The Actuarial Profession
making financial sense of the future

The changing medical environment
Dr John Schoonbee, Chief Medical Officer, Swiss Re Europe

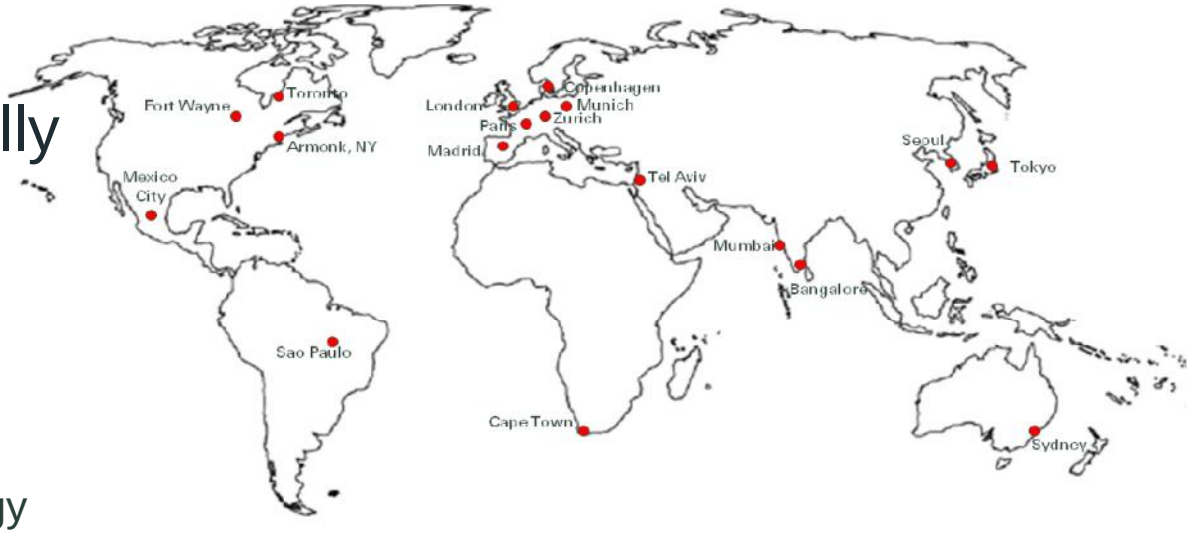
How much do we really know about longevity?

12 June 2012, London

Swiss Re Medical Officers Global Network

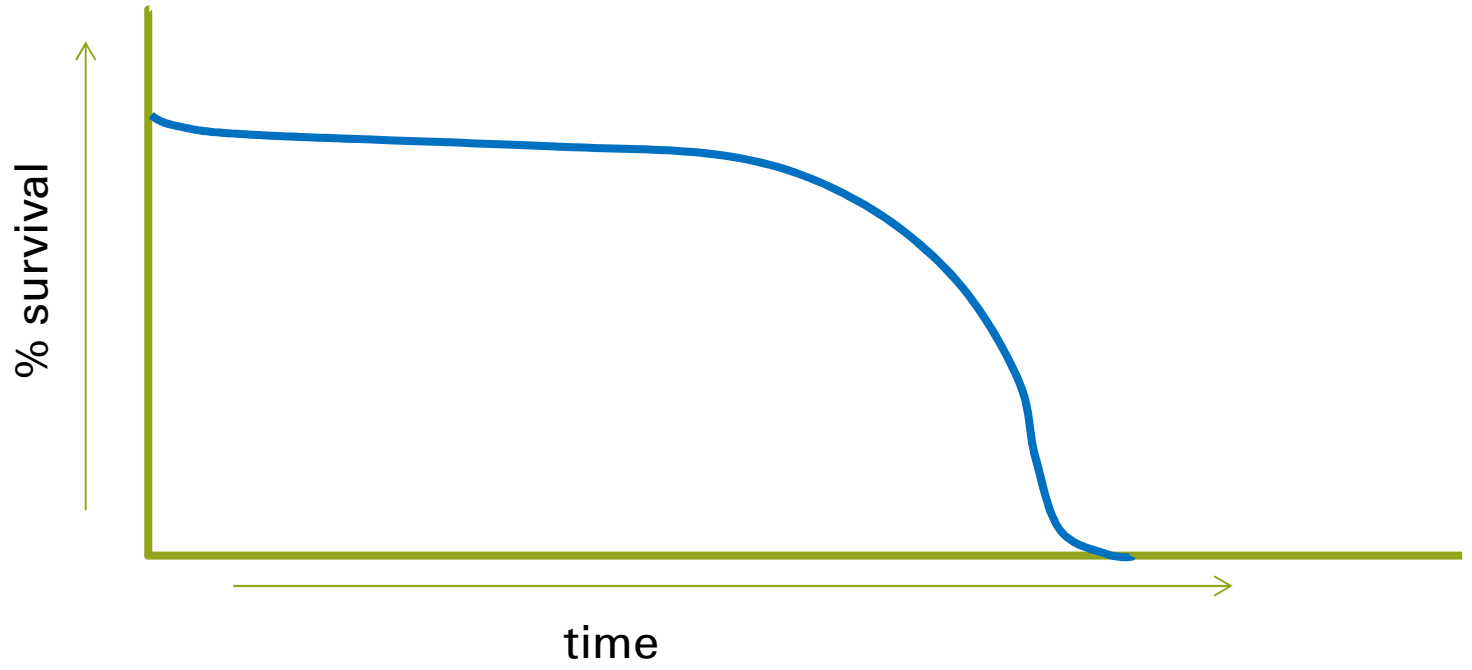
Swiss Re Medical Officers Global Network

- 36 medical officers globally
- spanning all 6 continents
- covering 15 languages
- Specialities include
  - oncology
  - cardiology
  - surgery
  - psychiatry
  - neurology
  - geriatrics
  - hepatology
  - diabetology
  - internal medicine
  - occupational medicine
  - intensive care/ER
  - epidemiology



Today’s theme – survival curve shifts

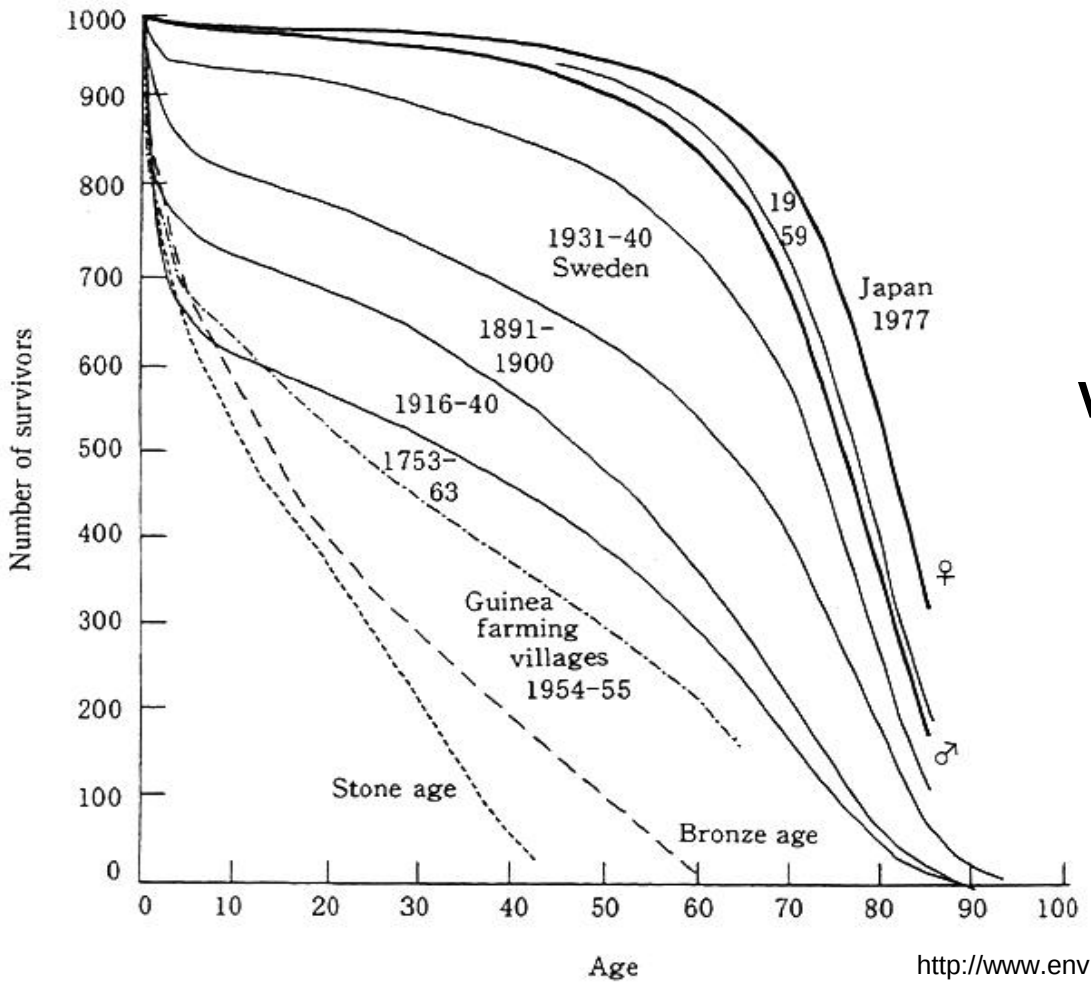
How is the changing medical environment related to the "Mortality Improvement Assumption"



Mortality improvement assumption

- Very important aspect of pricing life insurance
  - Margins decreasing
  - WOL products incentivised for intermediaries to sell
  - Older age u/w increasing
  - Annuities and impaired annuities (thank goodness)
  - LTC becoming more relevant

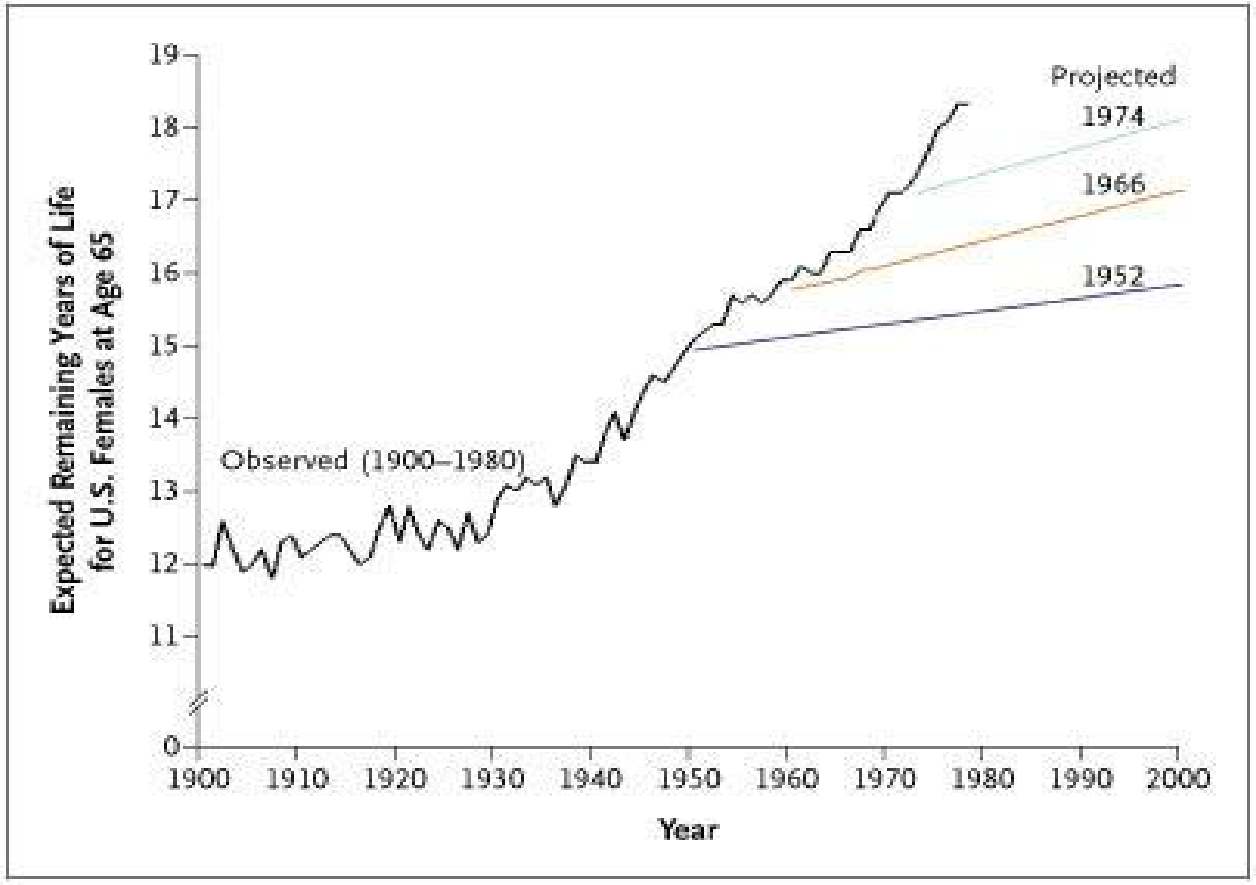
History of survival



what's next ?

