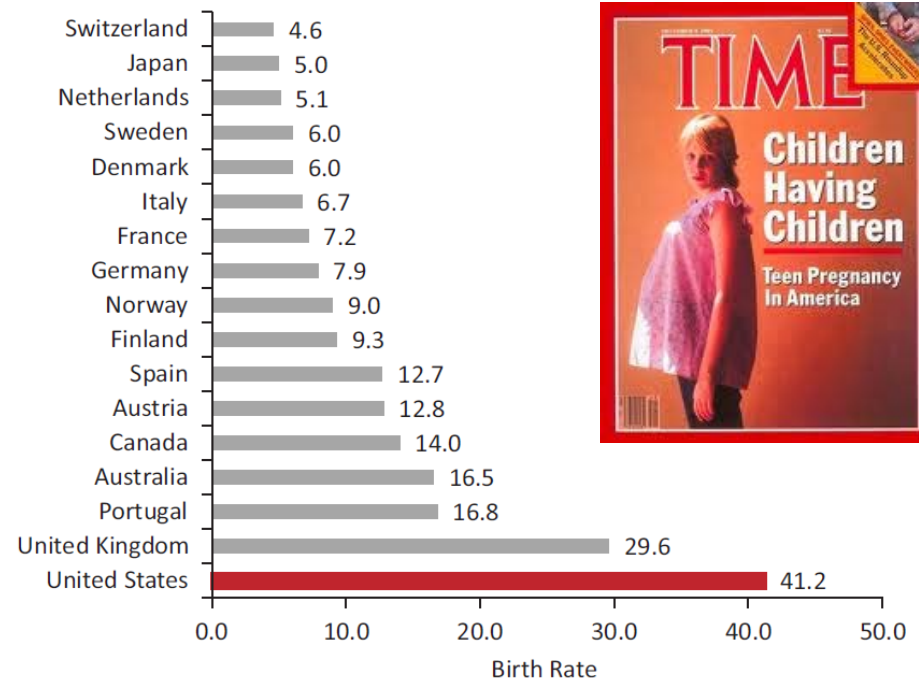
Adolescent Sexual Health

The US has the highest teen pregnancy rate among peer countries:

- The 2010 US teen pregnancy rate was nearly 3.5 times the average of peer countries.

In 16 developed countries, the prevalence of syphilis, gonorrhea, and chlamydia among teens age 15-19 was higher in the US than in other high-income countries that provided comparison data.

Among high-income countries, the US has the highest prevalence of HIV infection at ages 15-24.





Age 50 and Above

Disease and Disadvantage in the United States and in England

James Banks, PhD

Michael Marmot, MD

Zoe Oldfield, MSc

James P. Smith, PhD

Context The United States spends considerably more money on health care than the United Kingdom, but whether that translates to better health outcomes is unclear.

Objective To assess the relative health status of older individuals in England and the United States, especially how their health status varies by important socioeconomic position.

Design, Setting, and Participants We analyzed representative samples of older adults in England and the United States.

EXPLAINING DIVERGENT LEVELS OF LONGEVITY IN HIGH-INCOME COUNTRIES

Eileen M. Crimmins, Samuel H. Preston, and Barney Cohen, *Editors*

Panel on Understanding Divergent Trends in Longevity in High-Income Countries

Differences In Disease Prevalence As A Source Of The U.S.-European Health Care Spending Gap

Americans are diagnosed with and treated for several chronic illnesses more often than their European counterparts are.

by **Kenneth E. Thorpe, David H. Howard, and Katya Galactionova**

Health Disadvantage in US Adults Aged 50 to 74 Years: A Comparison of the Health of Rich and Poor Americans With That of Europeans

Mauricio Avendano, PhD, M. Maria Glymour, ScD, James Banks, PhD, and Johan P. Mackenbach, PhD

Differences in health between Americans and Western Europeans: Effects on longevity and public finance

Pierre-Carl Michaud^{a,*}, Dana Goldman^b, Darius Lakdawalla^b, Adam Gailey^c, Yuhui Zheng^d

A Tale of Two Countries—the United States and Japan: Are Differences in Health Due to Differences in Overweight?

