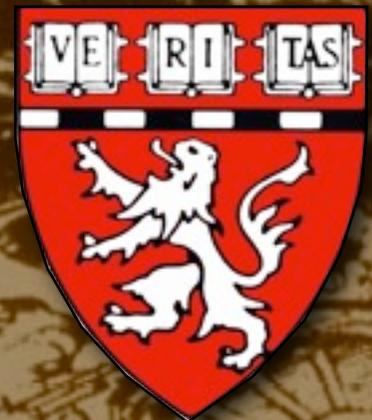
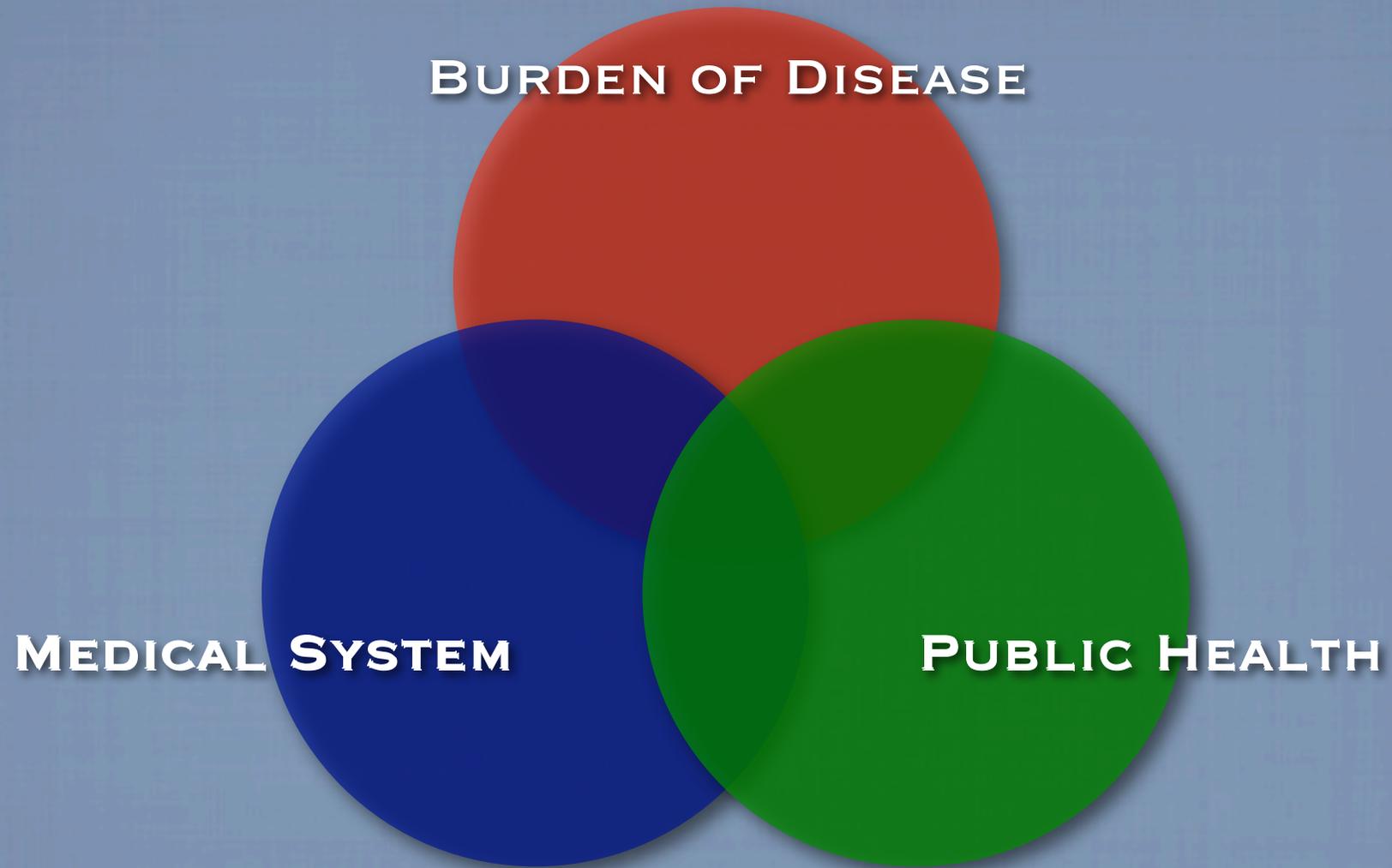


THE BURDEN OF DISEASE

DAVID S. JONES, M.D., PH.D.

PROGRAM IN SCIENCE, TECHNOLOGY, AND SOCIETY, MIT
MACVICAR FACULTY FELLOW, MIT
DEPARTMENT OF GLOBAL HEALTH AND SOCIAL MEDICINE, HMS





“THE COLLECTIVE CHARACTER OF DISEASES THAT AFFECT US AS A POPULATION” -- ALLAN BRANDT

Slide showing country distribution of estimated 2.7 million adults and children newly infected with HIV in 2007 from UNAIDS has been removed due to copyright restrictions.
See Slide 5 in "Core Slides: Global summary of the HIV and AIDS epidemic, 2007." UNAIDS 2008.

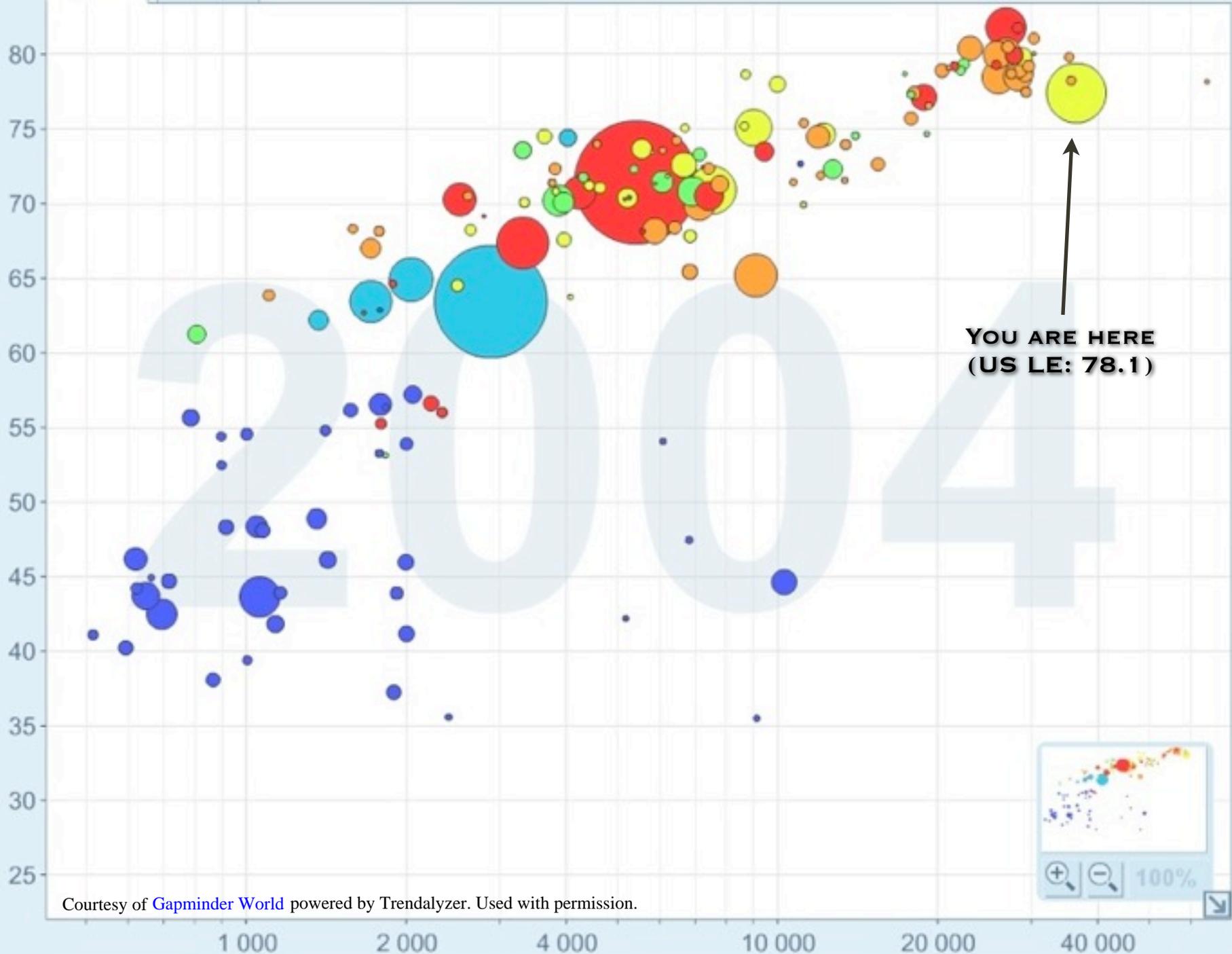
Help?

Chart

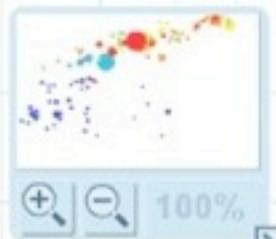
Map

lin

Life expectancy, years



**YOU ARE HERE
(US LE: 78.1)**



Courtesy of [Gapminder World](#) powered by Trendalyzer. Used with permission.

Income per capita in international dollars (GNP or GNI)

log

Help?

Chart

Map



Courtesy of [Gapminder World](#) powered by Trendalyzer. Used with permission.



BURDEN OF DISEASE: ER RX

Table 20. Number and percentage of drug mentions for the 20 most frequently occurring therapeutic drug classes at emergency department visits with corresponding standard errors: United States, 2005

Therapeutic class ¹	Number of occurrences in thousands	Standard error in thousands	Percent of drug mentions ²	Standard error of percent
Narcotic analgesics	32,898	1,812	16.1	0.9
NSAIDs ³	26,035	1,532	12.7	0.6
Nonnarcotic analgesics	14,992	903	7.3	0.5
Antipyretics	13,766	839	6.7	0.5
Vertigo or motion sickness or vomiting.	12,974	716	6.3	0.4
Antihistamines	12,925	761	6.3	0.4
Sedatives or hypnotics	9,741	632	4.8	0.3
Cephalosporins	8,746	603	4.3	0.3
Antiasthmatics or bronchodilators	7,849	570	3.8	0.4
Penicillins	7,313	538	3.6	0.3
Acid or peptic disorders	6,151	458	3.0	0.3
Replenishers or regulators of electrolytes or water balance	6,099	610	3.0	0.5
Adrenal corticosteroids	6,062	387	3.0	0.2
Lincosamides or macrolides	5,460	382	2.7	0.2
Quinolones	4,639	295	2.3	0.2
Skeletal muscle hyperactivity	4,578	298	2.2	0.2
Antianxiety agents	4,161	280	2.0	0.2
Vaccines or antisera	3,636	240	1.8	0.2
Pharmaceutical aids	3,582	536	1.7	0.5
Surgical aids	3,475	528	1.7	0.4

¹Based on the standard four-digit drug classification used in the *National Drug Code Directory*, 1995 edition (30).

²Based on an estimated 204,851,000 drug mentions at emergency department visits in 2005. Total of all therapeutic classes will exceed total drug mentions because up to three classes may be coded for each drug.

³NSAIDs are nonsteroidal anti-inflammatory drugs.