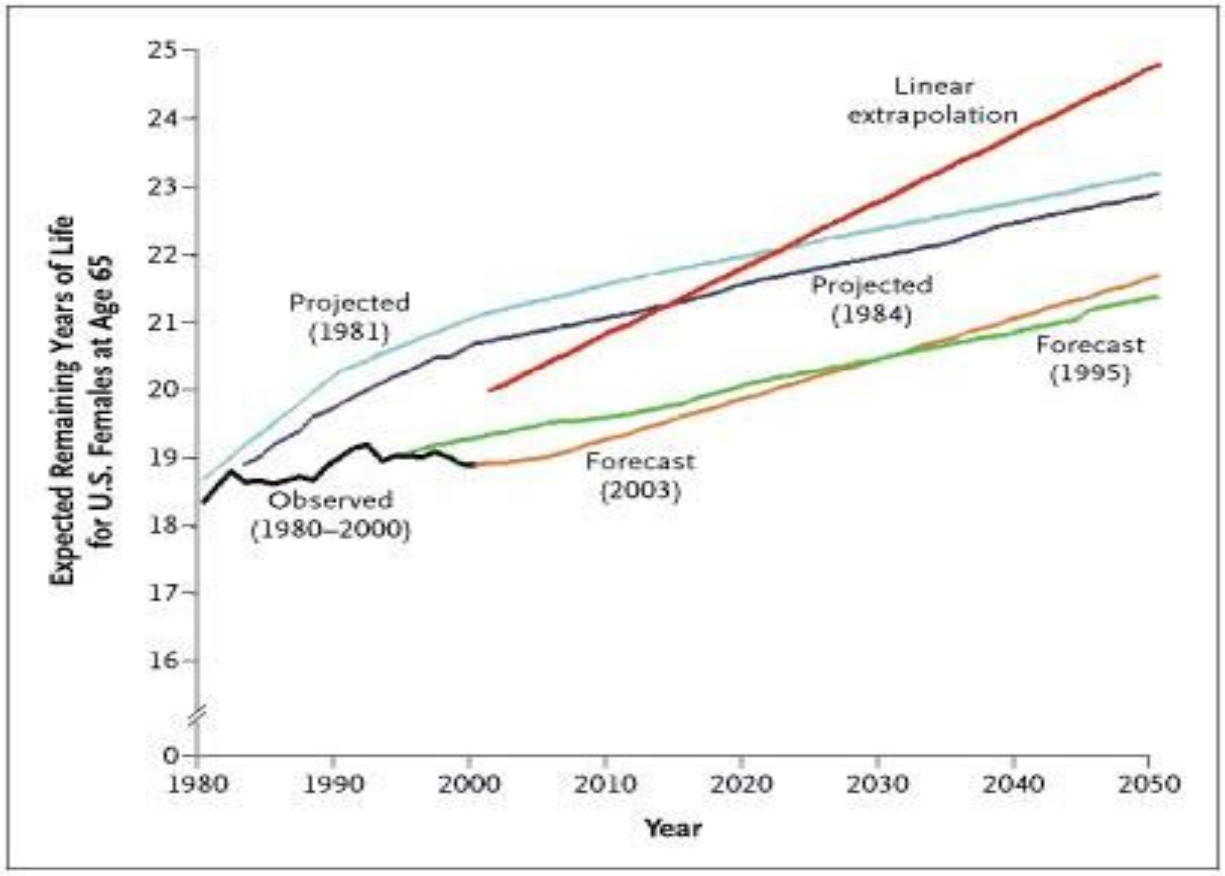
http://www.env.go.jp/en/wpaper/1995/eae240000000000.html

Life expectancy for U.S. females (to 1970)



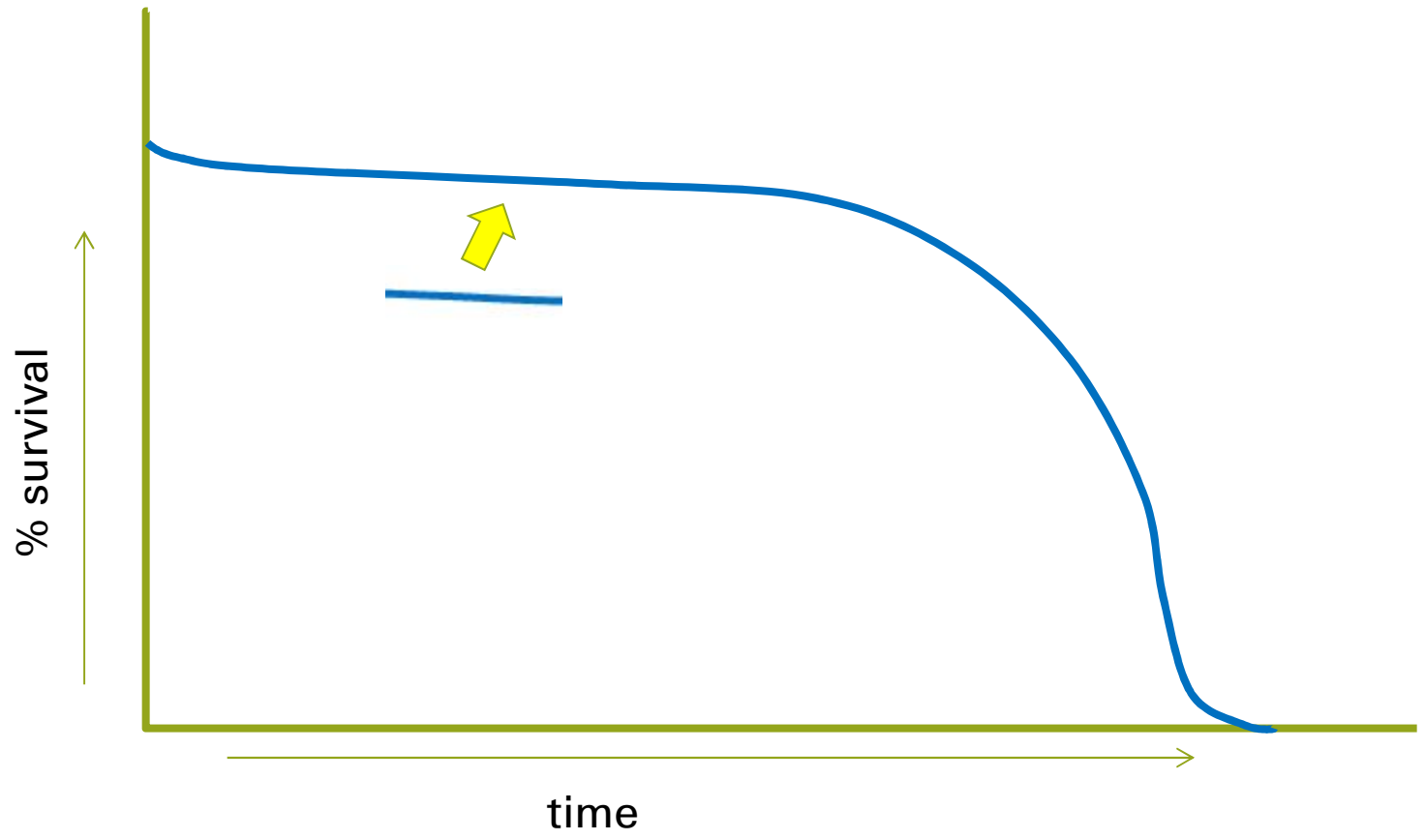
Olshansky, SJ et al, NEJM, March 17,2005;352 (11):1138

Life expectancy for U.S. females (to 2050)



Olshansky, SJ et al, NEJM, March 17,2005;352 (11):1138

Survival curve : shift 1



Landmark publication (Lancet 2003) Jaggy et al.

- Original cohort
  - Switzerland
  - original study 1997-2001

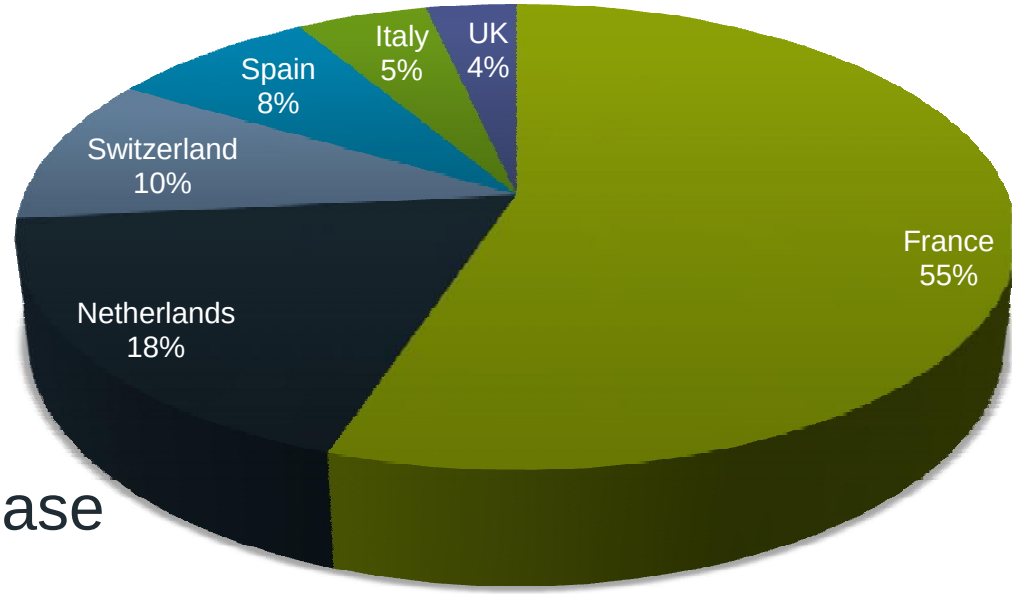
…"Patients with successfully treated cancer have much the same excess death rates but are not excluded from life insurance policies". (Extracted from abstract)

	Hepatitis-C negative			Hepatitis-C positive		
	Patients (follow-up years)	Deaths	EDR (95% CI)	Patients (follow-up years)	Deaths	EDR (95% CI)
All	2318 (7598)	134	14·0 (11·3–17·2	1645 (5313)	211	38·1 (33·2–43·7)
Successfully treated patients						
CD4 >250 (cells/μL)	1567 (4498)	35	4·2 (2·0–7·2)	944 (2521)	59	21·7 (16·5–28·4)
CD4 >250 (cells/μL), and viral load <400 (copies/mL)	1281 (3594)	25	3·4 (1·1–6·7)	726 (1894)	42	20·5 (14·8–28·1)
CD4 >250 (cells/μL), and viral load >400 (copies/mL)	274 (861)	10	8·0 (2·7–17·6)	215 (618)	17	25·9 (15·6–42·0)
CD4 >250 (cells/μL), and viral load <400 (copies/mL), but CD4 nadir <250 cells/μL before HAART	545 (1564)	11	3·1 (0·0–8·6)	425 (1118)	28	23·3 (15·6–34·2)
Patients with unsuccessful treatment						
CD4 count never >250 cells/μL	257 (620)	76	117·4 (93·9–145·6)	309 (777)	89	112·7 (92·2–137·0)

Excess death rates (EDR) per 1000 patient-years in Swiss patients of the SHCS, 1997–2001

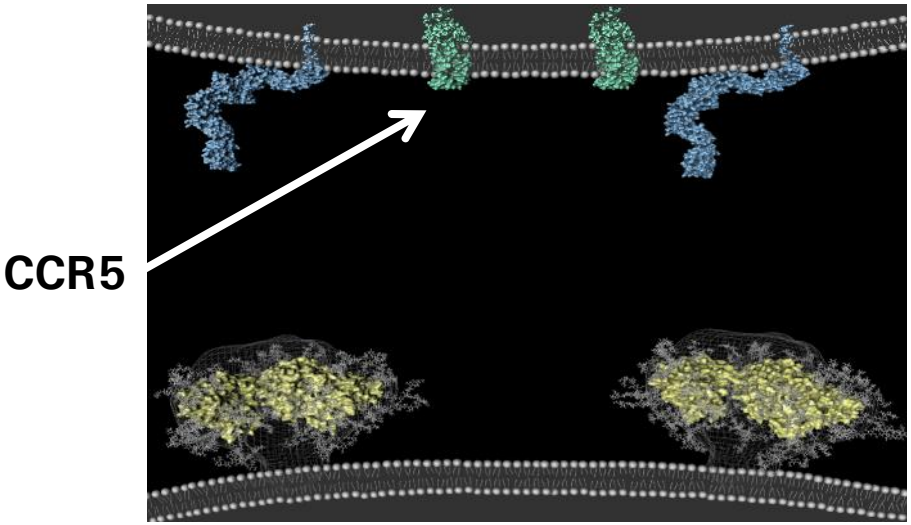
Expansion of the Jaggy et al. study

- Collaboration
  - Swiss Re
  - ART Cohort Collaboration
- Expanded study
  - based on the ART-CC database
  - 10 cohorts in 6 countries
  - longer period of analysis – 1997-2008
  - over 34 000 patients with known CD4+ count and viral load count at 6 months after starting ART
- Review expected to be completed shortly



Cure is possible

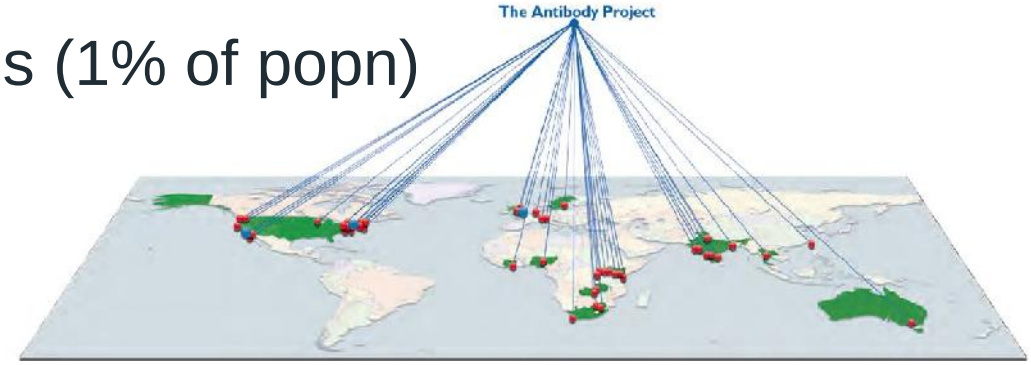
Timothy Brown
Science. 2011 May 13;332(6031):784-5, 787-9.