Sandra L. Reynolds¹, Aaron Hagedorn², Jihye Yeom², Yasuhiko Saito³, Eise Yokoyama³, and Eileen M. Crimmins²

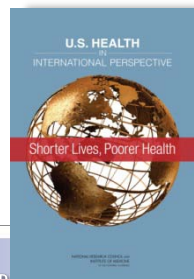
¹University of South Florida, Tampa, FL, USA

²University of Southern California, Los Angeles, CA, USA

³Nihon University, Tokyo, Japan

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Age 50 and Above

Disease and Disadvantage in the United States and in England

James Banks, PhD
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James P. Smith, PhD

Context The United Kingdom, but
Objective To assess
United States, especially
socioeconomic position
Design Setting

Differences in Disease Prevalence As A Source of U.S.-European Health Spending Gap

Americans are diagnosed with and treated for
illnesses more often than their European counterparts

by Kenneth E. Thorpe, David H. Howard, and

Differences in health Effects on longevity and

Pierre-Carl Michaud^{a,*}, Dan

A Tale of Two Countries—the United States and Japan Differences in Health Due to Differences in Overweight

Sandra L. Reynolds¹, Aaron Hagedorn², Jihye Yeom², Yasuhiko Saito³
and Eileen M. Crimmins²

¹University of South Florida, Tampa, FL, USA

²University of Southern California, Los Angeles, CA, USA

³Nihon University, Tokyo, Japan

EXPLAINING DIVERGENT LEVELS OF LONGEVITY IN HIGH-INCOME COUNTRIES

Conditions more prevalent in the US among those age 50 and older

- Overweight/obesity
- Diabetes
- Hypertension
- Heart disease
- Myocardial infarction
- Stroke
- Chronic lung disease
- Asthma
- Cancer
- Arthritis
- Activity limitations

and Barney Cohen, *Editors*

Longevity in High-Income Countries

Age 50 to 74 Years: and Poor Americans

and Johan P. Mackenbach, PhD

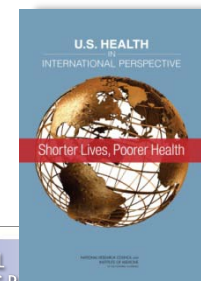
ing^d





The Good News: Some US Health Advantages

- Cancer mortality
- Stroke mortality
- Control of blood pressure and cholesterol levels
- Suicide
- Elderly survival
- Self-rated health





DISADVANTAGE: SUMMARY

- Americans die younger and have higher rates of disease and injury than people in other wealthy nations.
- The problem is not new. It has existed for decades, especially for women.
- The problem is pervasive. It affects both sexes, young and old, and multiple areas of health, from infant mortality to traffic fatalities, from teen pregnancies to heart disease.
- Earlier reports highlighted the US health disadvantage after age 50. This report finds as large a disadvantage among younger Americans. US infants, children, and teens die younger and have greater rates of illness and injury than youth in other countries.
- The problem is not limited to the poor or uninsured. Even Americans with health insurance coverage, higher incomes, a college education, and healthy behaviors seem to be sicker than counterparts in other countries.
- The problem claims lives and dollars. It threatens US workforce productivity and economic competitiveness.





Nine Areas of US Health Disadvantage

Infant Mortality
&
Low Birth
Weight

Injuries &
Homicides

Adolescent
Pregnancy &
STIs

HIV & AIDS

Drug-related
Deaths

Obesity &
Diabetes

Cardiovascular
Disease

Chronic Lung
Disease

Disability



Health Systems

US health system's strengths

- Cancer screening
- Control of blood pressure and serum lipids
- Patient-centered communication and attentiveness



Why health care does not fully explain the US health disadvantage

- Some conditions responsible for the US health disadvantage (e.g., violence, car crashes) are only marginally influenced by health care.
- Direct evidence of worse health care outcomes in the US (e.g., higher case-fatality rates) is lacking.
- Even conditions that are treatable by health care have origins outside the clinic.
- Countries with better health outcomes lack consistent evidence of superior health system performance.