BURDEN OF DISEASE: HOSPITAL ADMITS

TOP 10 PRINCIPAL DIAGNOSES* BY AGE GROUP	AGE GROUP					
	< 1 YEAR	1-17 YEARS	18-44 YEARS	45-64 YEARS	65-79 YEARS	80+ YEARS
Fever of unknown origin	17					
Asthma		128				
Appendicitis		74	140			
Affective or mood disorders (depression and bipolar disorder)		60	347	175		
Epilepsy, convulsions		49				
Chemotherapy and radiation therapy		34				
Skin and subcutaneous tissue infections		32				
Other infections of upper respiratory tract (nose, throat, trachea)		30				
Spondylosis, intervertebral disc disorders (back problems, disorders of intervertebral discs and bones in spinal column)			192	248		
Chest pain			171	402	219	
Schizophrenia			164			
Gallbladder disease			151			
Benign tumor of uterus			138			
Drug abuse disorders			128			
Diabetes mellitus with complications			123			
Hardening of the heart arteries and other heart disease				518	530	179
Heart attack (acute myocardial infarction)				258	274	188
Congestive heart failure				214	410	395
Complication of medical device, implant, or graft				201		
Osteoarthritis (degenerative joint disease)				186	276	
Chronic obstructive lung disease				178	285	
Cardiac dysrhythmias (irregular heart beat)					293	203
Acute cerebrovascular disease (stroke)					212	194
Rehabilitation care, fitting of prostheses, and adjustment of devices					207	141
Hip fracture						185

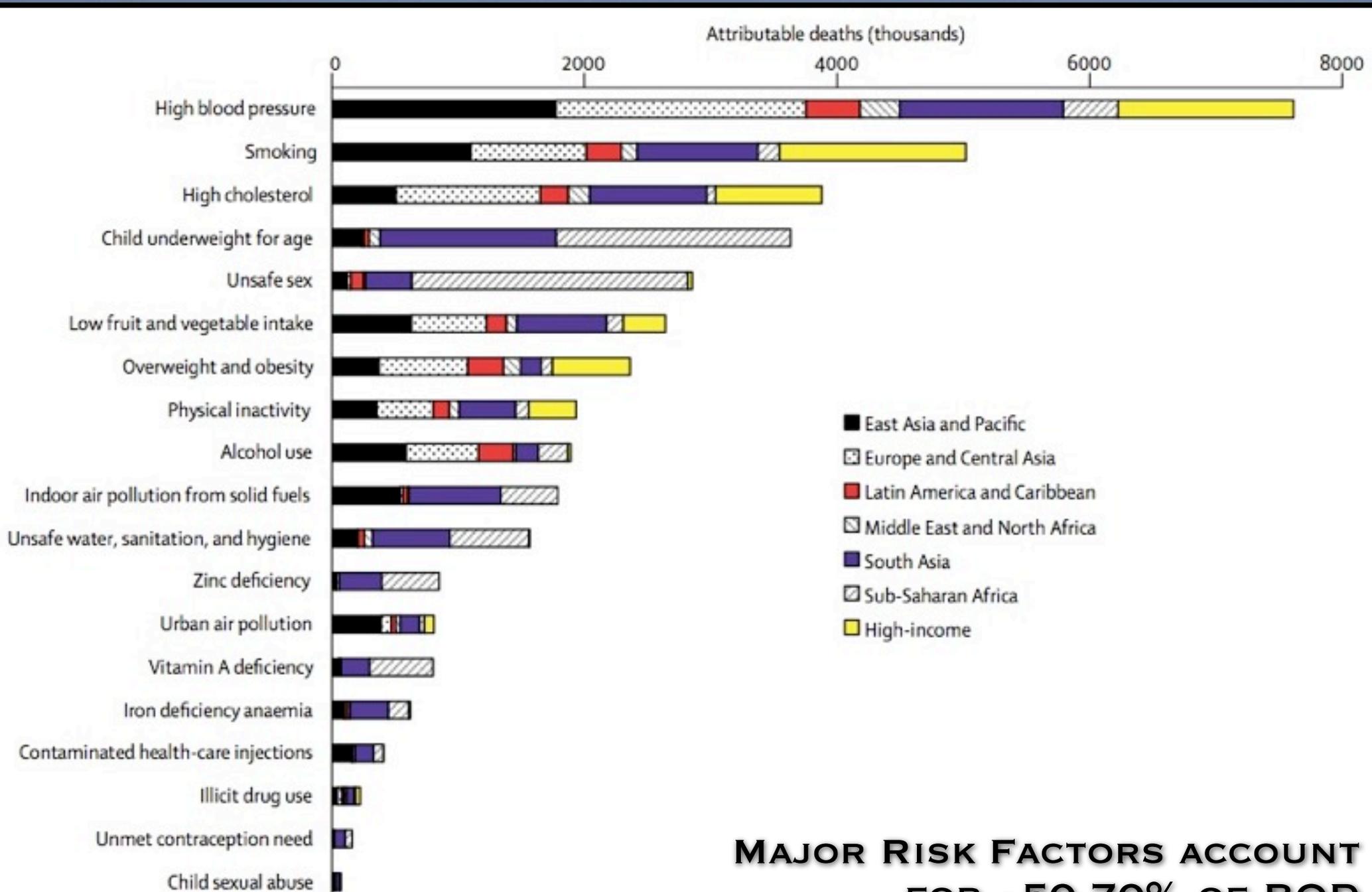
*Excludes pregnancy-related conditions.

Public domain table from Merrill, Chaya T., and Anne Elixhauser. *Hospitalization in the United States, 2002*. Rockville, MD: Agency for Healthcare Research and Quality, 2005. HCUP Fact Book No. 6. AHRQ Publication No. 05-0056. ISBN: 1587632179.

WHAT SHOULD DRIVE POLICY?

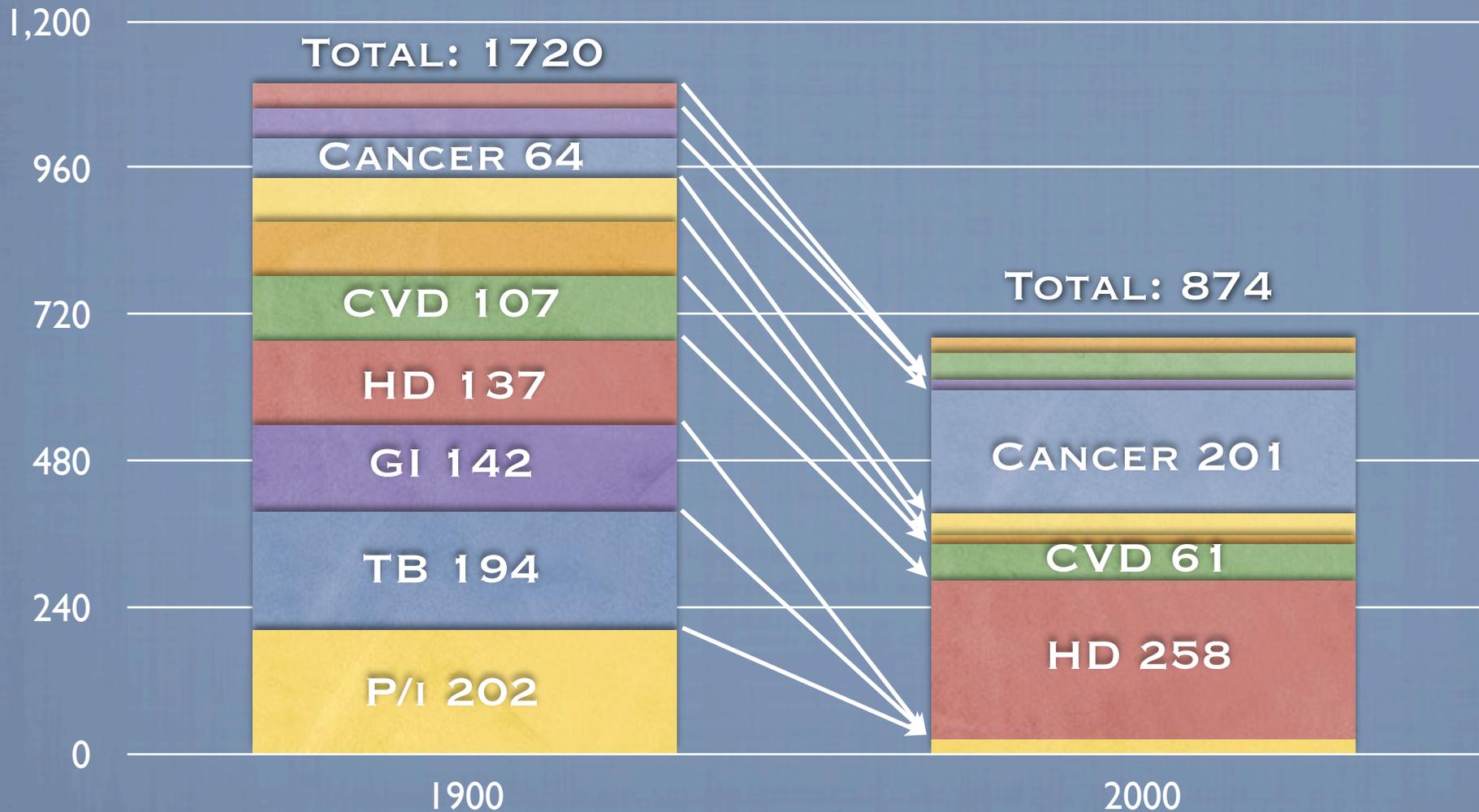
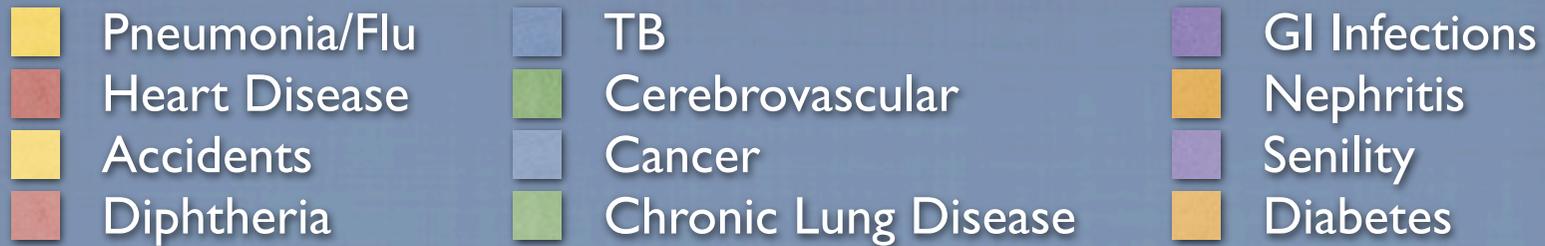
- CAUSES OF DEATH: CAD, CANCER, CVD
- CAUSES OF DISABILITY: CAD, CVD, DEPRESSION, ALZHEIMER'S
- OFFICE VISITS: COUGH, OB/GYN, HYPERTENSION, SORE THROAT
- ER: STOMACH PAIN, CHEST PAIN, FEVER, COUGH, HEADACHE, OPIATE DEPENDENCE?

BURDEN OF DISEASE: ATTRIBUTABLE CAUSES



MAJOR RISK FACTORS ACCOUNT FOR ~50-70% OF BOD

CHANGE OVER TIME



CAUSES OF DEATH, 1900 vs. 2000 (RATE / 100,000)

PREDICTING THE BURDEN OF DISEASE

Table 5. Changes in Rankings for 15 Leading Causes of DALYs, 2002 and 2030 (Baseline Scenario)

Category	Disease or Injury	2002 Rank	2030 Ranks	Change in Rank
Within top 15	Perinatal conditions	1	5	-4
	Lower respiratory infections	2	8	-6
	HIV/AIDS	3	1	+2
	Unipolar depressive disorders	4	2	+2
	Diarrhoeal diseases	5	12	-7
	Ischaemic heart disease	6	3	+3
	Cerebrovascular disease	7	6	+1
	Road traffic accidents	8	4	+4
	Malaria	9	15	-6
	Tuberculosis	10	25	-15
	COPD	11	7	+4
	Congenital anomalies	12	20	-8
	Hearing loss, adult onset	13	9	+4
	Cataracts	14	10	+4
	Violence	15	13	+2
Outside top 15	Self-inflicted injuries	17	14	+3
	Diabetes mellitus	20	11	+9

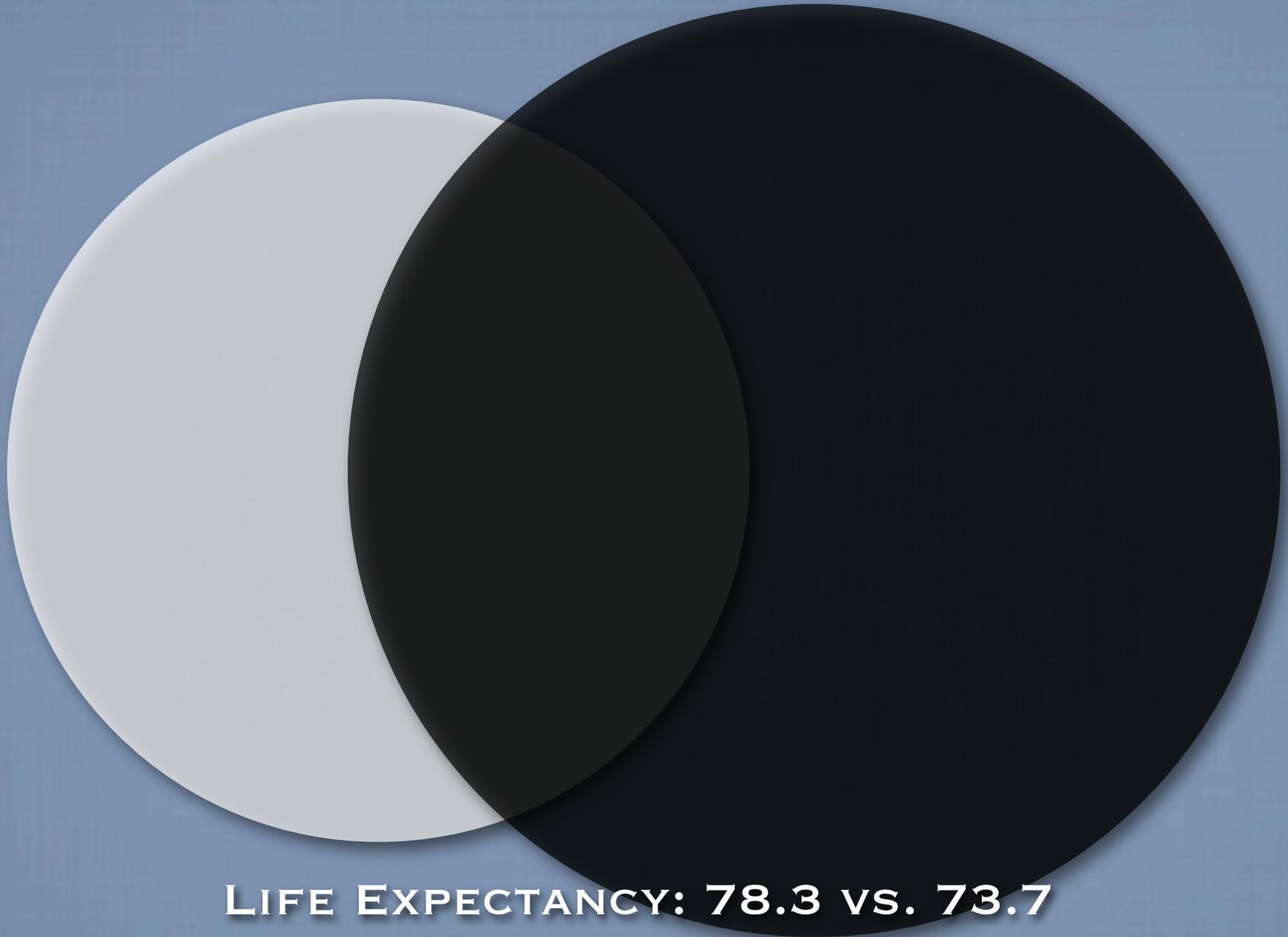
doi: 10.1371/journal.pmed.0030442.t005

Mathers, Colin D., and Dejan Loncar. "Projections of Global Mortality and Burden of Disease from 2002 to 2030." *PLoS Medicine* 3, no. 11 (2006).