Vaccines

- RV144 or Thai trial (2003-6)
  - ALVAC HIV, AIDSVAX B/E
- Broadly neutralising antibodies (1% of popn)

Dr Wayne Koff, IAVI



Simek etal, J Virol, 2009

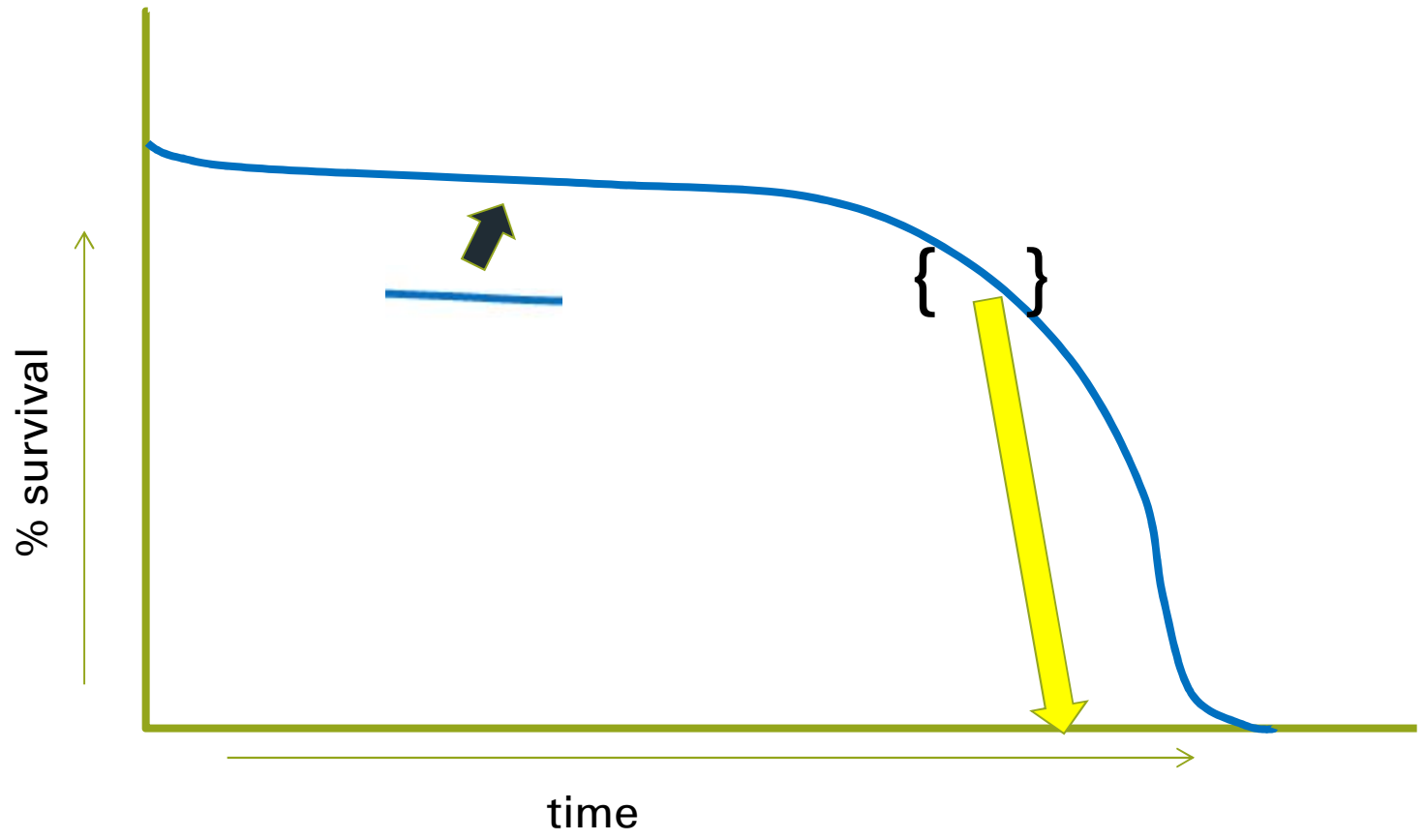
- In a recent study, thirteen of 24 RM receiving either single or combination vectors (CMV/adenovirus) manifested early complete control of SIV (undetectable plasma virus), and in 12/13 of these RM, we observed long-term (≥1 year) protection

Nature. 2011 May 26;473(7348):456-7.

HIV cure significant for life insurance?

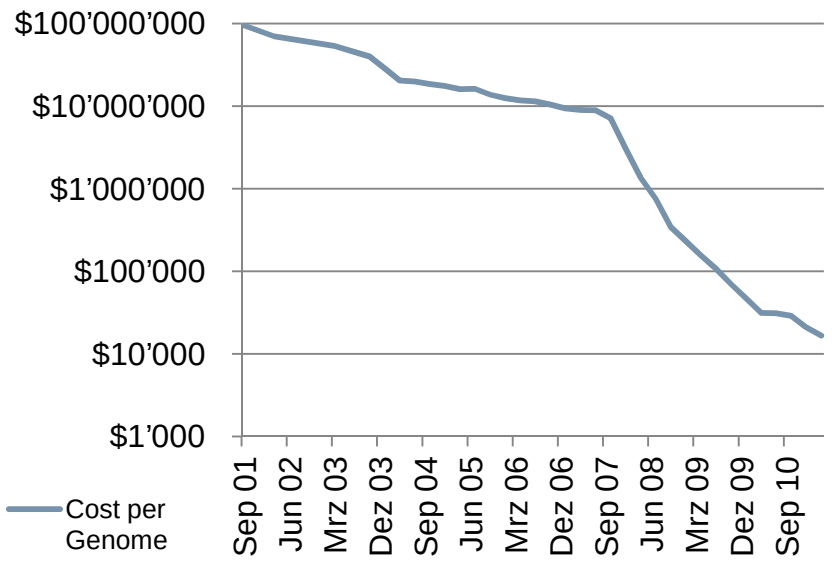
- For the general higher SEC classes, not that relevant
- Lower SEC insurance → lower HIV loadings (dependent on accessibility and affordability)
- Risk for CI products with products that pay out for becoming HIV positive, but in their definitions, do not address non lethality, treatment or cure
  - a good example of "future proofing" definitions

Survival curve : shift 2



Genomic sequencing – the "game changer"
Key area for long-term R&D assessment

- Unprecedented acceleration in sequencing

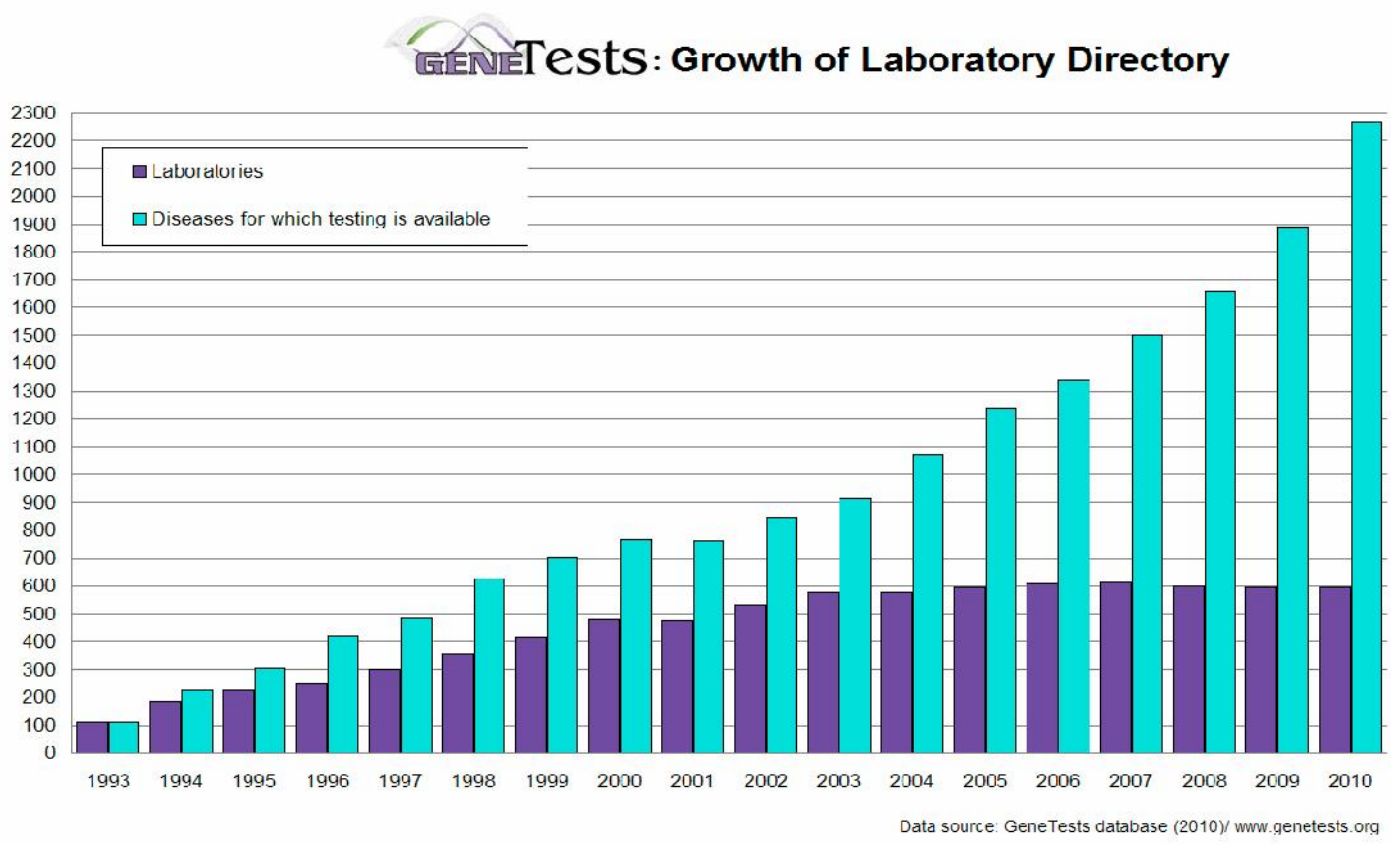


- George Church (Harvard Medical School) predicting 100 million individuals tested in next 5 years at sub $1000 cost
- Contrary forces to potential improvements
  - Rejection of technology across
  - Likely disillusionment through over-promising diagnostics in next decade
  - Disease management vs. curative treatment – Pharma business model
  - Contributory role of both genetics and environment to most diseases

Increase in number of tests offered

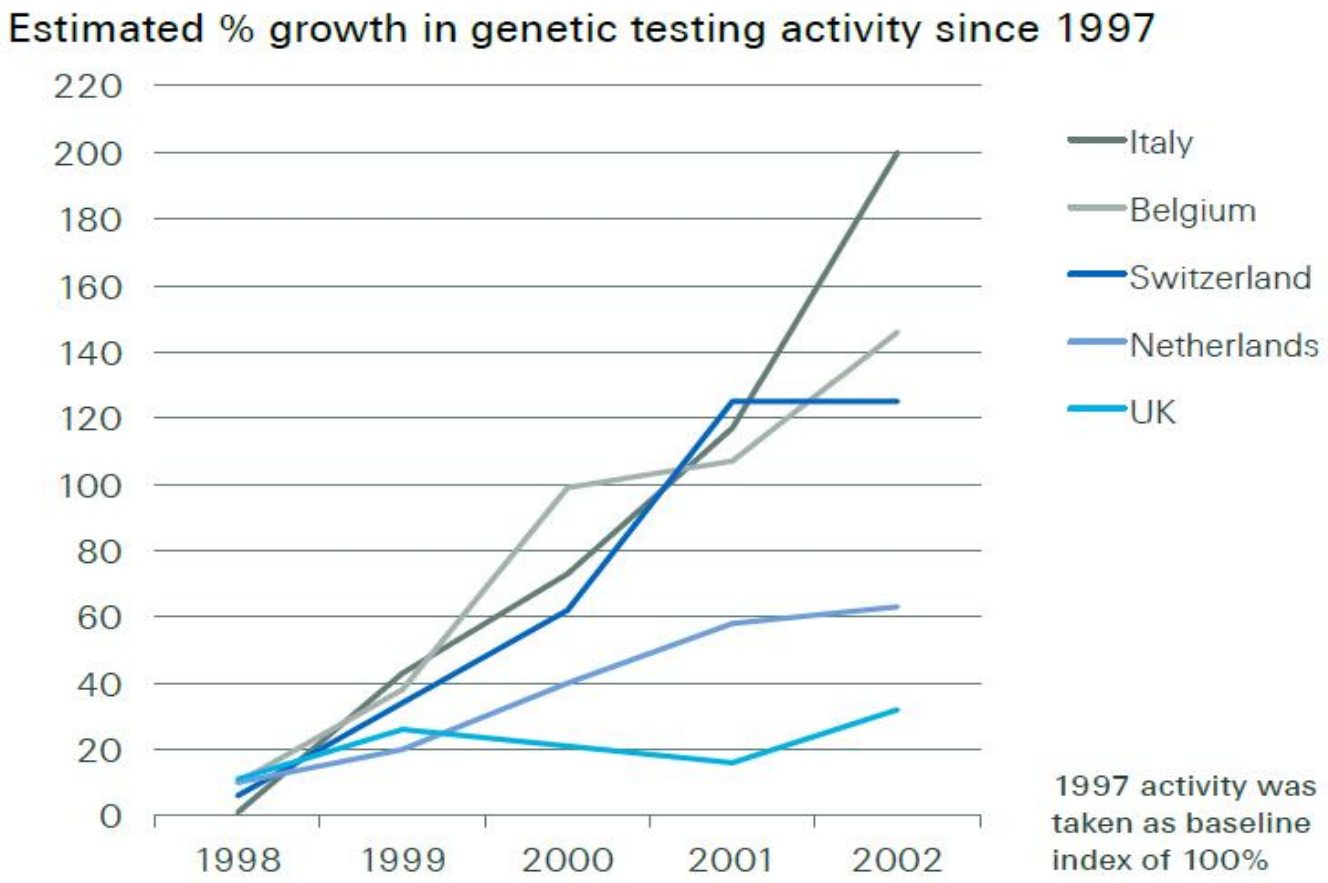
GeneTests
- 2,433 disease-genes
- 1,171 tests in clinics
- 602 laboratories
- 541 GeneReviews

UKGTN
- 541 genetic diseases tested in UK Genetic Testing Network



Increase in number of tests done

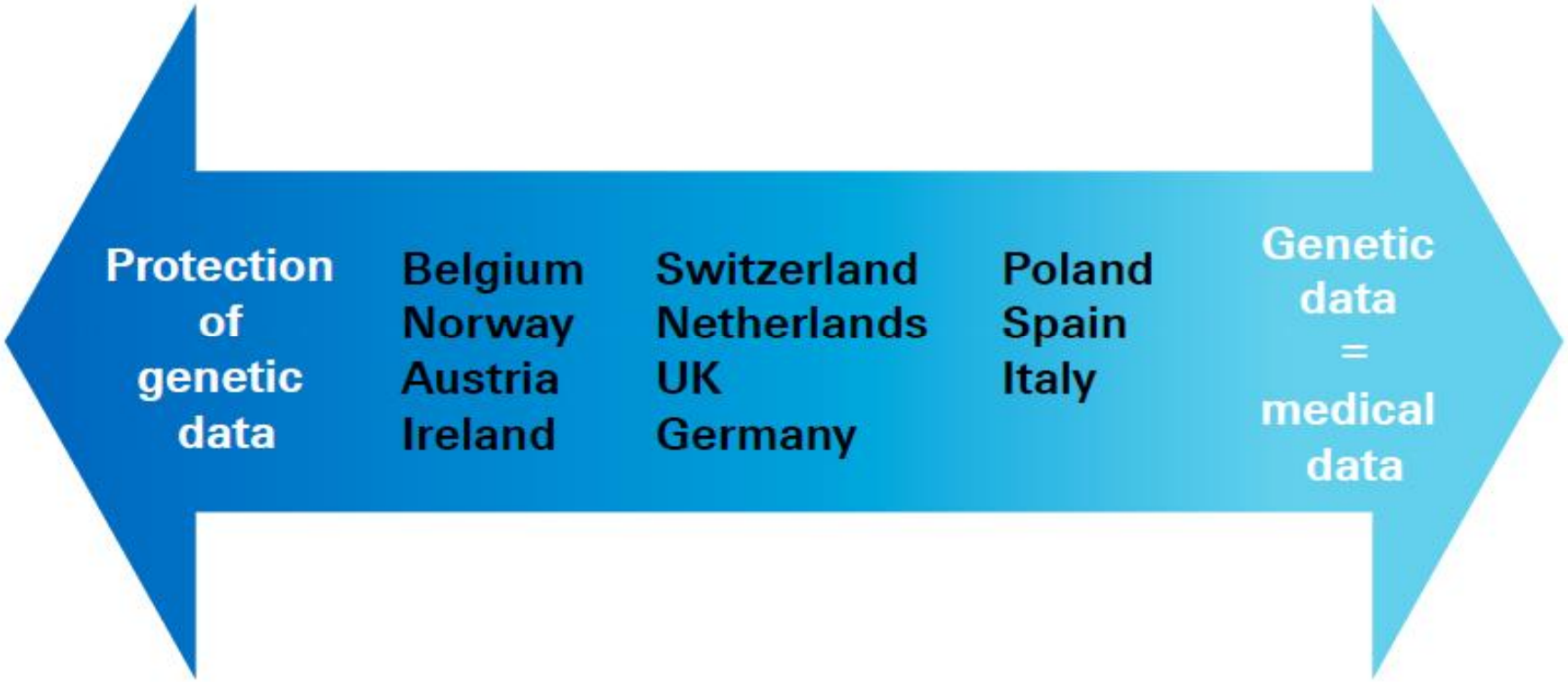
In 2002 in Europe 700,000 genetic tests were done in 1500 laboratories for use in clinical practice.