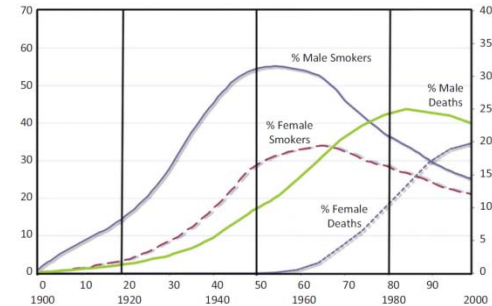




Individual Behaviors

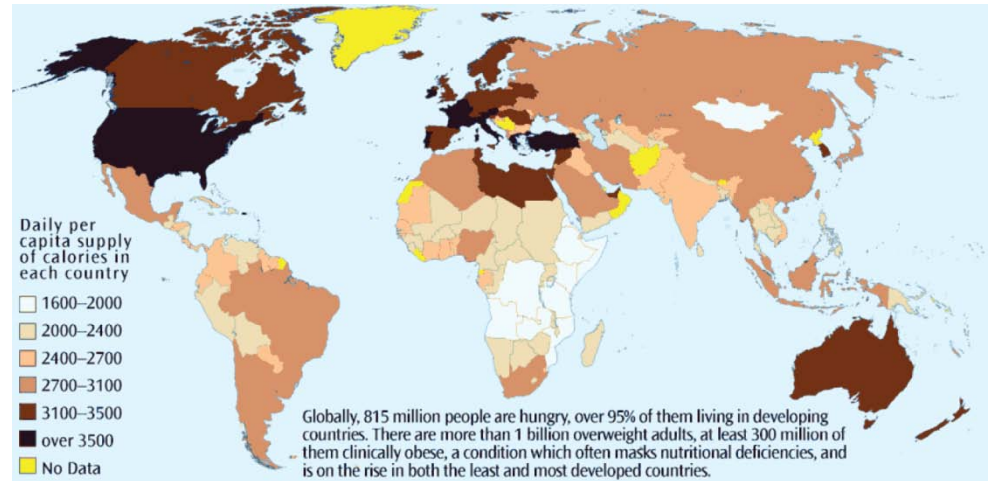
Smoking

- Although the US had the highest smoking rates in the 1950s, it now has the lowest rates of all peer countries but Sweden.
- Smoking could explain shorter life expectancy in older adults, but not the health disadvantages observed in younger Americans.



Diet

- **Americans consume more calories than people in any other country.**
- Between 1999-2001 and 2005-2007, US fat intake rose from 7th to 4th in the world.





Individual Behaviors (Continued)

- Physical inactivity
 - Evidence is inadequate to compare physical activity levels in the US and other countries.
- Alcohol and other drug use
 - Americans consume less alcohol than people in other high-income countries.
 - Use of illicit and prescription drugs may be more prevalent in the US.
- Sexual practices
 - Compared to teens in other countries, US teens appear to:
 - Become sexually active at an earlier age
 - Have more sexual partners
 - Not properly use contraceptives or effective barrier methods