HEALTH INEQUALITIES

Images from Boston Metro newspaper removed due to copyright restrictions.
See article in Associated Press, "[Not Just Cliche: Rock Stars More Likely to Die Young](#)," *USA Today*, September 4, 2007,
(accessed September 21, 2010).

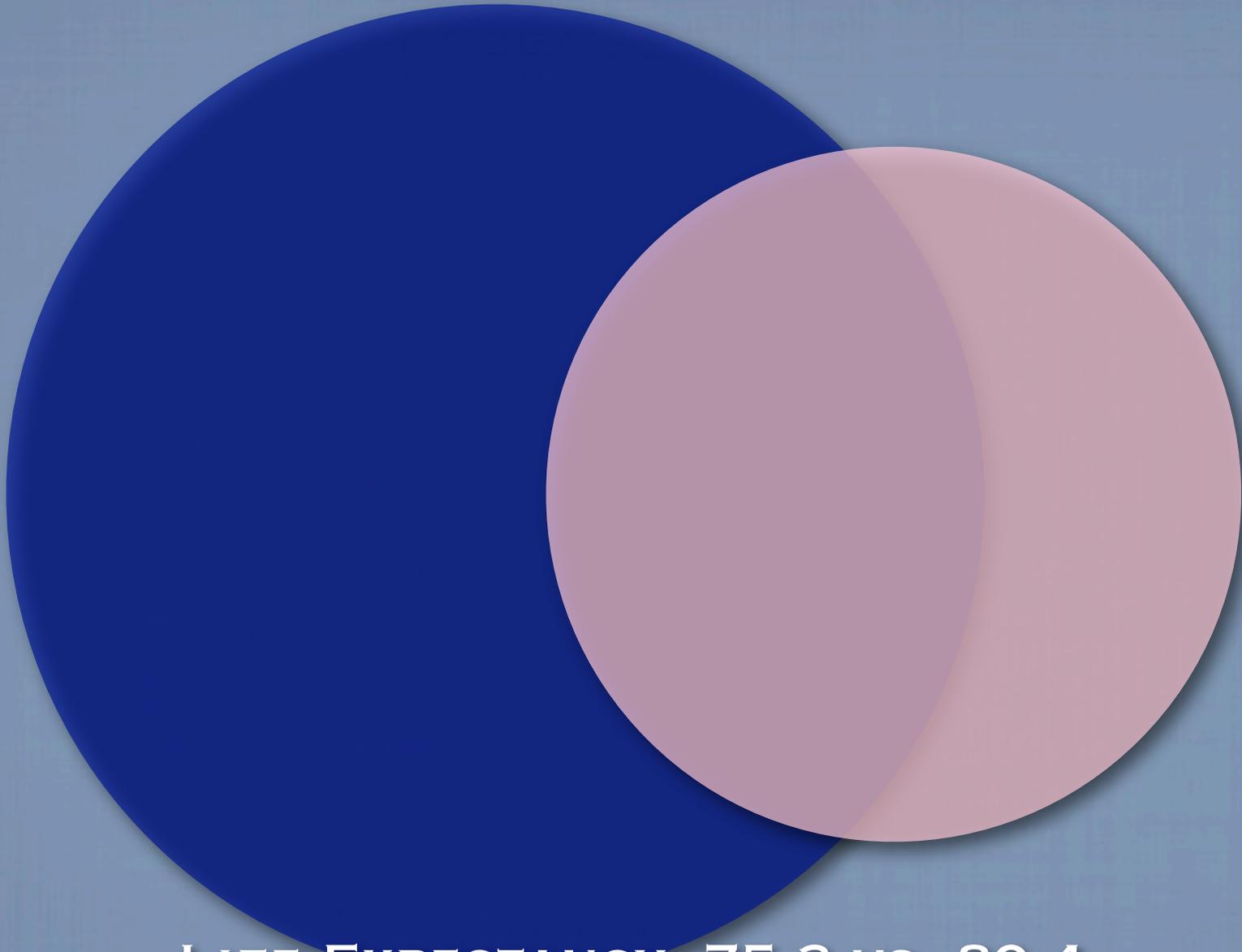
HEALTH INEQUALITIES: WHITE-BLACK



LIFE EXPECTANCY: 78.3 vs. 73.7

AGE-ADJUSTED MORTALITY: 751.2 vs. 942.6/100,000

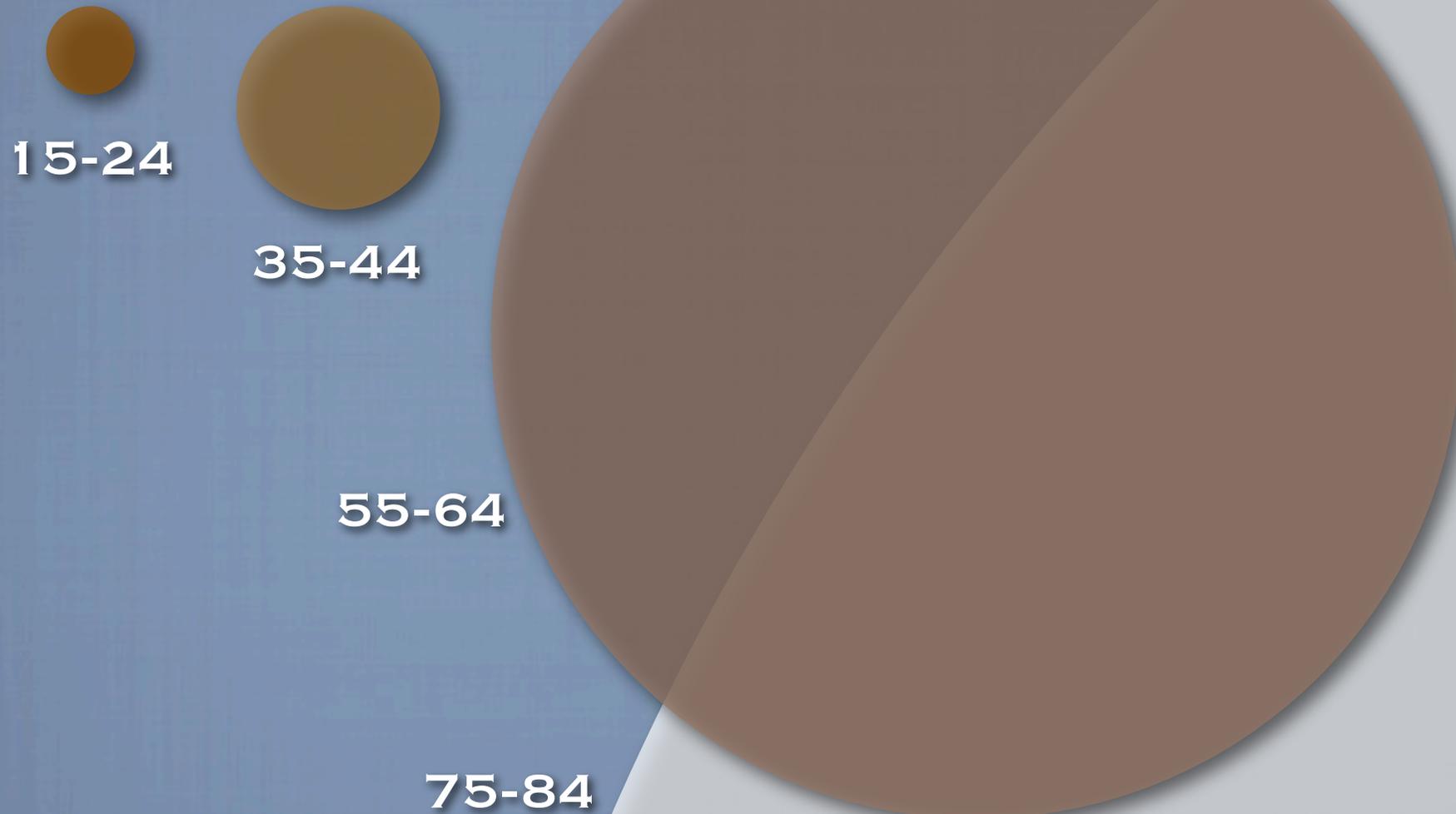
HEALTH INEQUALITIES: MEN - WOMEN



LIFE EXPECTANCY: 75.3 vs. 80.4

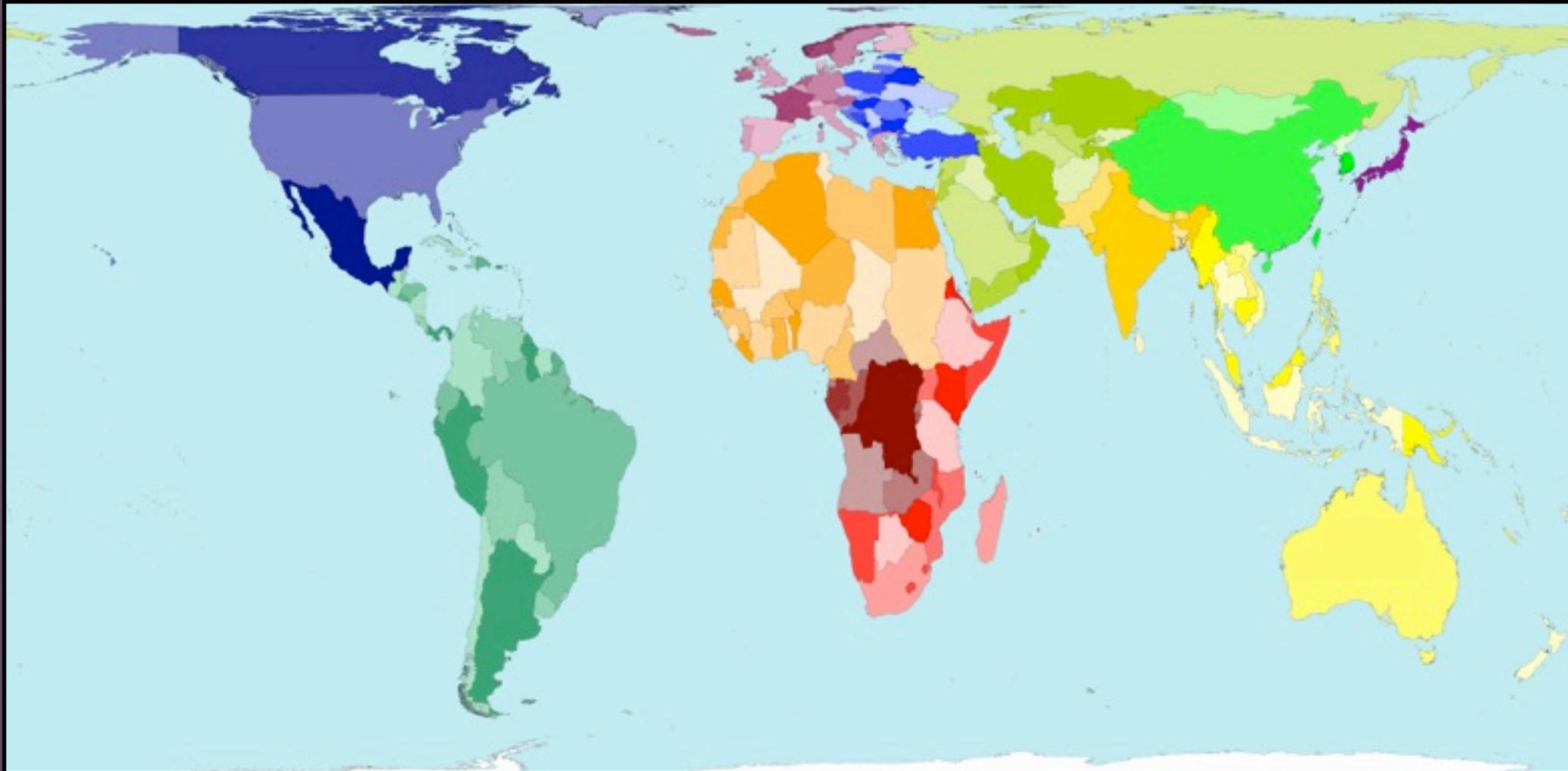
AGE-ADJUSTED MORTALITY: 905.8 vs. 643.4/100,000