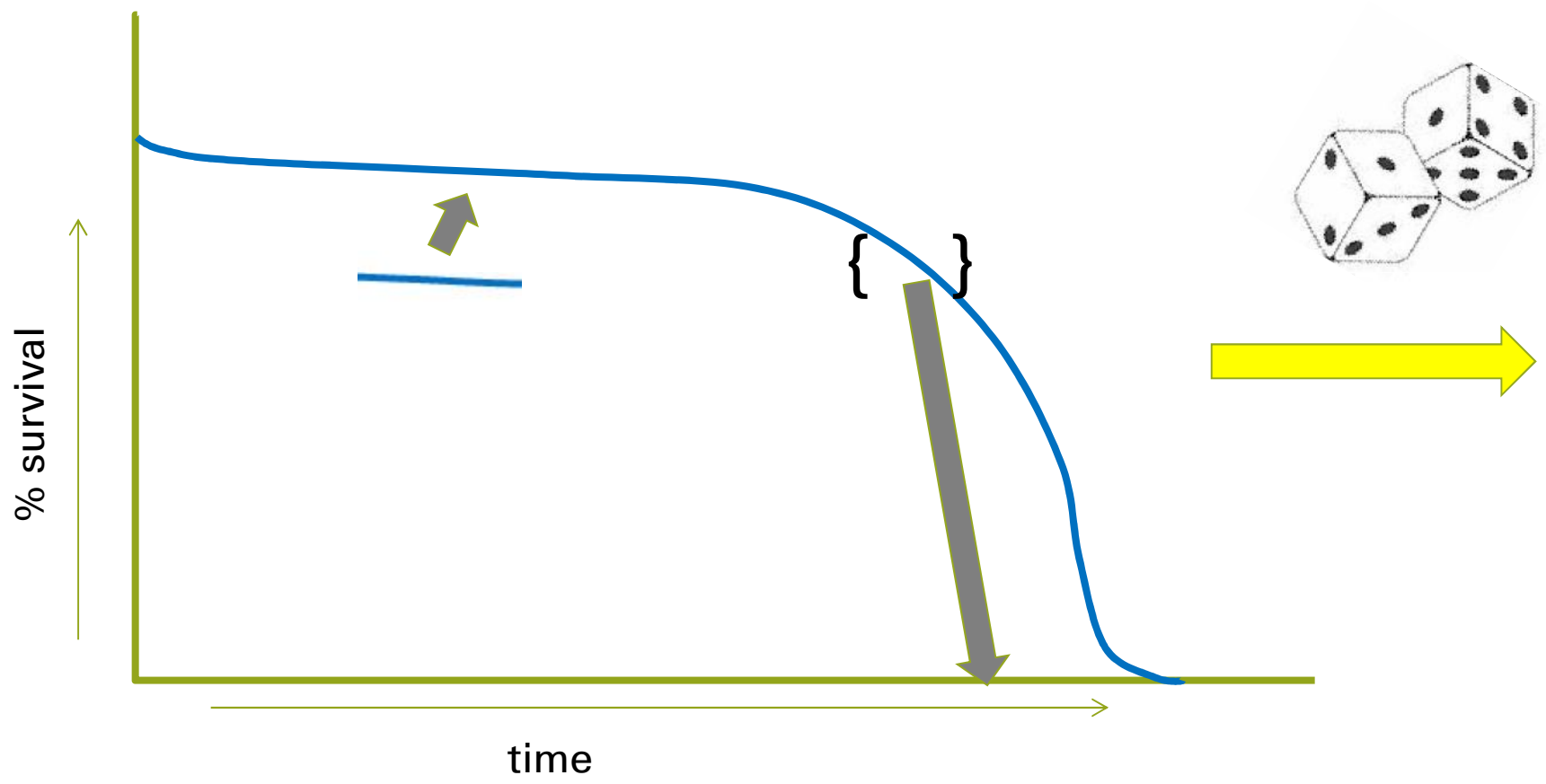
Ibarreta et al. EC Sep 2003 EUR 20977 EN

50% of insurance seminar audience said they would go for genetic testing.

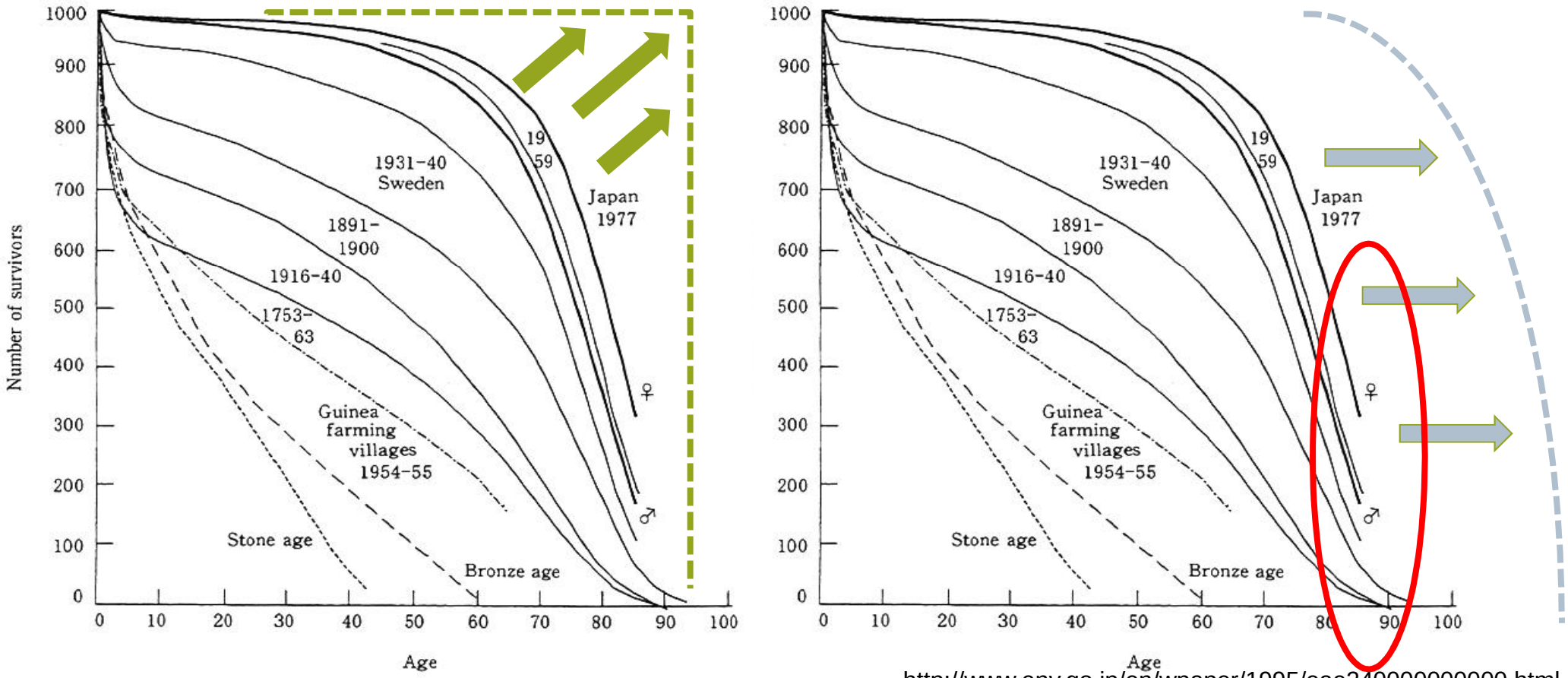
Legislation will leave individuals more and more able to select against life insurers



Survival curve : shift 3



Future of longevity – "Rectangularisation" or Methuselah



http://www.env.go.jp/en/wpaper/1995/eae240000000000.html

Age-specific contributions to the increase in record life expectancy : women from 1850 to 2007

	1850–1900	1900–25	1925–50	1950–75	1975–90	1990–2007
0–14 years	62·13%	54·75%	30·99%	29·72%	11·20%	5·93%
15–49 years	29·09%	31·55%	37·64%	17·70%	6·47%	4·67%
50–64 years	5·34%	9·32%	18·67%	16·27%	24·29%	10·67%
65–79 years	3·17%	4·44%	12·72%	28·24%	40·57%	37·22%
>80 years	0·27%	−0·06%	−0·03%	8·07%	17·47%	41·51%

Declining early/mid-life mortality

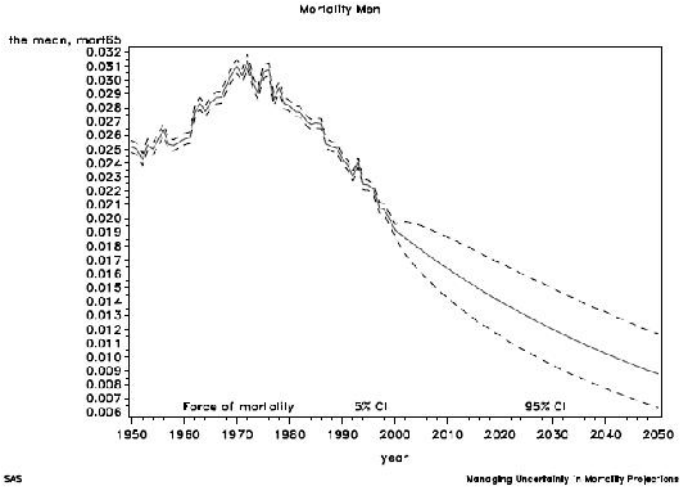
Declining later life mortality

Lancet 374:1196(2009). Data derived from the Human Mortality Database and from Oeppen J, Vaupel JW. Broken limits to life expectancy. Science 2002; 296: 1029–31.

Ageing and Longevity

- Mathematical models ≠ biological permissibility

- What causes ageing?



Swiss Association of Actuaries, 2002

... concept of an "ageing gene" – no such thing

- "… senility is … an artifact of domestication; that is, something revealed and made manifest only by the most unnatural experiment of prolonging an animal's life by sheltering it from the hazards of its ordinary existence."

Peter Medawar, An Unsolved Problem in Biology, 1951
(Nobel Prize in Physiology or Medicine: 1960)

Disposable soma theory

- 2 jobs : reproduction and maintenance
- maintenance cannot get 100%
- hence senescence is a byproduct (not a component) of our biology (we are not designed to die, but we are not designed to live forever)
- Senescence has many modalities
  - most if not all of which are stochastic
  - these are ubiquitous, continuous and affect everything
  - their effects accumulate, interact and create emergent effects
- Cost of longevity
  - reduced developmental viability, increased developmental lethality
  - age-dependent infertility (FOXO3). premature ovarian failure (FOXO3)