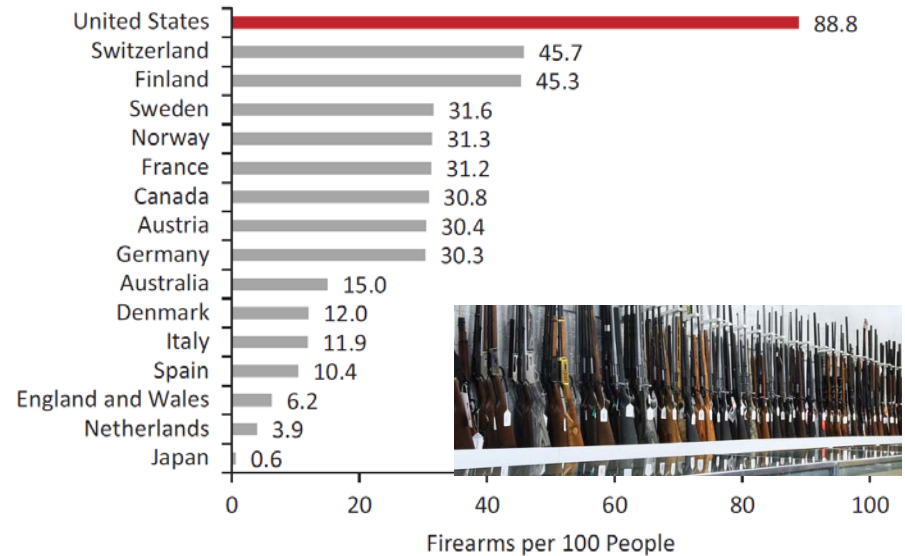




Individual Behaviors (Continued)

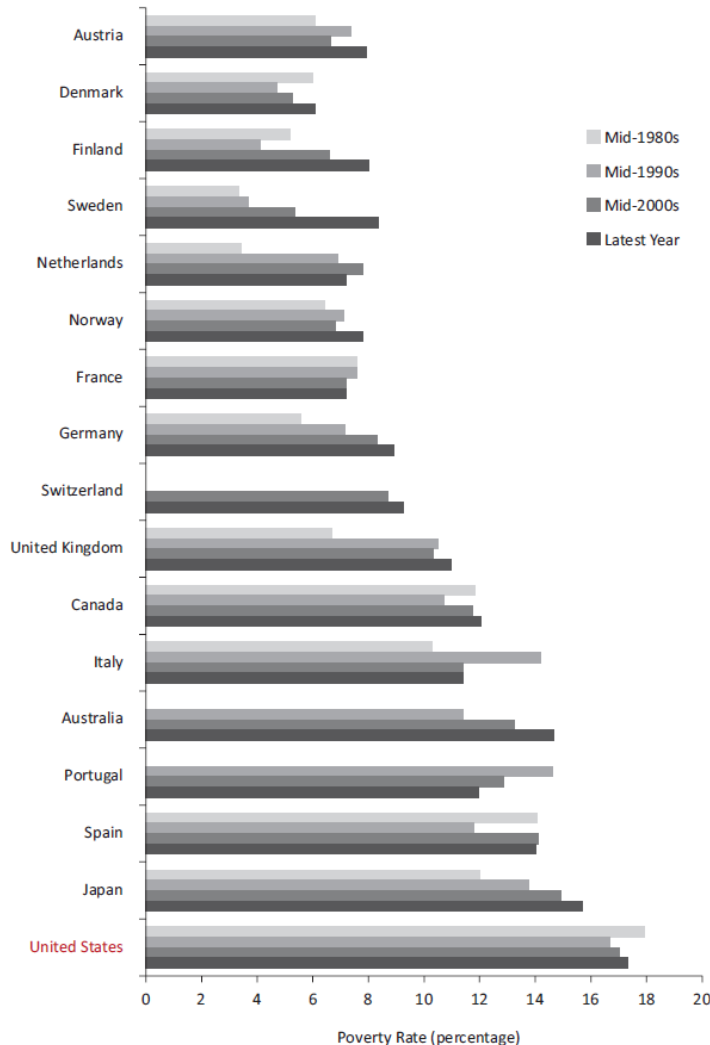
Injurious behaviors

- There is limited cross-national evidence about injurious behaviors.
- Civilian possession of firearms is much common in the US (89 firearms per 100 Americans) than in peer countries.
- US motorists are less likely to fasten front seatbelts, and motorcycle helmet use may also be lower in the US than in other high-income countries.
- 32% of US road accidents are attributable to alcohol, a higher proportion than in other high-income countries.