HEALTH INEQUALITIES: AGE



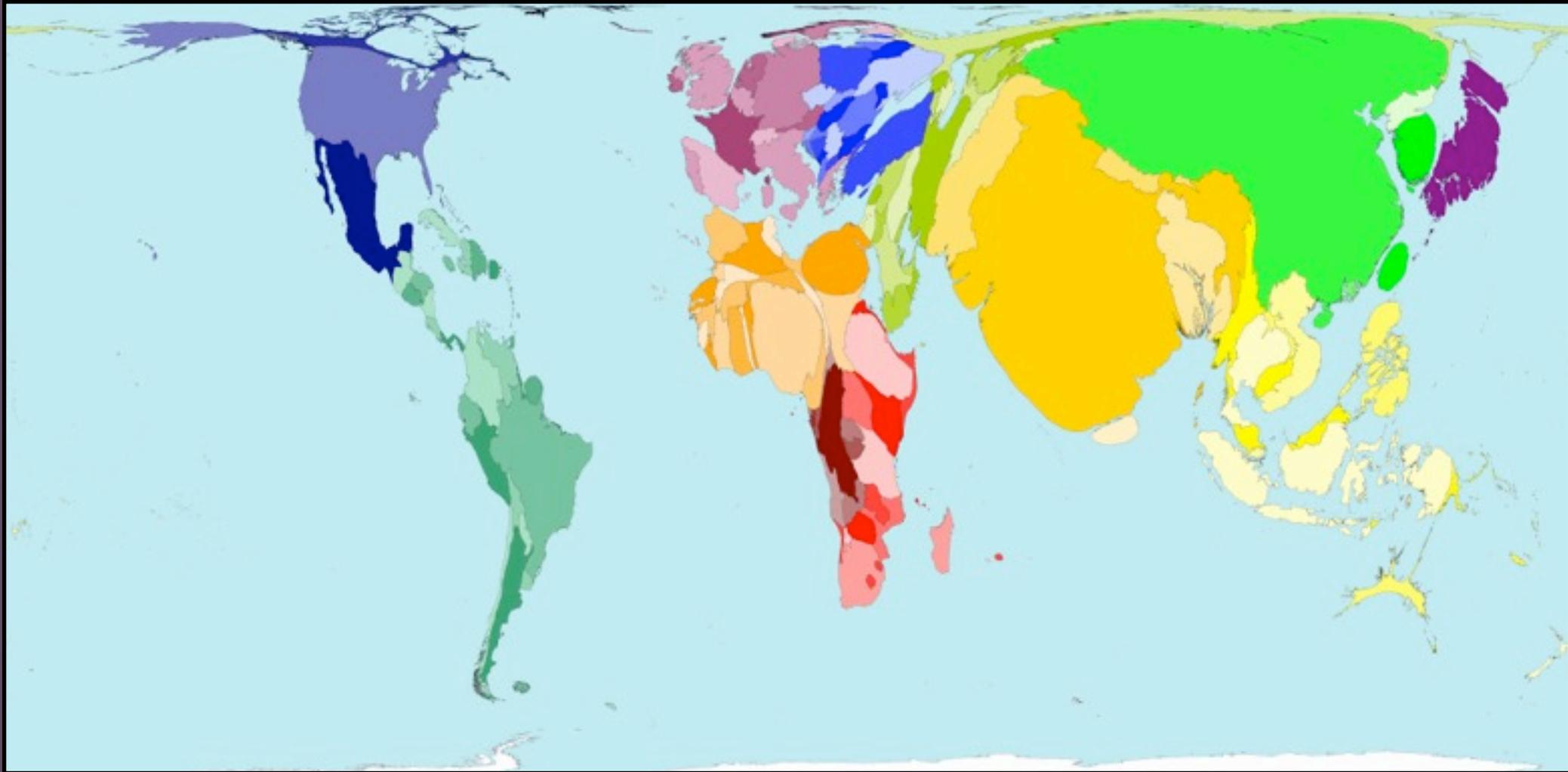
AGE-ADJUSTED MORTALITY: 80.2 vs. 184.3 vs. 875.7 vs. 5017.4

WORLDMAPPER: LAND AREA



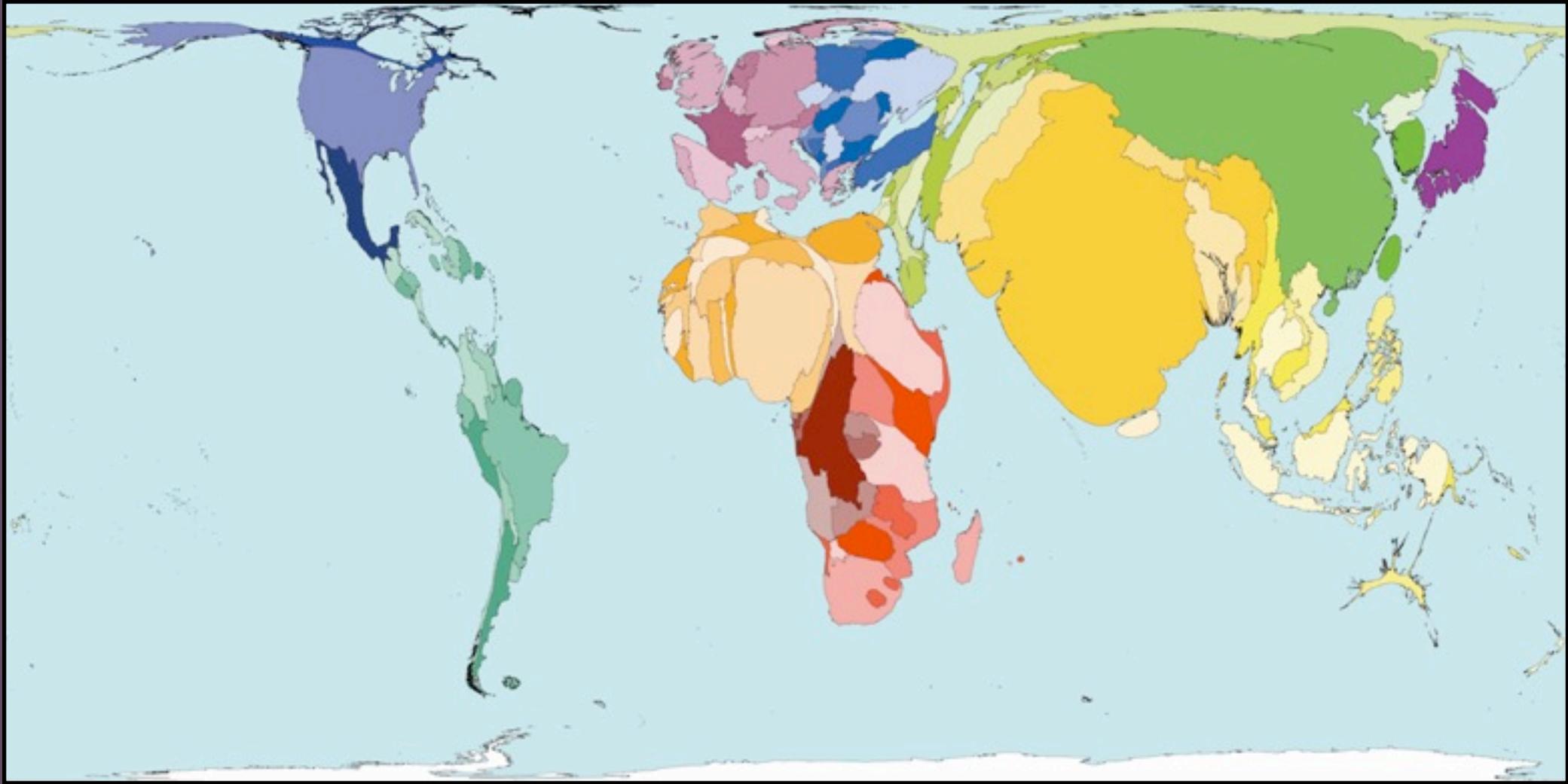
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WORLDMAPPER: POPULATION



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ALL DEATHS



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HIV PREVALENCE



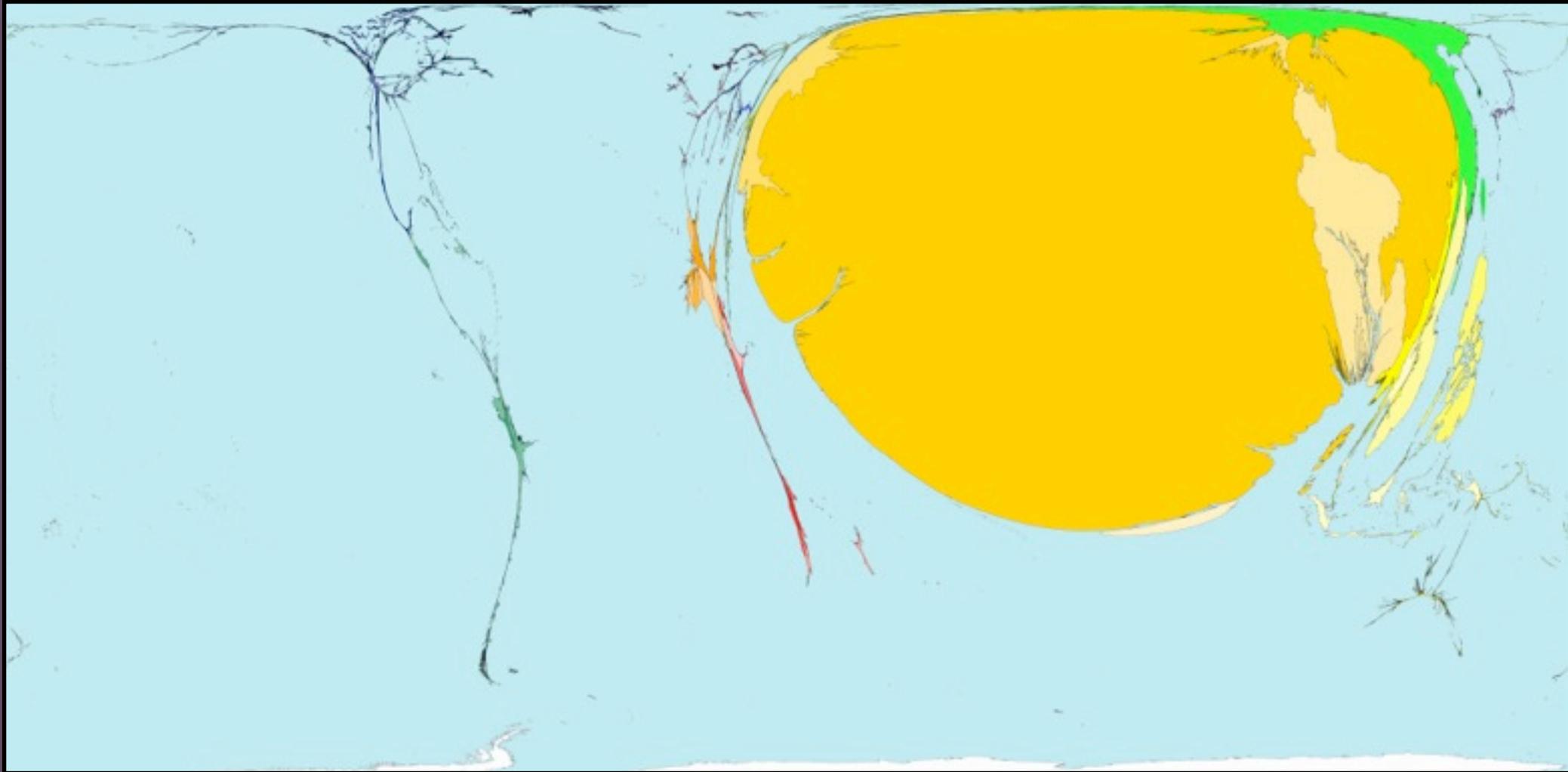
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MALARIA DEATHS