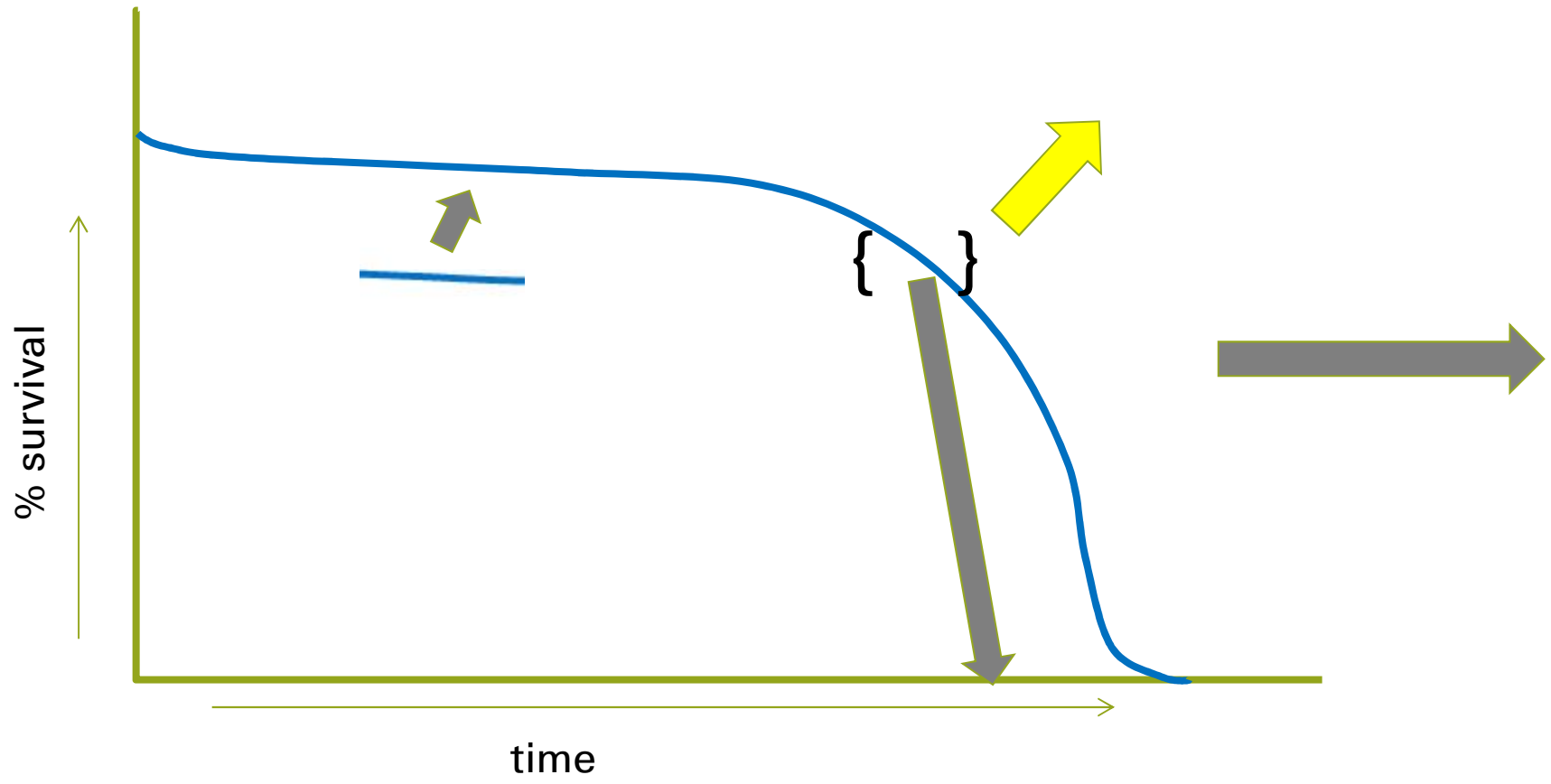
Impact of wrong longevity assumptions

- Life insurance assumptions perhaps overzealous and need to be throttled back
- Long guarantees and whole of life increases risk
- Annuities will offset this to a degree

(1013 cells) x (3 x 109 base pairs) x (2 x 103 polypeptides) = 6×10^{25} targets

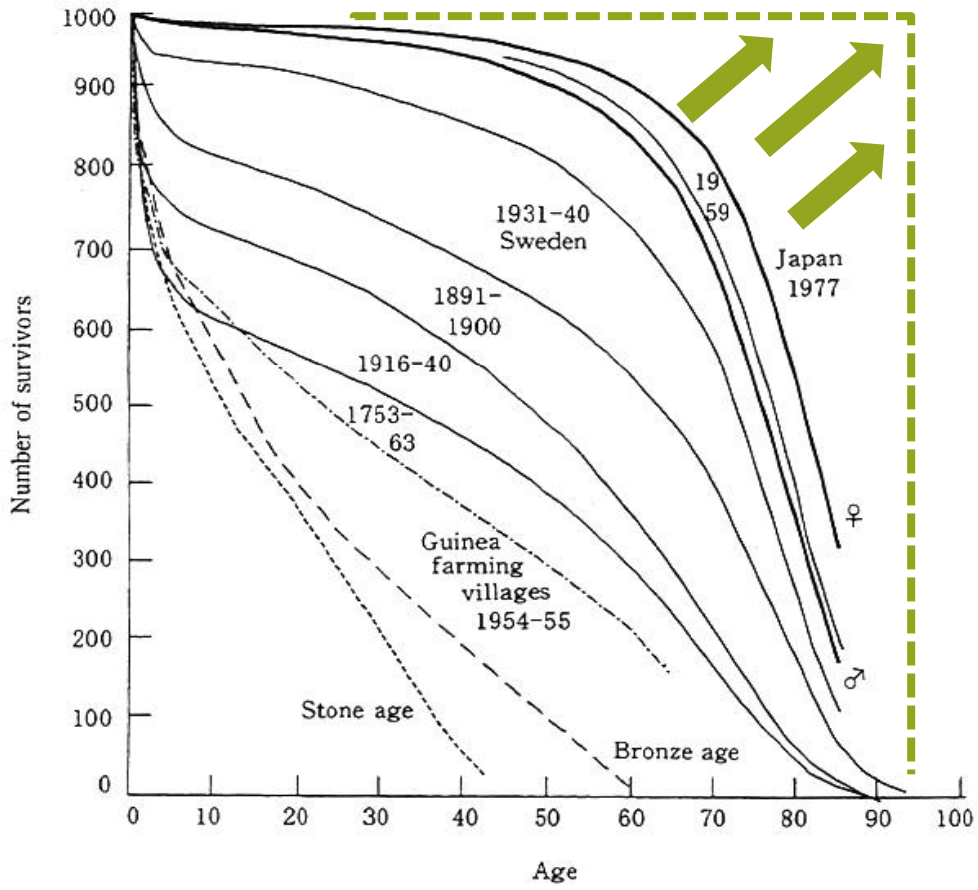
(80 yrs) x (356 days) x (24 hrs) x (60 min) x (60 s) x (108 ns) ≈ 4.1×10^{15} ns

Survival curve : shift 4



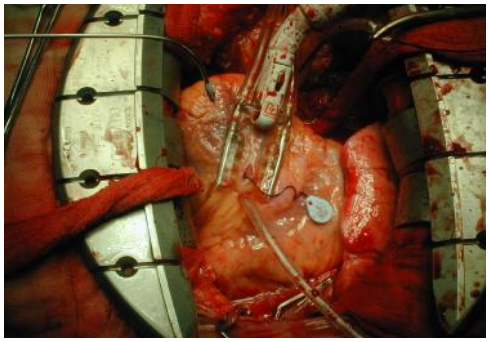
Medical "advances"

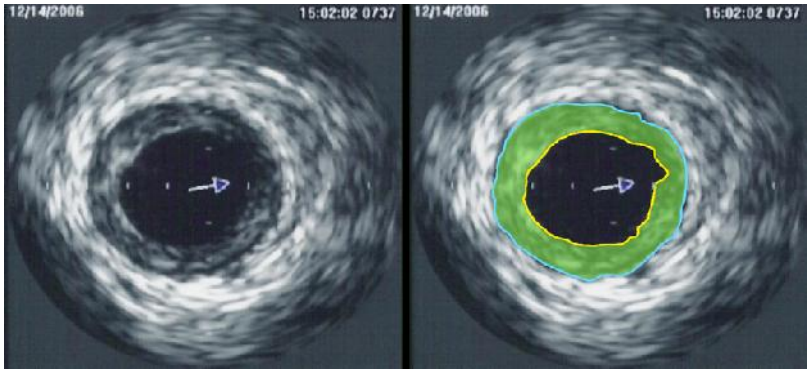
- Rectangularise the curve



Advances in CAD treatment

- Coronary IV ultrasound
- Minimally invasive techniques
- CAC, HsCRP
- Total Artificial Heart

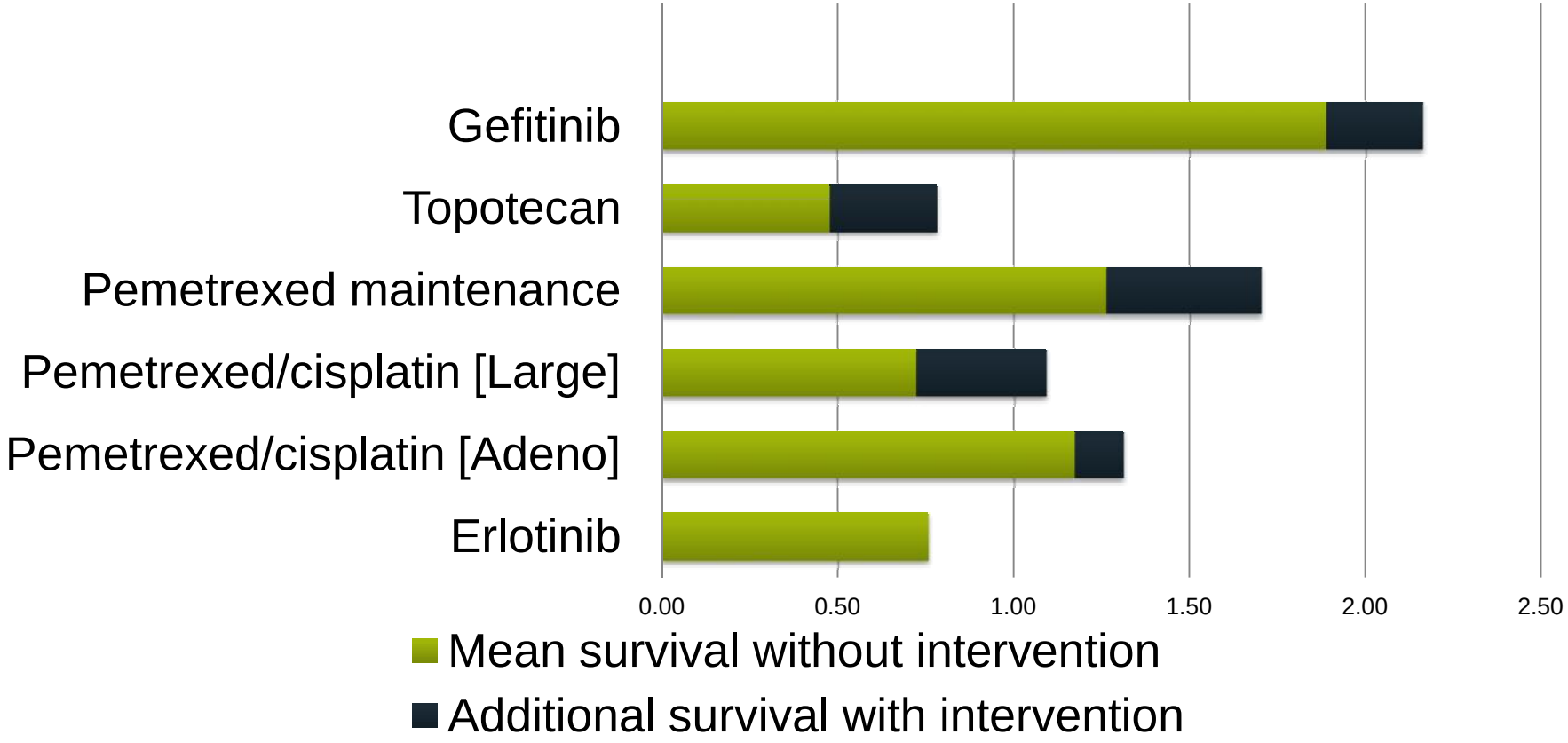




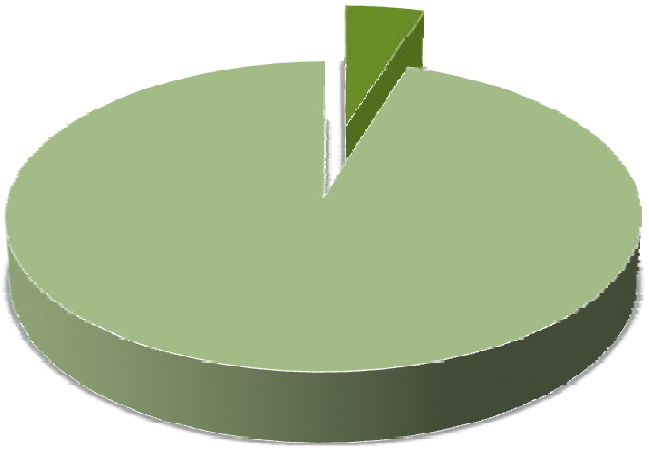
SynCardia Freedom Driver

Lung cancer treatments

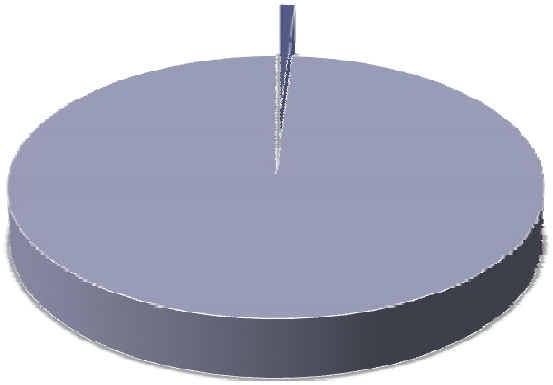
Modelled life expectancy with and without interventions