Social Factors

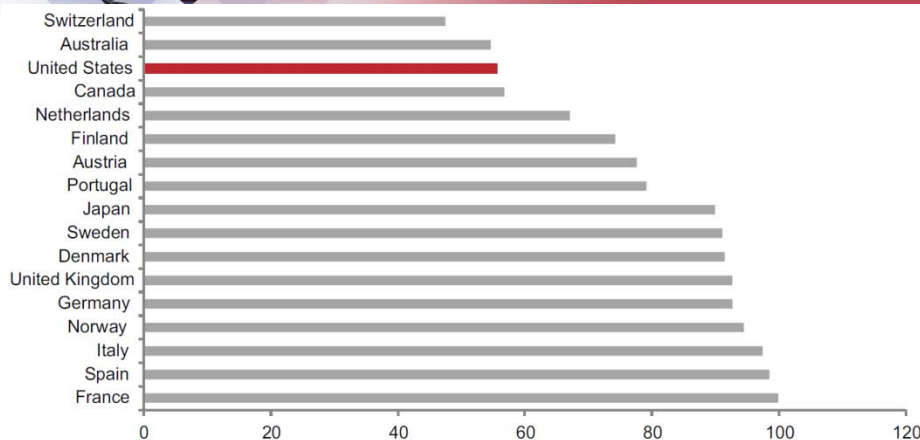


- The US has the highest level of income inequality among peer countries, 4th highest in the OECD.
- Since the 1980s, the US has had the highest relative poverty rates among peer countries.
- Since the mid-1980s, the US has had the highest rate of child poverty among peer countries.
- As of 2008, 22% of US children lived in poverty, the 5th highest rate among 34 OECD countries.

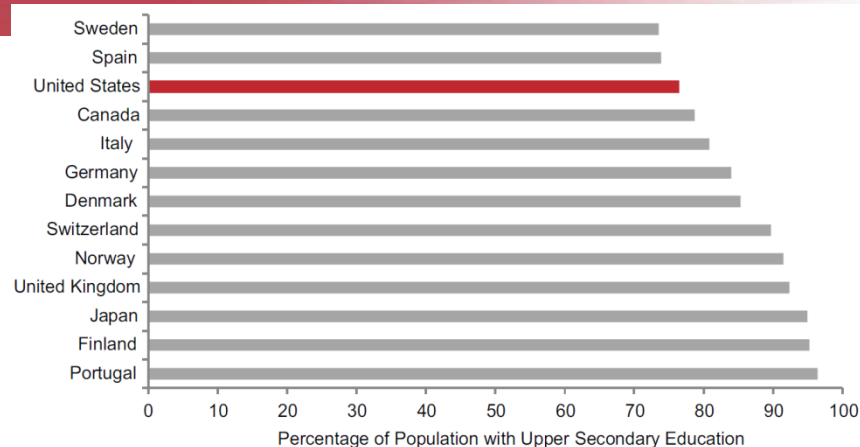




Education



Percent of children aged 3-5 enrolled in preschool, 2008



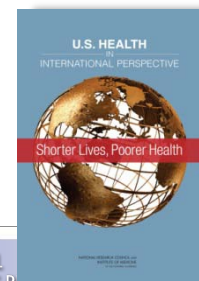
Percent of population with secondary education, 2008



US preschool enrollment is lower than in most high-income countries.