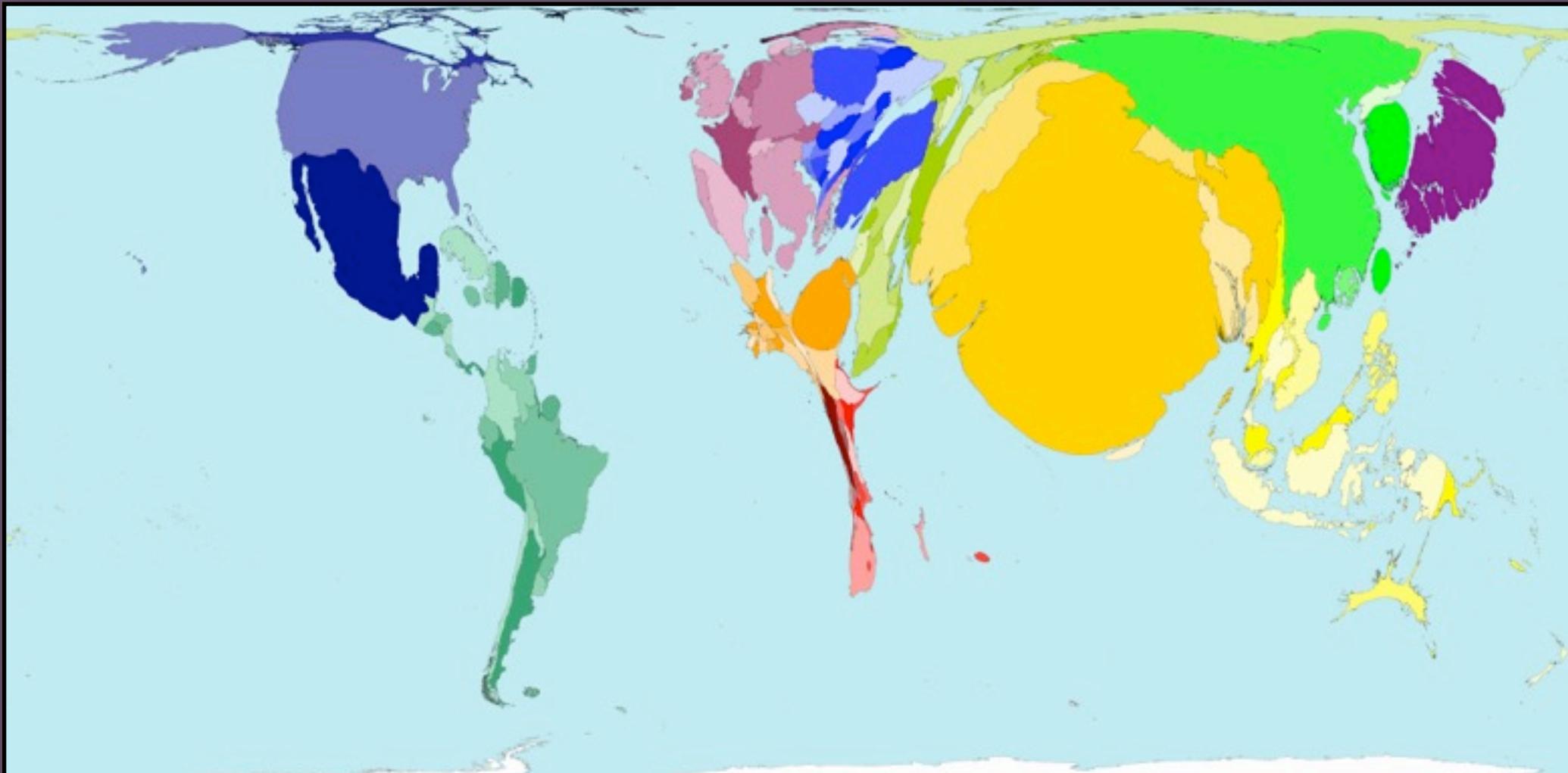
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ANY GUESSES?



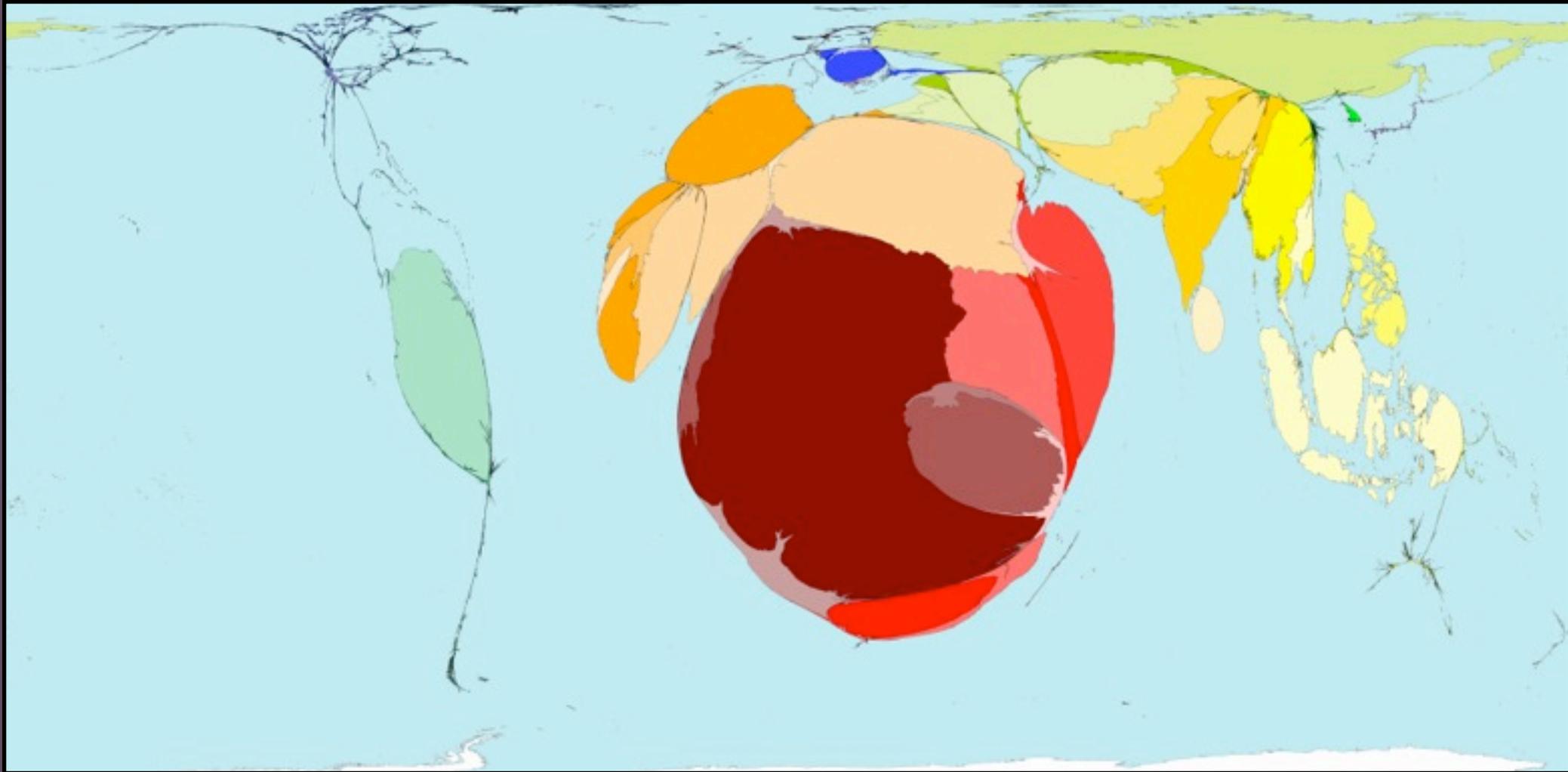
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DIABETES PREVALENCE



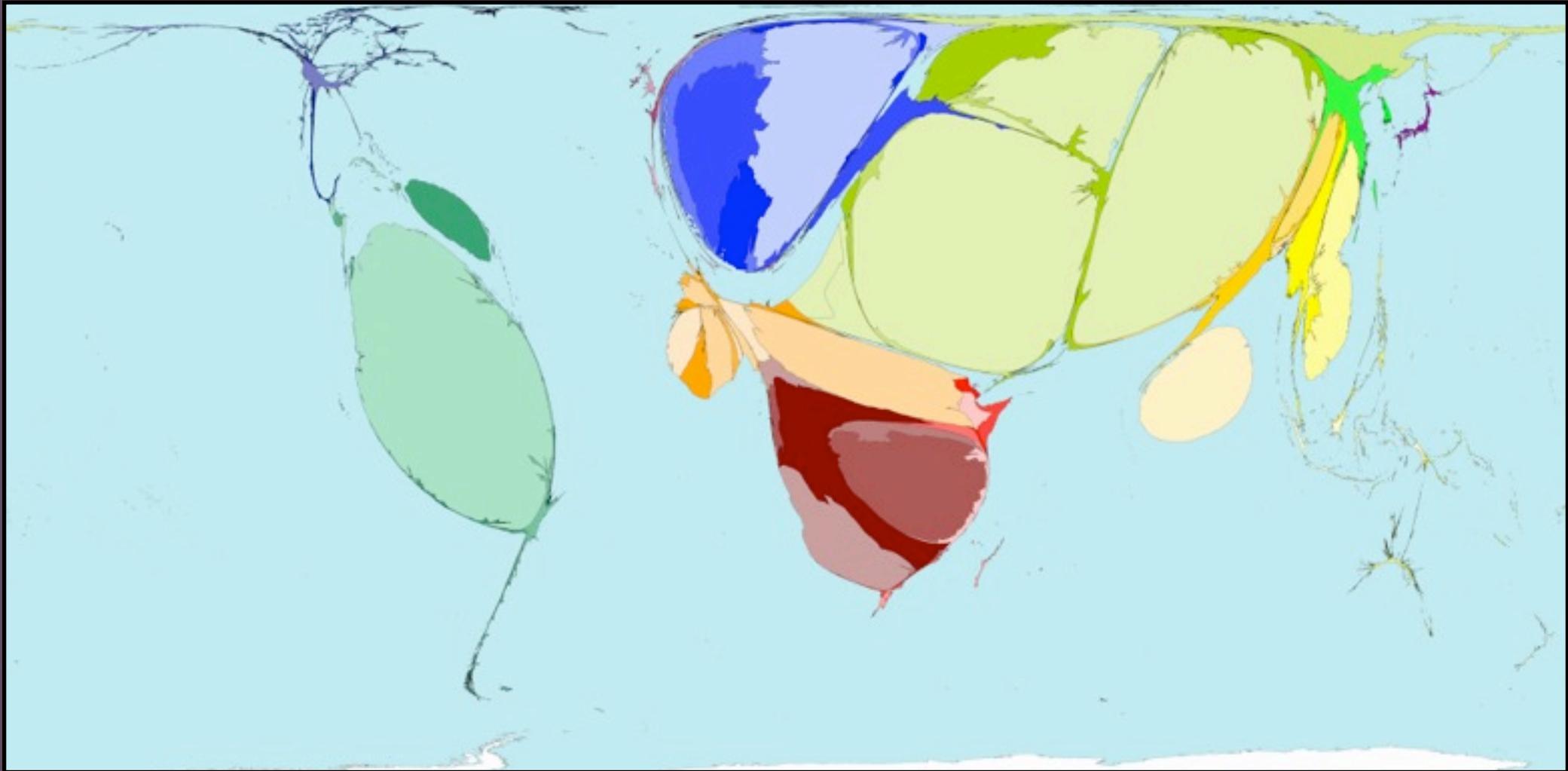
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WAR DEATHS



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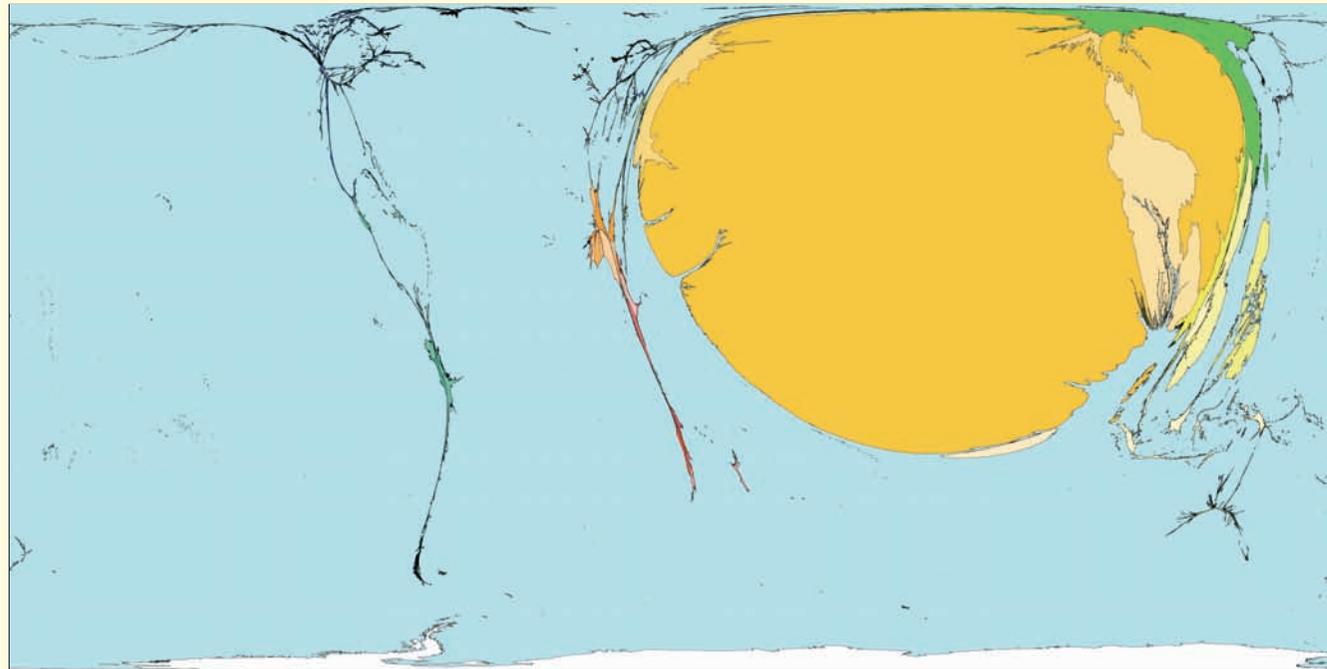
REFUGEE ORIGINS



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HEALTH INEQUALITIES: RABIES DEATHS

Rabies Deaths



Rabies occurs in animals but can be transmitted to humans; for example when bitten by a rabid animal. Once symptoms begin, up to 90 days after the bite, it is almost always fatal. Only human deaths are shown on this map.