Indicated/recommended populations as a % of total incident lung cancer cases



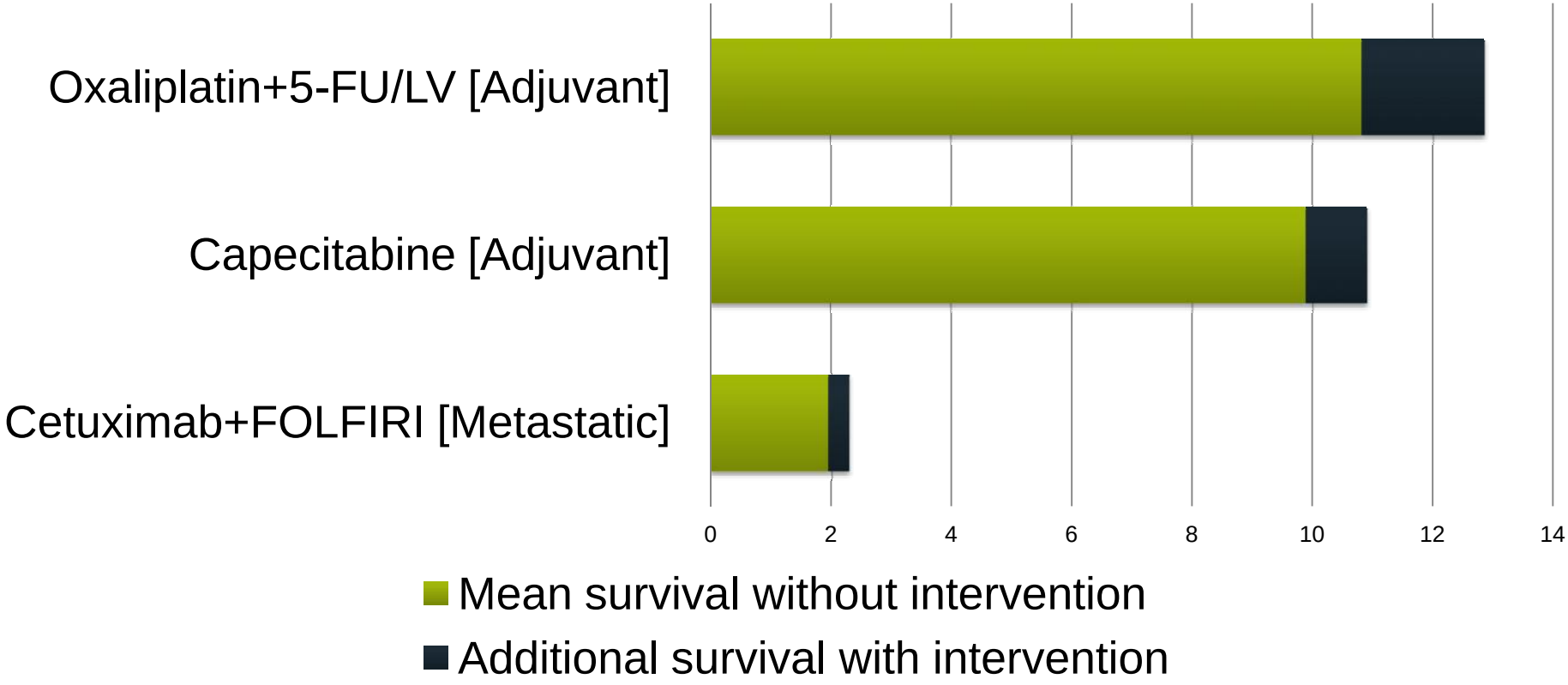
Pemetrexed TA190



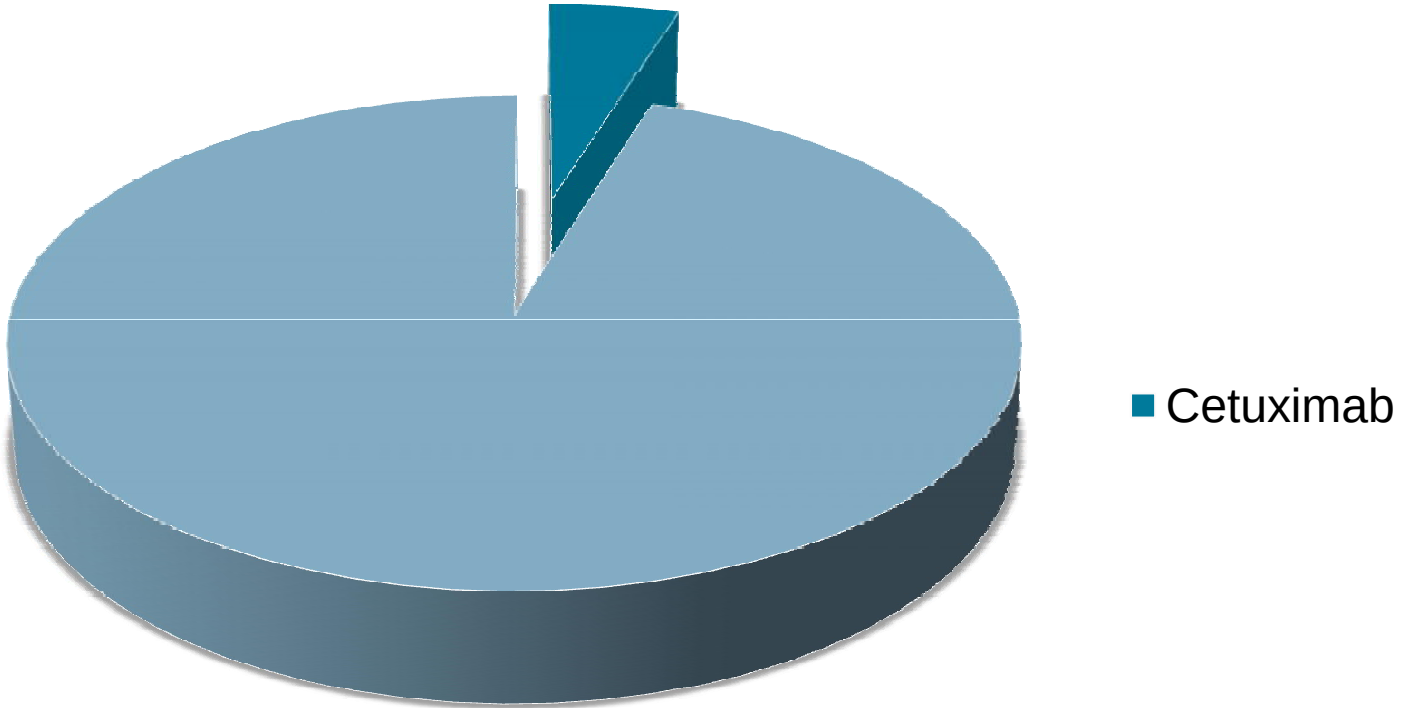
Topotecan

Colorectal cancer treatments

Modelled life expectancy with and without interventions



Indicated/recommended populations as a % of total incident colorectal cancer cases



Top major medical advances

- Control of infectious disease;
- Mass immunization campaigns;
- Vitamins;
- Cardiovascular risk factors; and
- Rational drug design.

Merck Manual of Diagnosis and Therapy

Ten great public health achievements - United States: 1900-1999

- Vaccination
- Motor-vehicle safety
- Safer workplaces
- Control of infectious diseases
- Decline in deaths from coronary heart disease and stroke
- Safer and healthier foods
- Healthier mothers and babies
- Family planning
- Fluoridation of drinking water
- Recognition of tobacco use as a health hazard

MMWR (Morbidity and Mortality Weekly Report) by the U.S. Centers for Disease Control and Prevention (CDC)

Top 10 US medical advances 2000-2010

- Human Genome Discoveries Reach the Bedside
- Doctors and Patients Harness Information Technology
- Anti-Smoking Laws and Campaigns Reduce Public Smoking
- Heart Disease Deaths Drop by 40 Percent
- Stem Cell Research: Laboratory Breakthroughs and Some Clinical Advances
- Targeted Therapies for Cancer Expand With New Drugs
- Combination Drug Therapy Extends HIV Survival
- Minimally Invasive Techniques Revolutionize Surgery
- Study Finds Heart, Cancer Risk With Hormone Replacement Therapy
- Scientists Peer Into Mind With Functional MRI

ABC news and Medpage Today

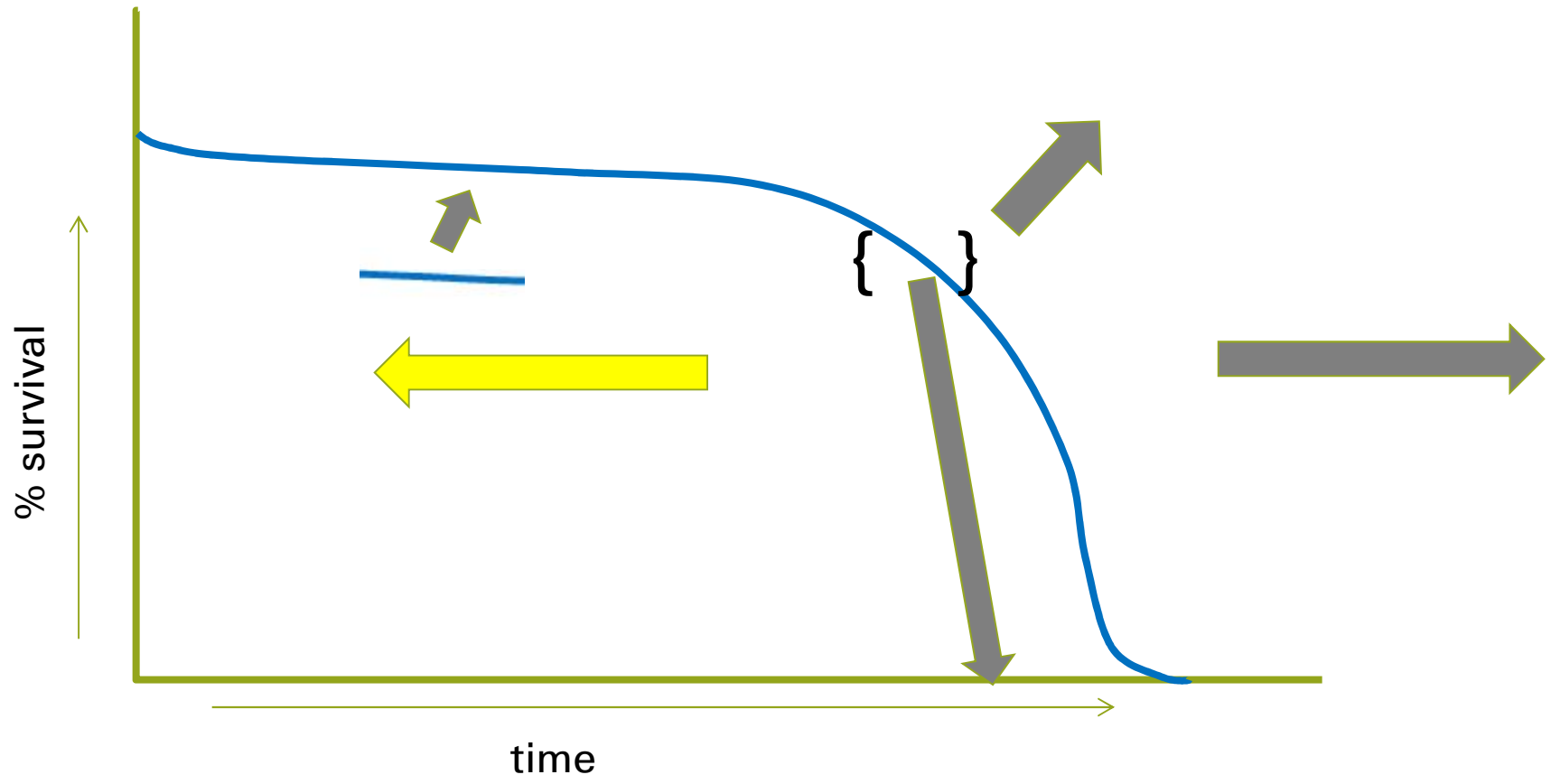
Healthcare expenditure vs. life expectancy

www.gapminder.com

Medical advances

- More effort for less reward
- Expensive drugs – won’t be made available to to all
- Lifestyle is becoming more important than medical advances

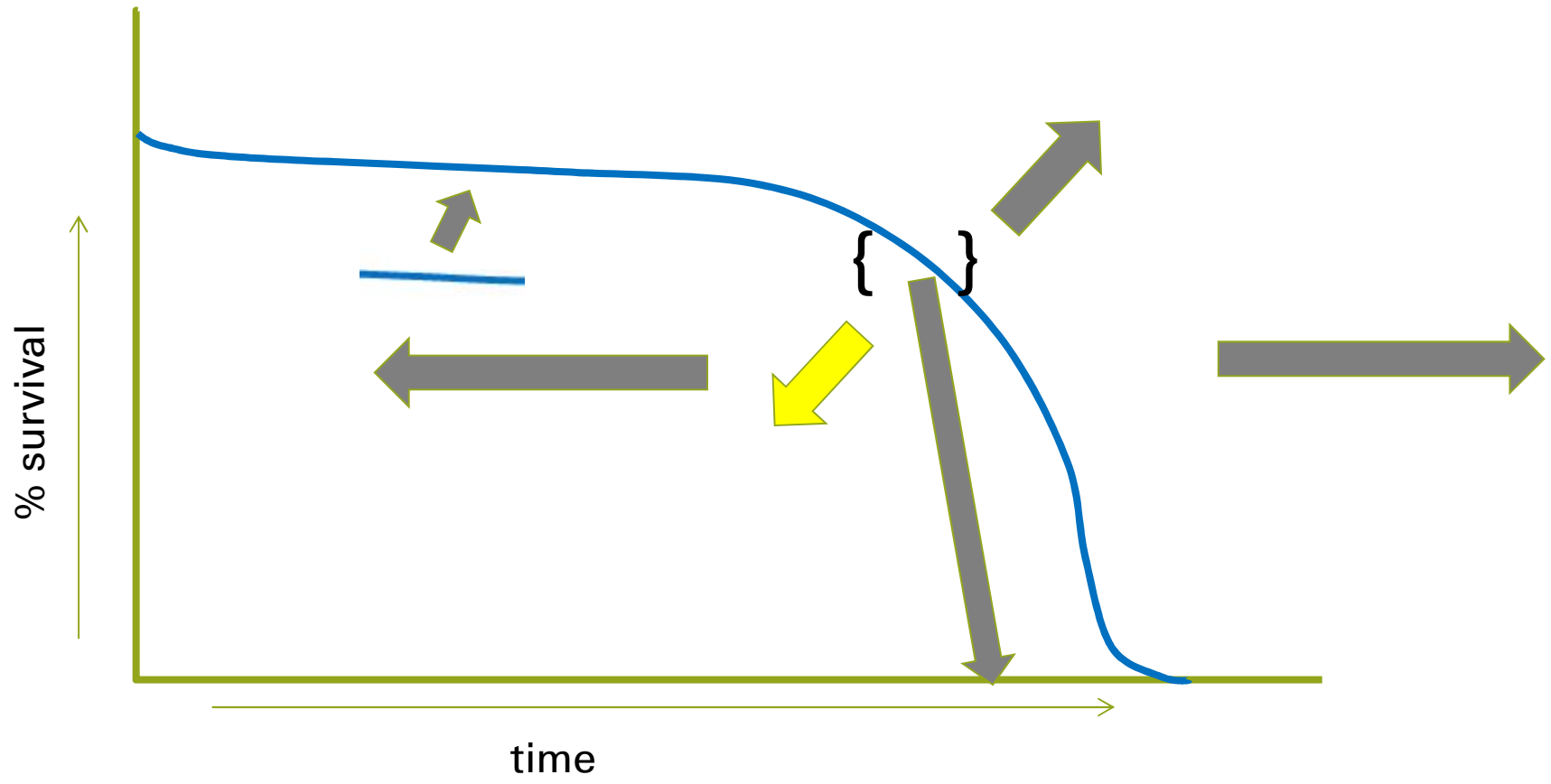
Survival curve : shift 5



Lag effect of risks of new lifestyles, technologies

- Plastics that are carcinogenic
- Smoking lag effect
- Nanoparticles
- Hormones given to cows
- Pesticides
- GM foods