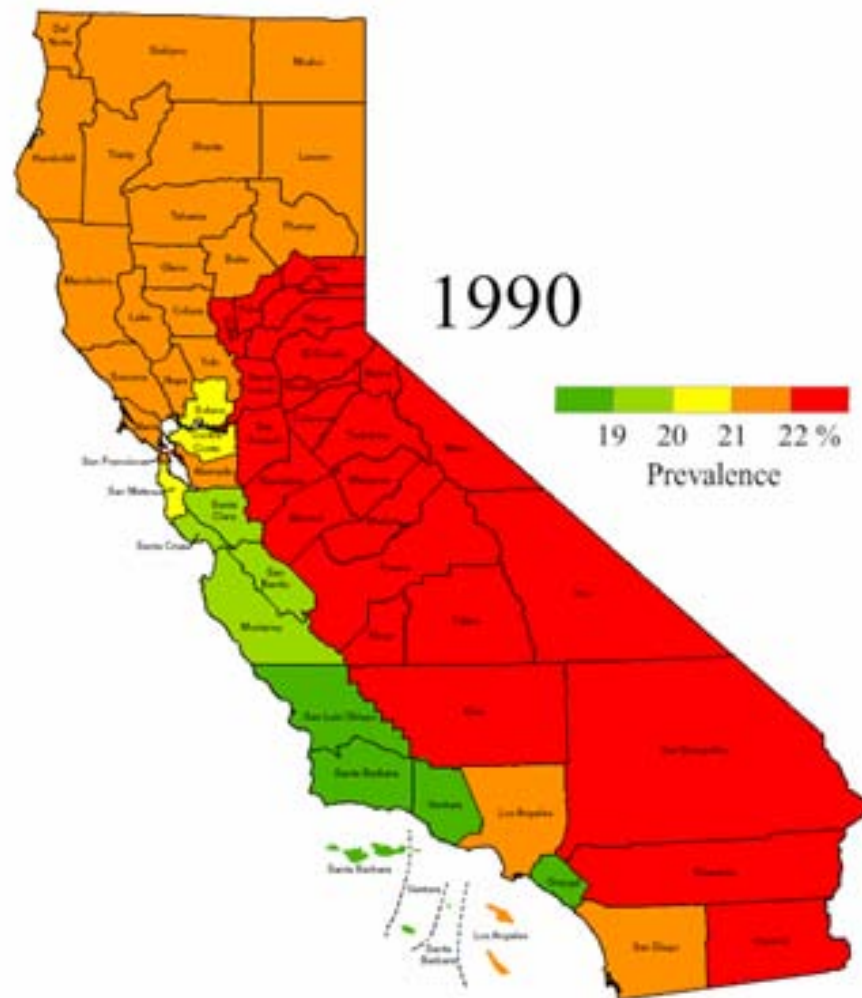
Among adults of all ages, the US ranks well in educational attainment, but other countries (including emerging economies) are outpacing the US in the educational attainment of young people (e.g., graduation rates).

US grade school students score above average, but by age 15 US students have average or below-average scores on math, science, and reading.



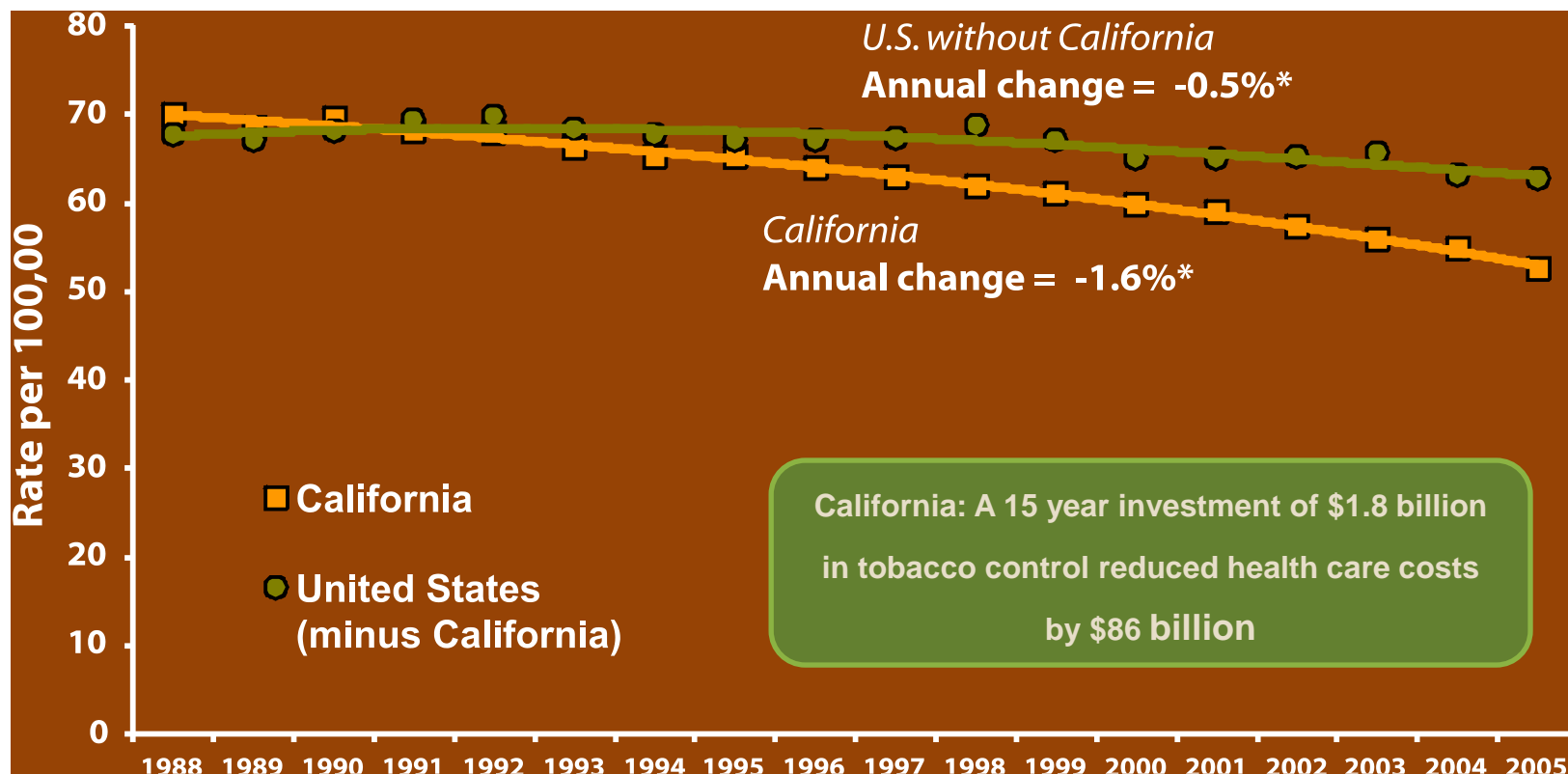
California adult smoking prevalence by region, 1990 – 2002