India is where 85% of all human rabies deaths occurred between 1995 and 2004. Over this period there were 21404 rabies deaths a year there.

Dogs are responsible for most human deaths worldwide. Where rabies is common, dogs may be feared more than elsewhere. Thorough cleaning and vaccinations after being bitten by a rabid animal can prevent the development of rabies.

Territory size shows the proportion of human deaths from rabies worldwide that occurred there between 1995 and 2004.



Land area

Technical notes

- Data are from the World Health Organization, 2004, Human Resources for Health.
- *Data estimated from regional averages not shown in tables.
- *Only rates from the years with reported data were used.
- See website for further information.

HIGHEST RABIES DEATH RATES

Rank	Territory	Value
1	India	2.27
2	Bangladesh	1.25
3	Gabon	0.92
4	Togo	0.92
5	Namibia	0.87
6	Sri Lanka	0.59
7	Pakistan	0.47
8	Philippines	0.40
9	Viet Nam	0.38
10	Myanmar	0.36

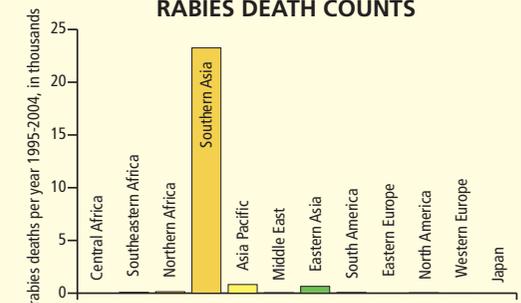
deaths per 100,000 persons per year 1995-2004*

HIGHEST RABIES DEATH COUNTS

Rank	Territory	Value
1	India	30004
2	Pakistan	2490
3	China	2009
4	Bangladesh	2000
5	Viet Nam	1550
6	Myanmar	1100
7	Philippines	398
8	Sri Lanka	168
9	Indonesia	144
10	Uganda	105

most deaths in a year 1995-2004*

RABIES DEATH COUNTS



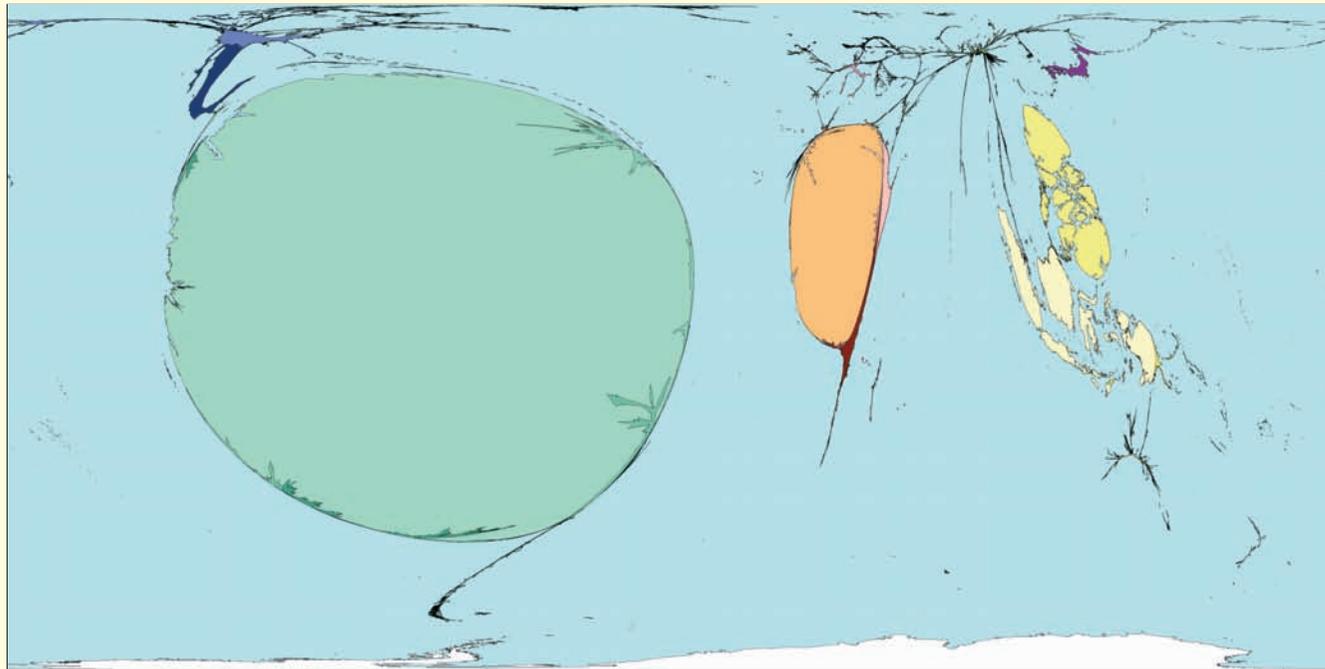
“About 3.5 million dog bites are registered every year in India. The Government cannot give vaccine free of cost to all people. By 2006, the price of vaccine is expected to increase ...”

K. Sandeep, 2002

DETERMINANTS OF DISEASE:

Killed by Volcanoes

The University of Sheffield, M The Leverhulme Trust, Geographical Association
 Produced by the SASI group (Sheffield) and Mark Newman (Michigan)

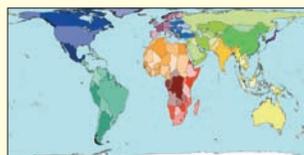


Of all the people killed by volcanoes between 1975 and 2000, 86% died in Colombia. Most of these people died in the town of Armero due to mud flows from the Nevado del Ruiz volcano, on 13th November 1985 - almost 22 thousand deaths were recorded there.

Volcanic activity can endanger human life in various ways: mud flows, lava flows, pyroclastic flows (super-heated toxic gas and debris), collapses and landslides, and the settling of ash and dust. Earthquakes and tsunamis caused by volcanic activity are not included here.

There were no deaths caused by volcanoes between 1975 and 2000 in 183 of the 200 mapped. Volcano-related deaths occurred most frequently in Indonesia, in 9 of the 26 years shown.

Territory size shows the proportion of all people killed by volcanoes between 1975 and 2000, that died there.



Land area

Technical notes
 • Data and definitions are from the United Nations Environment Programme (2005).
 • See website for further information.

TOTAL VOLCANO DEATHS

Rank	Territory	Value
1	Colombia	877.31
2	Cameroon	68.58
3	Philippines	27.65
4	Indonesia	25.35
5	Mexico	4.62
6	United States	3.46
7	Ethiopia	2.46
8	Dem Republic Congo	2.35
9	Japan	1.81
10	Papua New Guinea	0.35

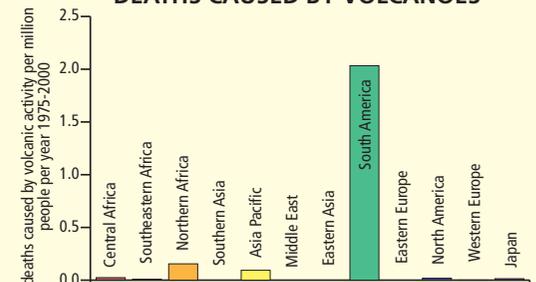
volcano deaths per year 1975-2000*

VOLCANO DEATHS PER MILLION

Rank	Territory	Value
1	Colombia	20.17
2	Cameroon	4.37
3	St Vincent & The Grenadines	0.77
4	Philippines	0.35
5	Indonesia	0.12
6	Timor-Leste	0.09
7	Papua New Guinea	0.06
8	Comoros	0.05
9	Democratic Rep Congo	0.05
10	Mexico	0.05

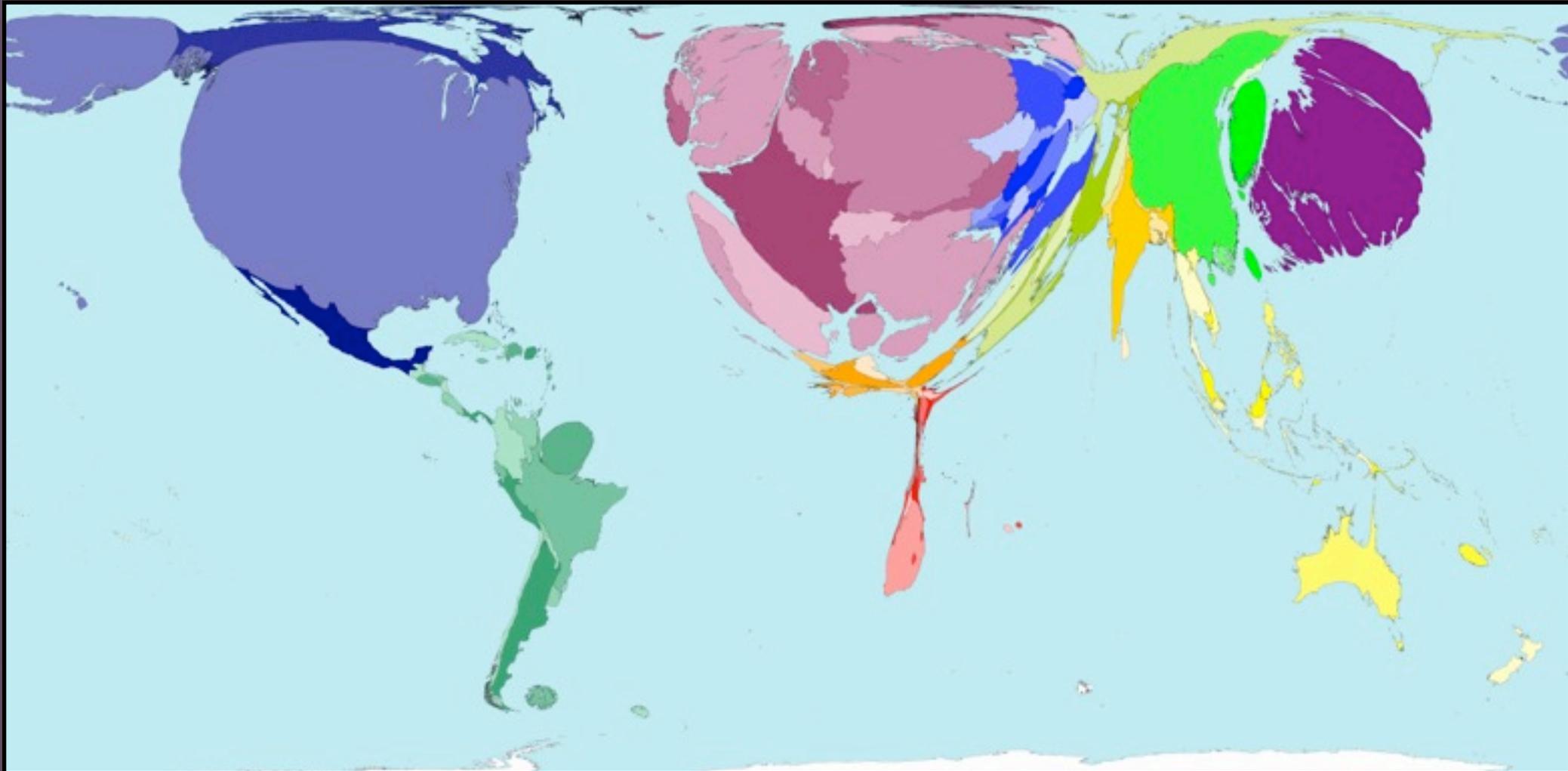
volcano deaths per million people per year 1975-2000*