Survival curve : shift 6



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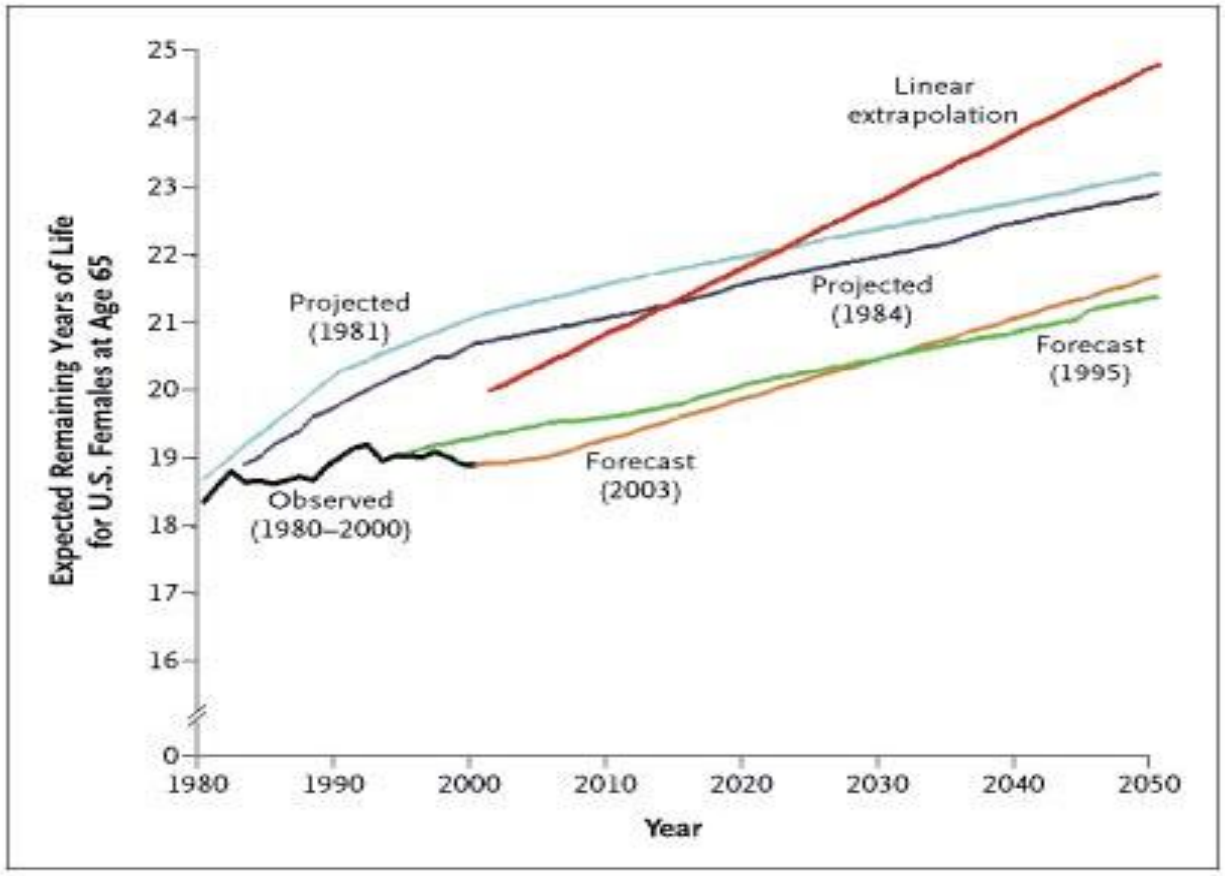


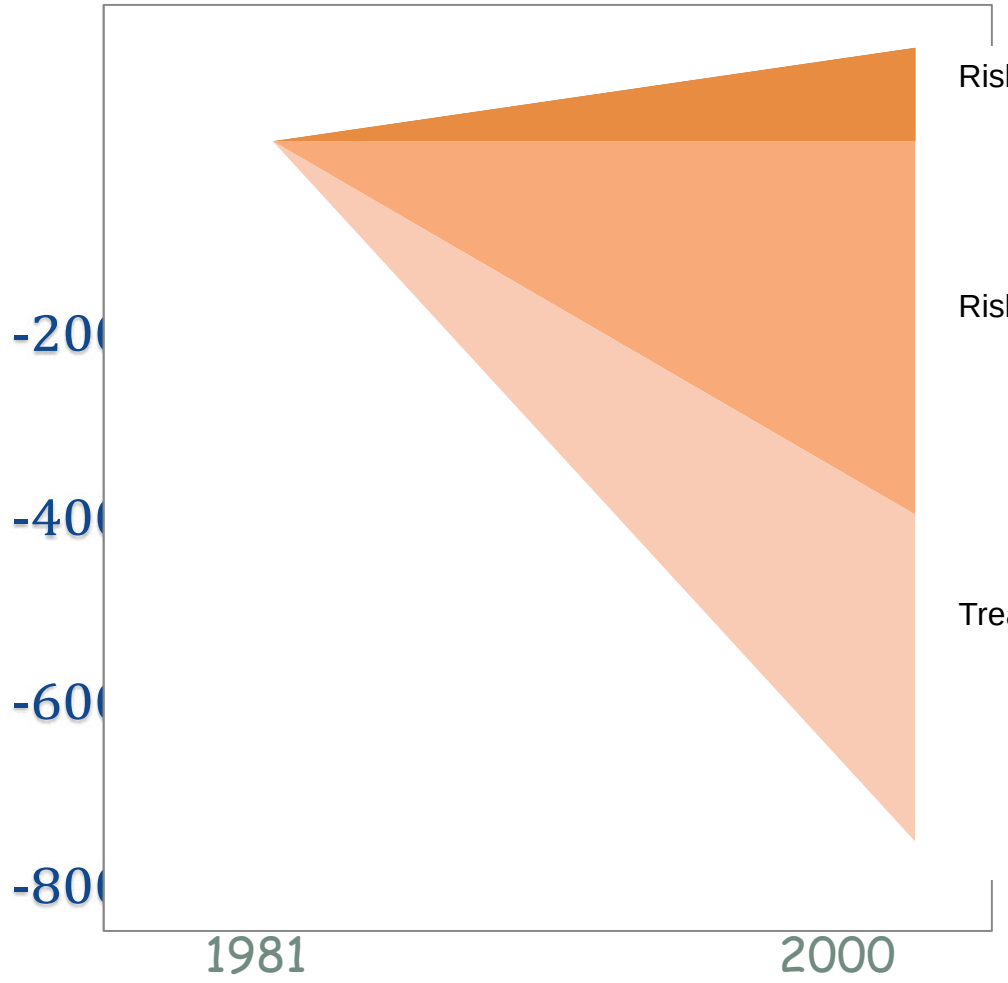
Olshansky, SJ et al, NEJM, March 17,2005;352 (11):1138

The ten leading causes of death by broad income group, 2004

Low-income countries	% of deaths	Middle-income countries	% of deaths	High-income countries	% of deaths
Lower respiratory infections	11.2	Stroke and other cerebrovascular disease	14.2	Coronary heart disease	16.3
Coronary heart disease	9.4	Coronary heart disease	13.9	Stroke and other cerebrovascular disease	9.3
Diarrhoeal diseases	6.9	Chronic obstructive pulmonary disease	7.4	Trachea, bronchus, lung cancers	5.9
HIV/AIDS	5.7	Lower respiratory infection	3.8	Lower respiratory infections	3.8
Stroke and other cerebrovascular disease	5.6	Trachea, bronchus, lung cancers	2.9	Chronic obstructive pulmonary disease	3.5
Chronic obstructive pulmonary disease	3.6	Road traffic accidents	2.8	Alzheimer and other dementias	3.4
Tuberculosis	3.5	Hypertensive heart disease	2.6	Colon and rectum cancers	3.3
Neonatal infections	3.4	Stomach cancer	2.2	Diabetes mellitus	2.8
Malaria	3.3	Tuberculosis	2.2	Breast cancer	2.0
Prematurity and low birth weight	3.2	Diabetes mellitus	2.1	Stomach cancer	1.8

WHO (2008a), "The top ten cause of death", WHO Fact Sheet No.310

Explaining the fall in CHD deaths in England & Wales 1981-2000



Risk Factors worse	+13%
Obesity (increase)	+3.5%
Diabetes (increase)	+4.8%
Physical activity (less)	+4.4%
Risk Factors better	-71%
Smoking	-41%
Cholesterol	-9%
Population BP fall	-9%
Deprivation	-3%
Other factors	-8%
Treatments	-42%
AMI treatments	-8%
Secondary prevention	-11%
Heart failure	-12%
Angina:CABG & PTCA	-4%
Angina: Aspirin etc	-5%
Hypertension therapies	-3%

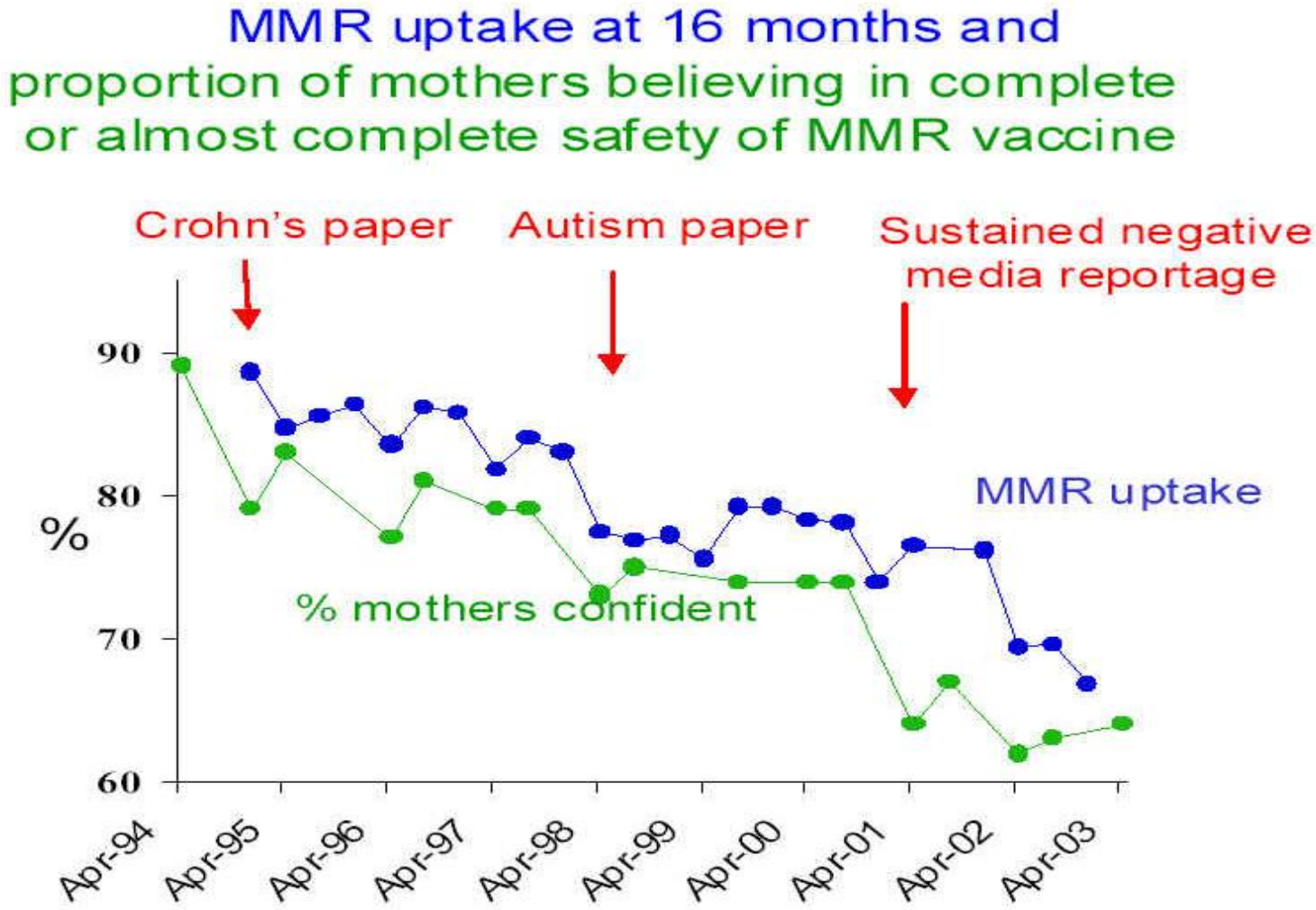
Unal, Critchley & Capewell, Circulation. 2004;109:1101

Behaviour does not only relate to risk factors

- Compliance
  - WHO study 2003, 50% compliance overall
  - Hypertension
    - Despite the availability of effective treatment, over half of the patients being treated for hypertension drop out of care entirely within a year of diagnosis
    - Of those who remain under medical supervision only about 50% take at least 80% of their prescribed medications
    - Approximately 75% of patients with a diagnosis of hypertension do not achieve optimum blood-pressure control

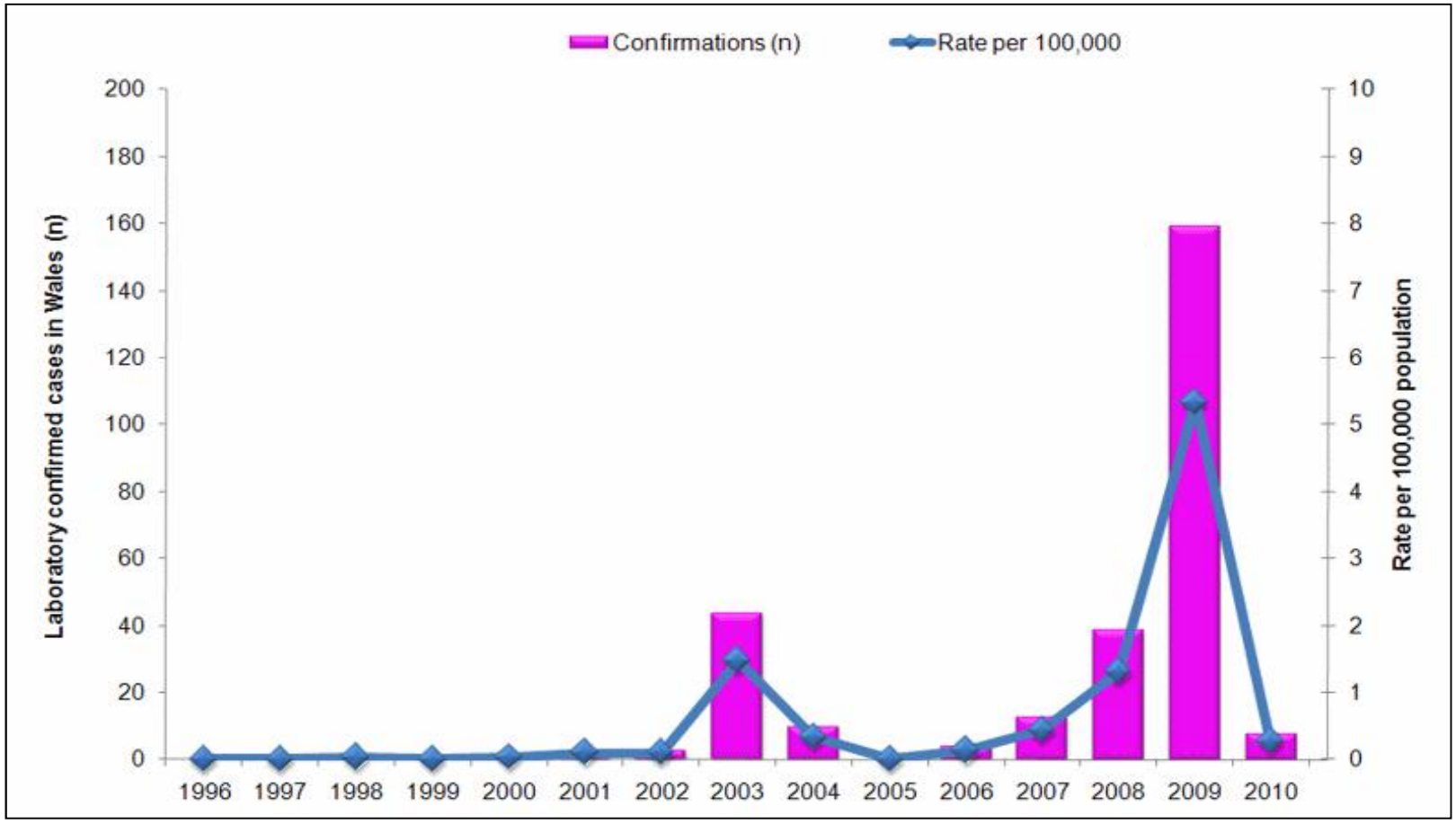
WHO 2003, Adherence to long-term therapies: evidence for action.