Data from
California
Tobacco Survey





Lung and bronchus cancer incidence rates in CA



Rates are per 100,000 and age-adjusted to the 2000 U.S. standard (19 age groups).

* The annual percent change is significantly different from zero ($p < 0.05$).

Source: Cancer Surveillance Section. Prepared by: California Department of Public Health, California Tobacco Control Program, 1988-2005. 2010.



Training the Next Generation of Behavioral and Social Scientists

- K-12
- The undergraduate curriculum
- The PhD program of the future
- The 2011 AAMC report of the future of the medical school curriculum
- The 2015 MCAT



Most PhD Programs Prepare Students to be Professors, but...

- Every year, ~50,000 doctorates are awarded by US academic institutions.
- More than 50% of doctorate holders work in fields outside academia (discipline-dependent.)



Graduate Education Modernization



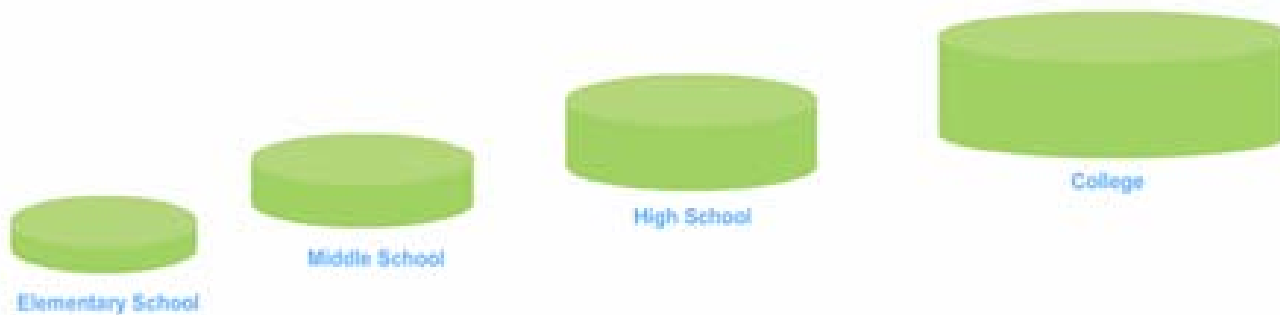
*Full-time S&E graduate students primary source of support
(2009 data: NSF 12-300)*



Committee on Science

Source of Support	# Students
NIH	23,570
NSF	21,513
Department of Defense	8,445
Department of Energy	4,594
Department of Agriculture	2,625
NASA	2,423
Total Federal Investment	~\$3B (conservative est.)