DEATHS CAUSED BY VOLCANOES



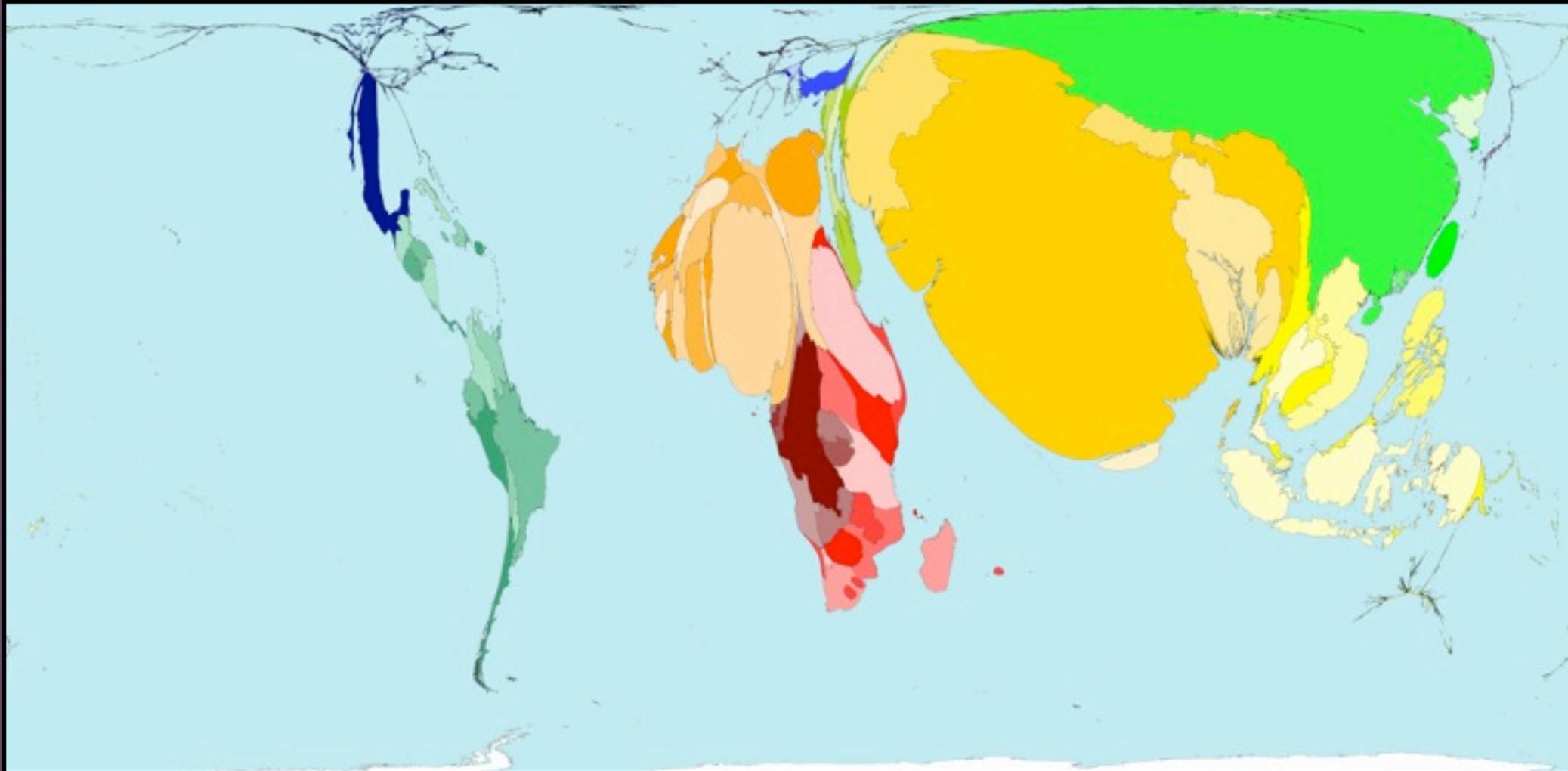
“Since the building was made of cement, I thought that it would resist, but the boulder-filled mud was coming in such an overwhelming way, like a wall of tractors, razing the city, razing everything ...” José Luis Restrepo, 1985

GOVERNMENT HEALTH SPENDING



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PROPORTION LIVING ON \$2 / DAY



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UNDERWEIGHT CHILDREN



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HEALTH INEQUALITIES: LE FOR WOMEN

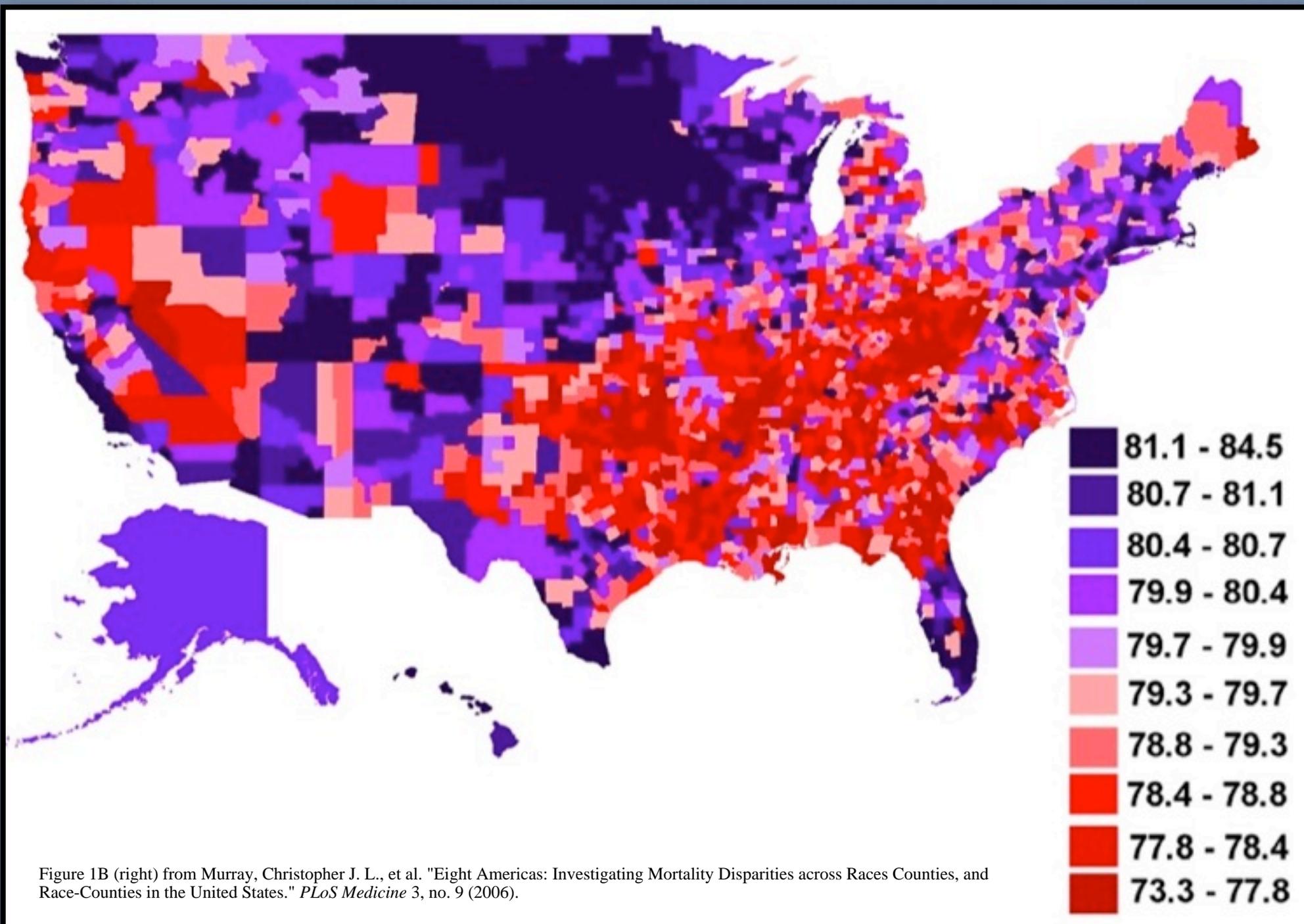


Figure 1B (right) from Murray, Christopher J. L., et al. "Eight Americas: Investigating Mortality Disparities across Races Counties, and Race-Counties in the United States." *PLoS Medicine* 3, no. 9 (2006).

- Red Line • Glenmont to Shady Grove
- Orange Line • New Carrollton to Vienna/Fairfax-GMU
- Blue Line • Franconia-Springfield to Largo Town Center
- Green Line • Branch Avenue to Greenbelt
- Yellow Line • Huntington to Mt Vernon Sq/7th St-Convention Center



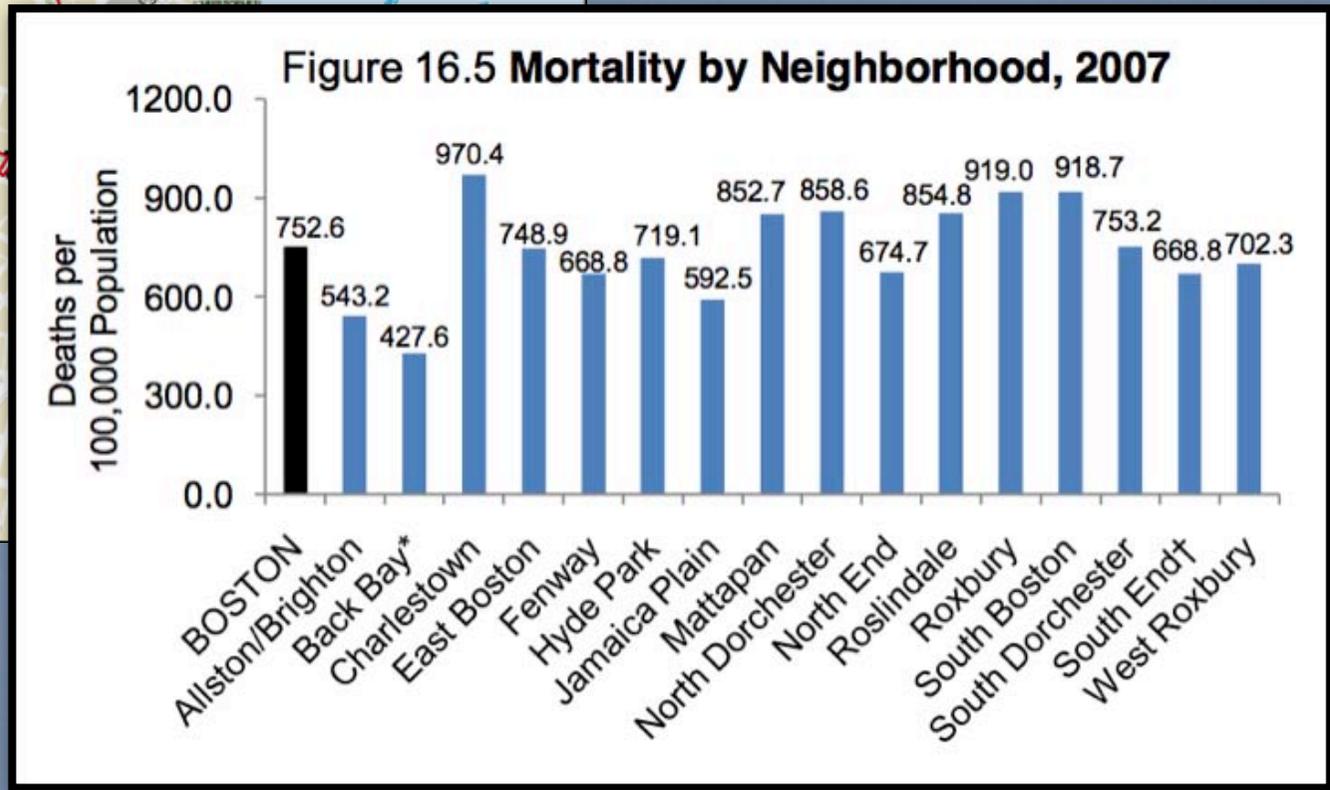
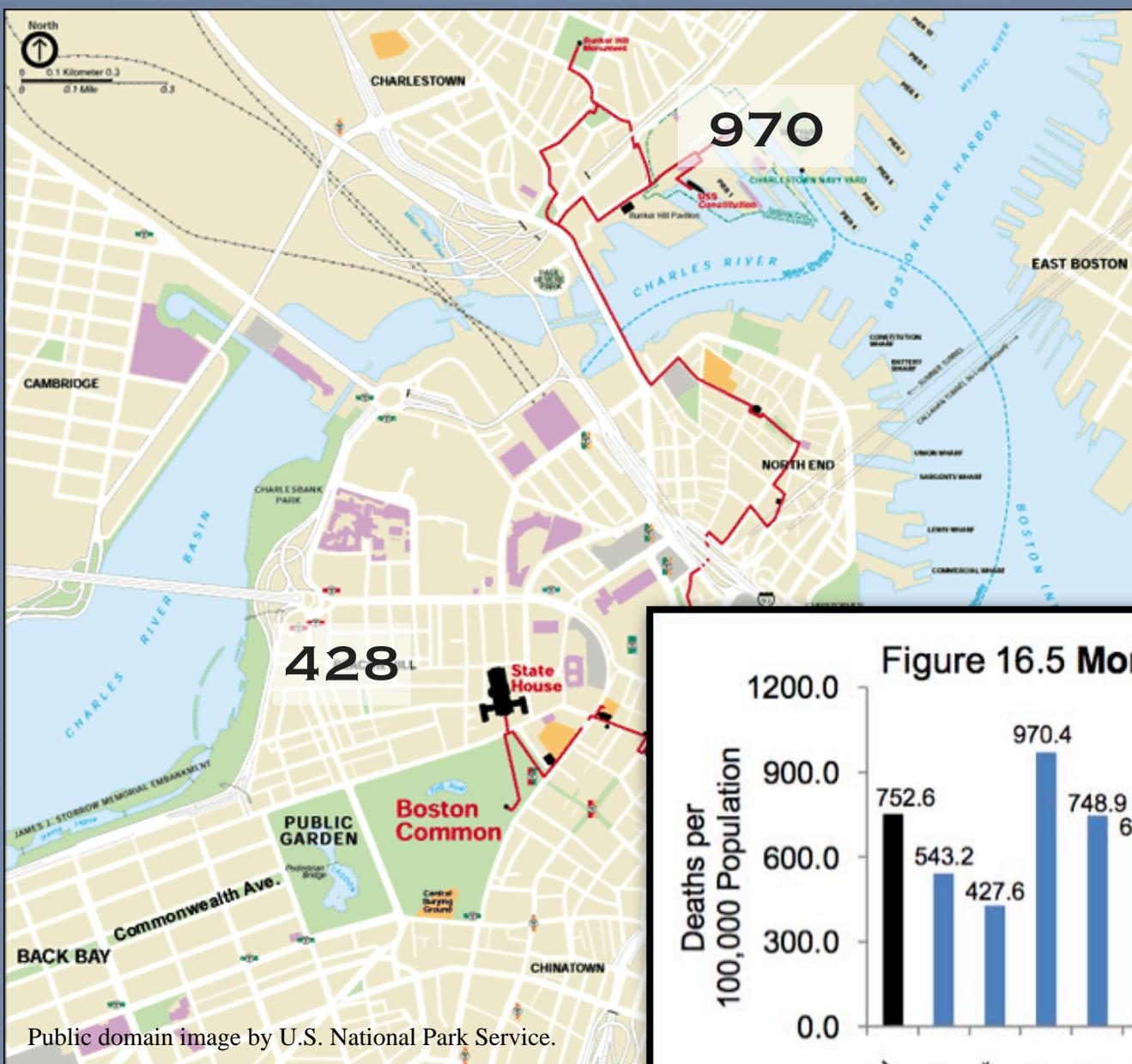
LE 77