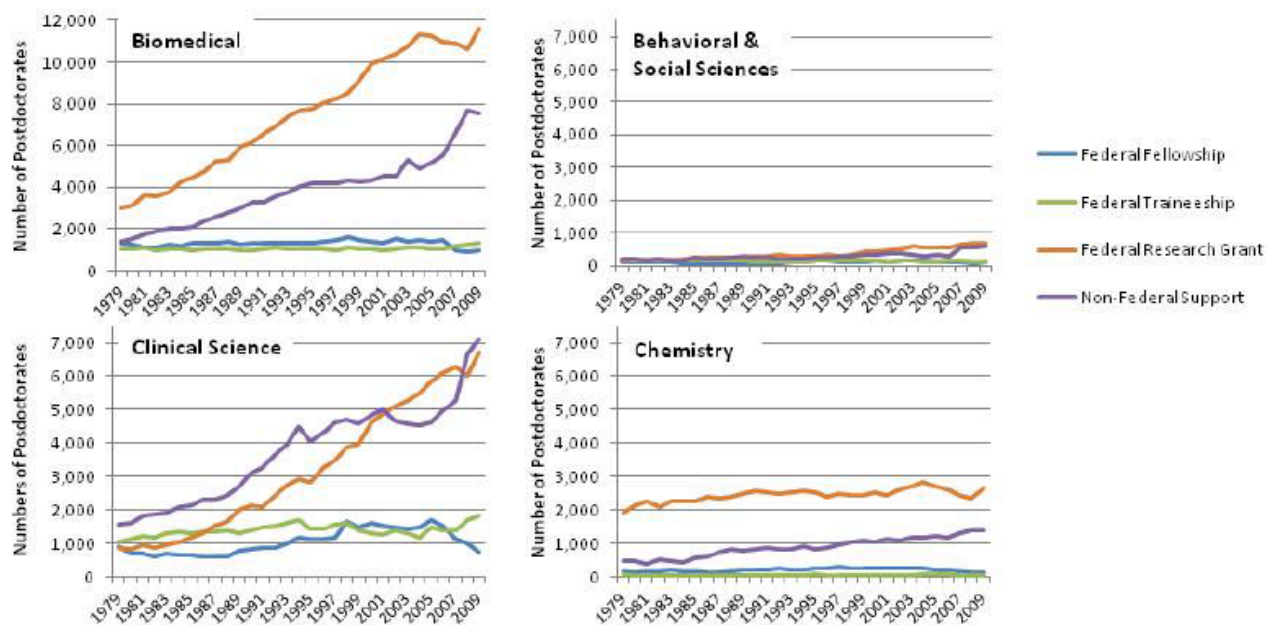
After moving to silos, can we come back together?





Post-Docs By Field

Postdoctorates, by Field and Type of Support



Source: GSS



What should the PhD curriculum look like?

- **Current Curriculum**

- Focused primarily on training professors
- Disciplinary focused
- Methods
 - Original small sample data collection
 - Non-harmonized measures
 - Emphasis on sample statistics (ANOVA, Regression)

- **Curriculum for Future**

- Trains for a range of job opportunities
- Team science, prepares for multidisciplinary work
- Methods
 - Big data
 - Harmonized measures
 - Data linkage
 - Pattern recognition
 - Systems Science



Why do we need to do this?

In a dynamic
environment,
if you are
standing still,
you will be left
behind



Jerry Garcia the Grateful Dead

***"Somebody has
to do
something,
and it's just
incredibly
pathetic that it
has to be us."***