LE 57

**LIFE
EXPECTANCY
INCREASES
1.5 YEARS
PER MILE
SE TO NW**

MORTALITY RATE DOUBLES OVER 2 MILES



Boston Public Health Commission. *Health of Boston 2009*. Research and Evaluation Office. Boston, MA, 2009. To access full report, visit <http://www.bphc.org/about/research/hob/Pages/Home.aspx> (accessed September 21, 2010).

The Dartmouth Atlas of Health Care

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For more than 20 years, the Dartmouth Atlas Project has documented glaring variations in how medical resources are distributed and used in the United States. The project uses Medicare data to provide comprehensive information and analysis about national, regional, and local markets, as well as individual hospitals and their affiliated physicians.

These reports, used by policymakers, the media, health care analysts and others, have radically changed our understanding of the efficiency and effectiveness of our health care system. This valuable data forms the foundation for many of the ongoing efforts to improve health and health systems across America.

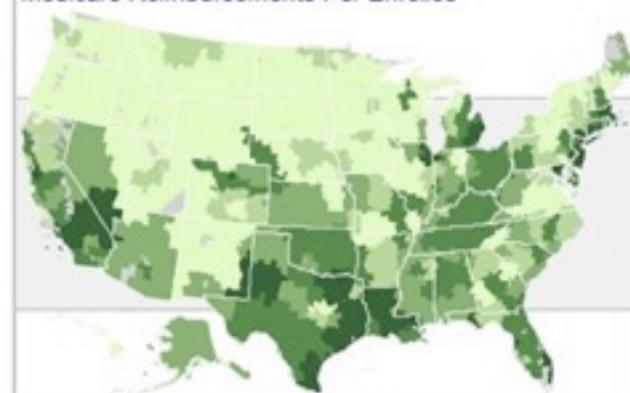
This website provides access to all Atlas reports and publications, as well as interactive tools to allow visitors to view specific regions and perform their own comparisons and analyses.

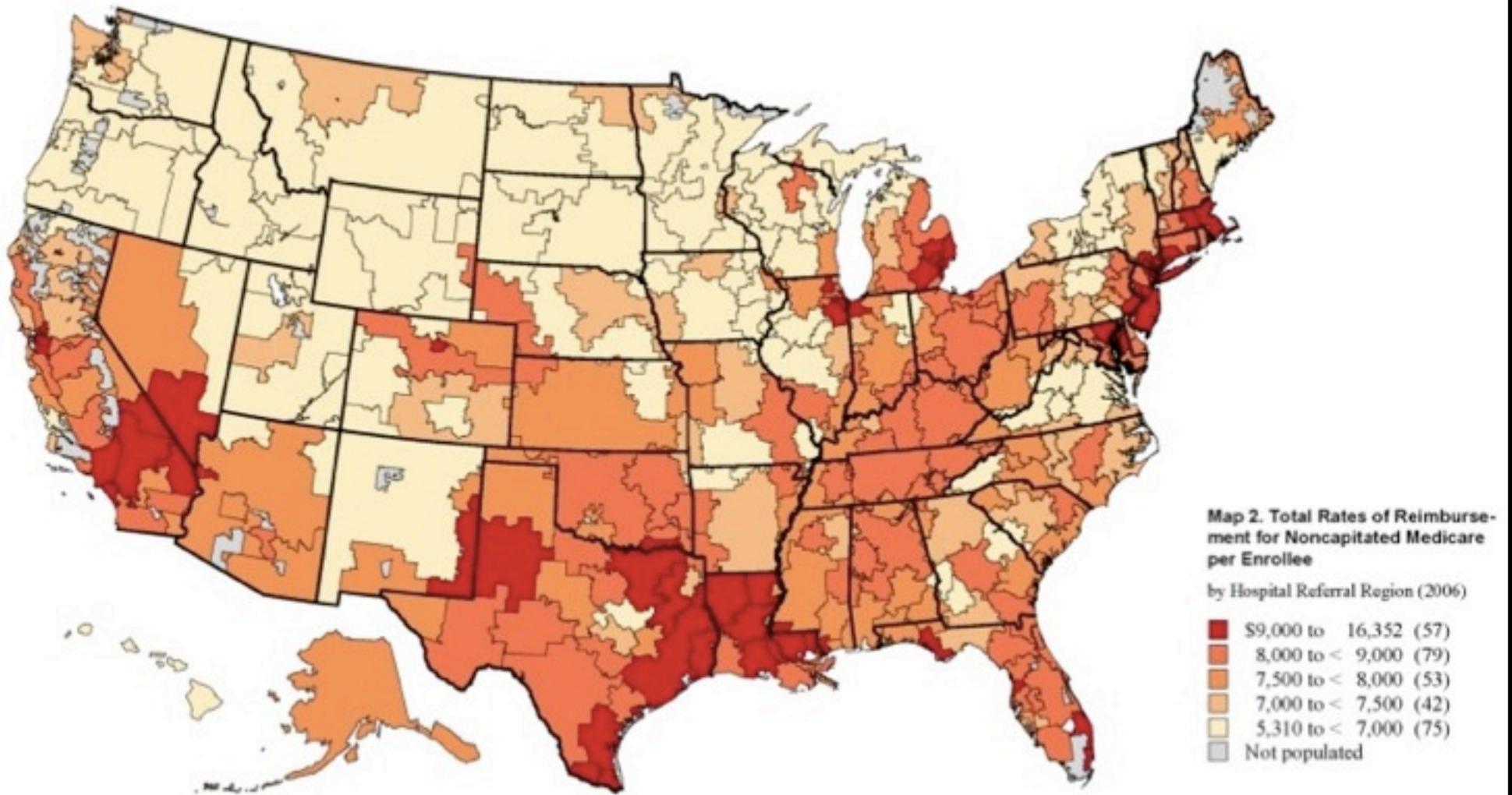
spotlight

Taming Wide Variations in Spending Key to Health Reform—*New England Journal of Medicine* Commentary from Dartmouth Atlas Project.

Huge inefficiencies in the U.S. health care system are hamstringing the nation's ability to expand access to care, according to a new analysis of Medicare spending by researchers of the Dartmouth Atlas Project, published February 26, 2009 in the *New England Journal of Medicine*. Many experts have blamed the growth in spending on advances in medical technology. But the differences in growth rates across regions show that advancing technology is only part of the explanation. Patients in high-cost regions have access to the same technology as those in low-cost regions, and those in low-cost regions are not deprived of needed care. On the contrary, the researchers note that care is often better in low-cost areas. The authors argue that the differences in growth are largely due to discretionary decisions by physicians that are influenced by the local availability of hospital beds, imaging centers and other resources—and a payment system that rewards growth and higher utilization.

Medicare Reimbursements Per Enrollee





Map 2 from Fisher, Elliot, Julie Bynum, and Jonathan Skinner. "The Policy Implications of Variations in Medicare Spending Growth." Brief Report by The Dartmouth Institute for Health Policy and Clinical Practice, 2009. Used with permission.





The FAIR

Fair Allocations In Research

FOUNDATION



Our Government's Bio-Medical Research Allocations by the National Institutes of Health

Disease	<u>2011 NIH Research \$\$</u>	Deaths Per Disease	\$\$ Per Patient Death	\$\$ Per Patient
COPD *	101 Million	126,128 (i)	\$ 811	\$ 7
Hepatitis C	102 Million	12,000 (g)	\$ 8,500	\$ 23
Cardiovascular Dis.	2.1 Billion	864,280 (b)	\$ 2,429	\$ 26
Hepatitis B	54 Million	5,000 (h)	\$ 10,800	\$ 43
Diabetes	1 Billion	72,449 (c)	\$ 13,803	\$ 42
Alzheimer's Dis.	480 Million	71,696 (d)	\$ 6,626	\$ 92
Parkinson's Dis.	171 Million	19,566 (f)	\$ 8,739	\$ 171
Prostate Cancer	329 Million	28,372 (e)	\$ 11,595	\$ 219
HIV/AIDS	3.2 Billion	14,110 (a)	\$ 225,656	\$ 3,032
All Cancers Total	6 Billion	559,888 (k)	\$ 10,716	\$ 4,152
Breast Cancer	765 Million	41,210 (k)	\$ 18,563	\$ 4,238
West Nile Virus	41 Million	28 (j)	\$1,464,285	\$ 64,364

CHALLENGES OF HEALTH INEQUALITIES

- CAN OUR EXPLANATIONS OF DISEASE PROVIDE AN ADEQUATE EXPLANATION OF HEALTH INEQUALITIES?
- CAN OUR HEALTH POLICIES, BASED ON THIS UNDERSTANDING, ALLEVIATE INEQUALITIES?
- WILL DESIRE FOR HEALTH AND SOCIAL JUSTICE MOTIVATE ADEQUATE RESPONSES?

SOURCES OF DATA

Deaths, Preliminary Data for 2004. National Center for Health Statistics.
www.cdc.gov/nchs/data/hestat/preliminarydeaths04_tables.pdf

The Health of Boston, 2008. Boston Public Health Commission.

“Gapminder World 2006.” <http://www.gapminder.org>

Global Burden of Disease and Risk Factors. Disease Control Priorities Project. <http://www.dcp2.org/pubs/GBD>

Lopez, Alan D., Colin D. Mathers, Majid Ezzati, Dean T. Jamison, and Christopher J.L. Murray. “Global and Regional Burden of Disease and Risk Factors, 2001: Systematic Analysis of Population Health Data.” *Lancet* 367 (27 May 2006): 1747-1757.

Mathers, Colin D., and Dejan Loncar. “Projections of Global Mortality and Burden of Disease from 2002 to 2030.” *PLoS Medicine* 3 (November 2006): 2011-2030.

Hospitalization in the United States, 2002. Agency for Healthcare Research and Quality.
www.ahrq.gov/data/hcup/factbk6/factbk6.pdf

National Ambulatory Medical Care Survey: 2004 Summary. National Center for Health Statistics.
<http://www.cdc.gov/nchs/data/ad/ad374.pdf>

National Hospital Ambulatory Medical Care Survey: 2005 Emergency Department Summary.
<http://www.cdc.gov/nchs/data/ad/ad386.pdf>

“Worldmapper: The World As You’ve Never Seen It.” <http://www.worldmapper.org/>

Murray, Christopher J.L., Sandeep C. Kulkarni, Catherine Michaud, Niels Tomijima, Maria T. Bulzacchelli, Terrell J. Landiorio, and Majid Ezzati. “Eight Americas: Investigating Mortality Disparities across Races, Counties, and Race-Counties in the United States.” *PLoS Medicine* 3 (September 2006): e260, 1-12.

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Spring 2010

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