Health awareness has a two-edged sword : Individuals as an obstacle to progress



Source: Sunday Times - Brian Deer

Measles in Wales: 1996-2011



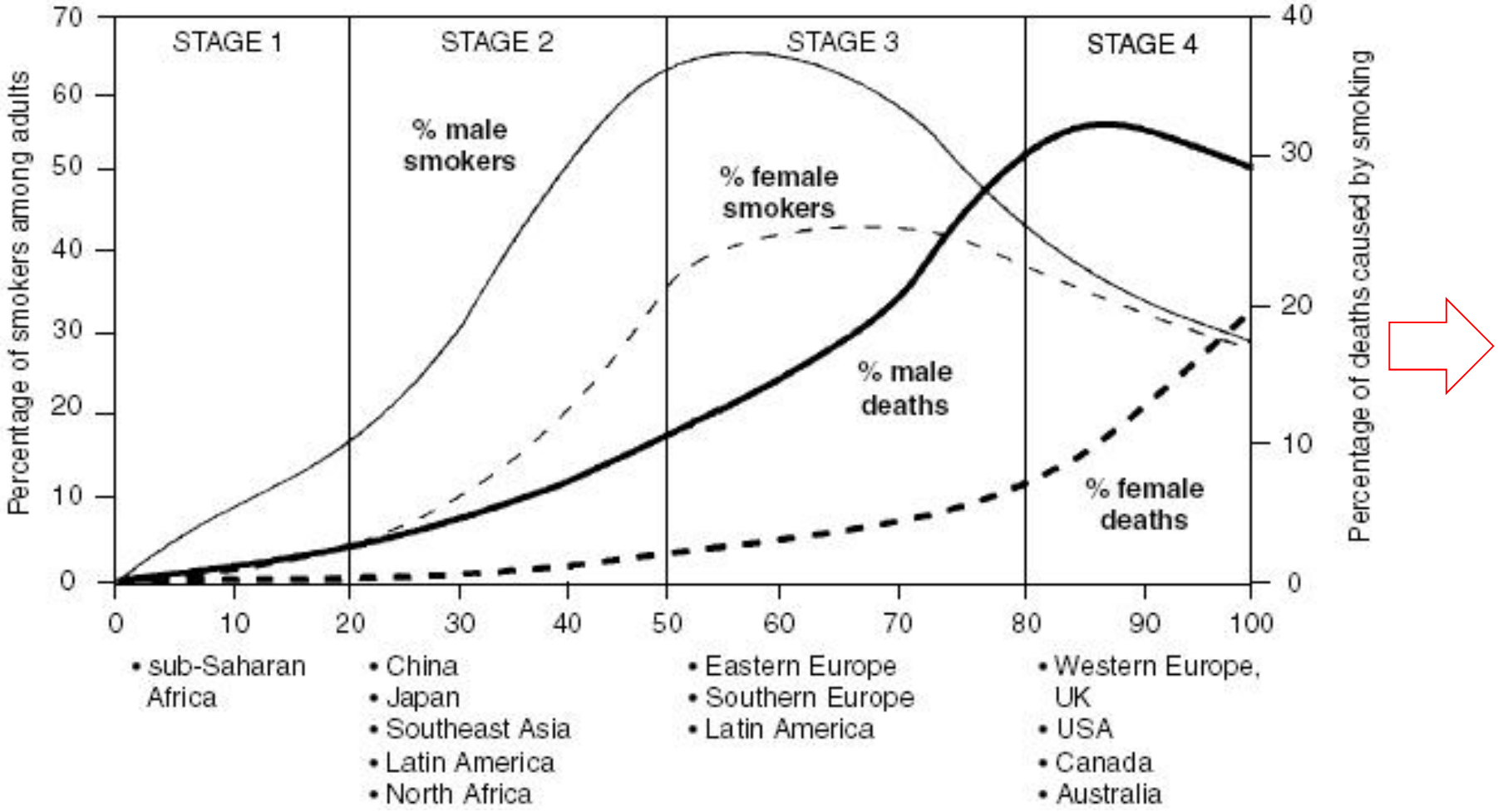
Health Protection Agency, May 2011

The story of Dracunculiasis

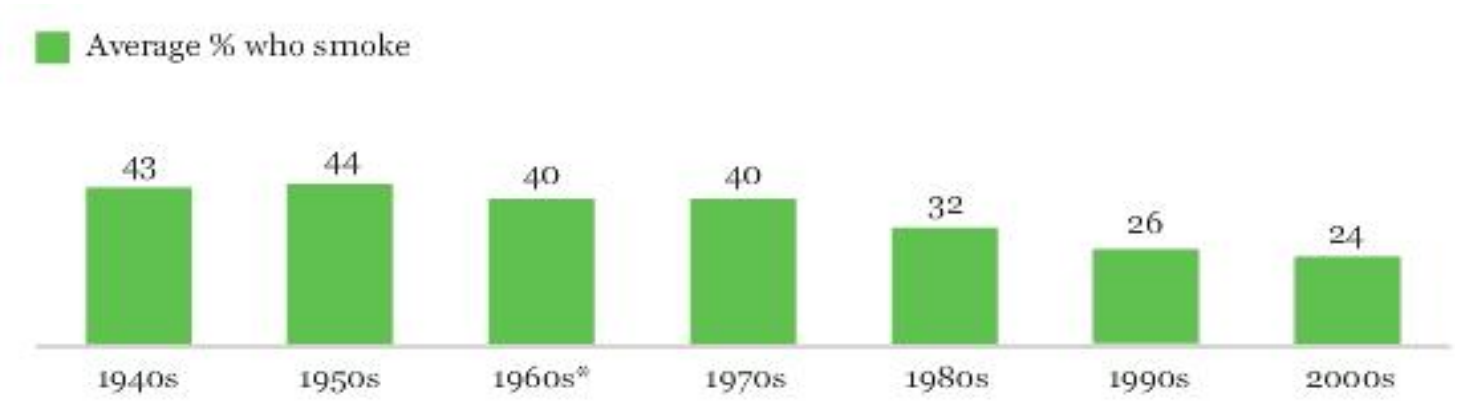
- 3500 years
- 3.5 million in 1986 - 20 African and Asian countries
- < 2000 cases now annually - South Sudan, Ethiopia, Mali and Chad
- 3 ways to prevent GW infection
  - keep infected away from water
  - filter water, kill water fleas
  - don’t drink infected water

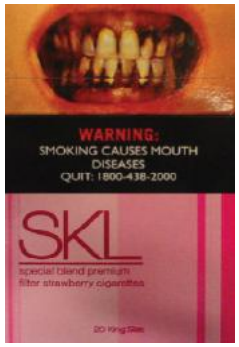
so what....?

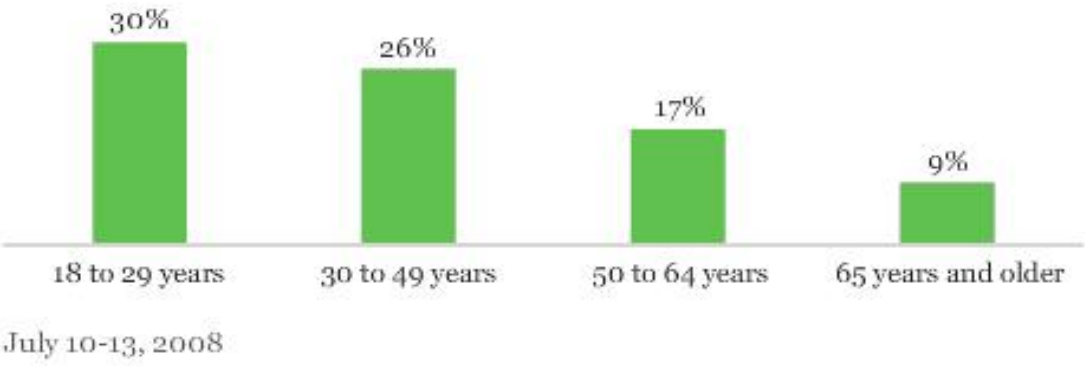
Cigarette Century (Allan M. Brandt)



US cigarette smoking

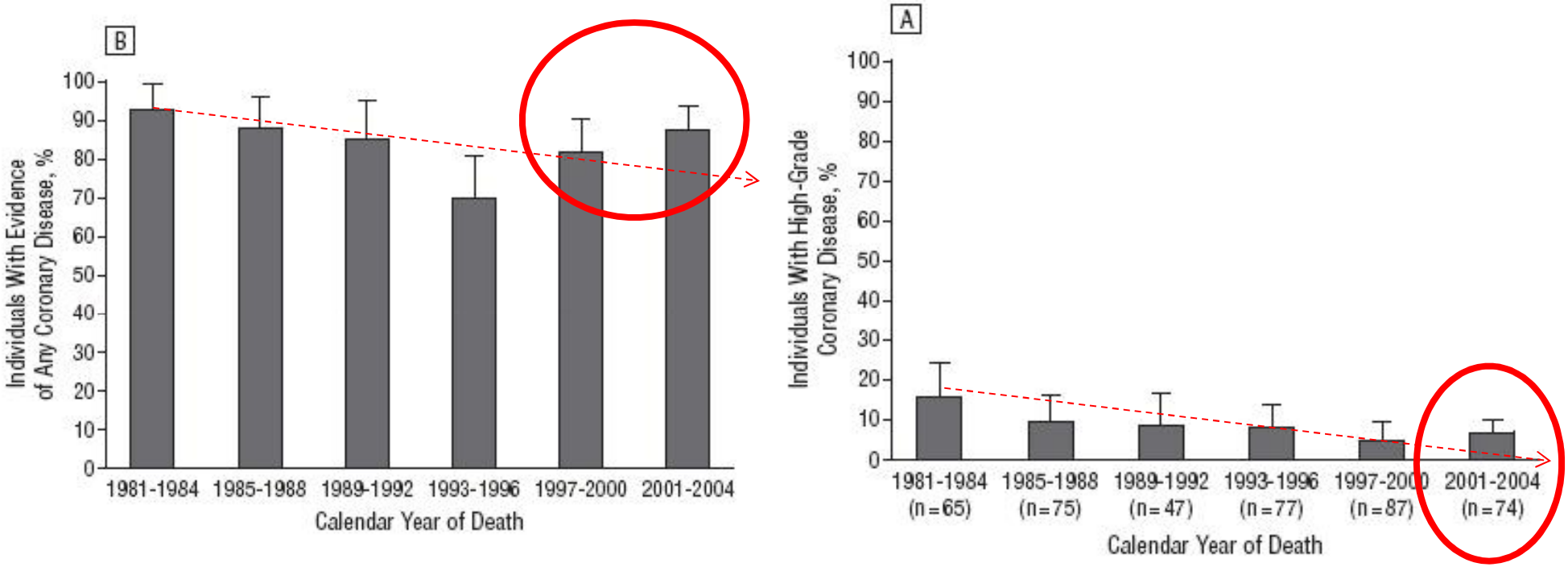






http://www.gallup.com/poll/109048/us-smoking-rate-still-coming-down.aspx

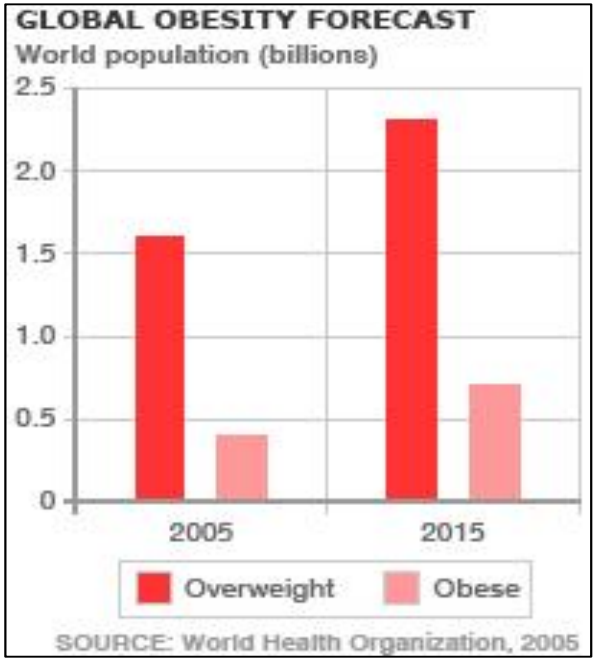
Warning signs: CAD trends in young adults- autopsy data

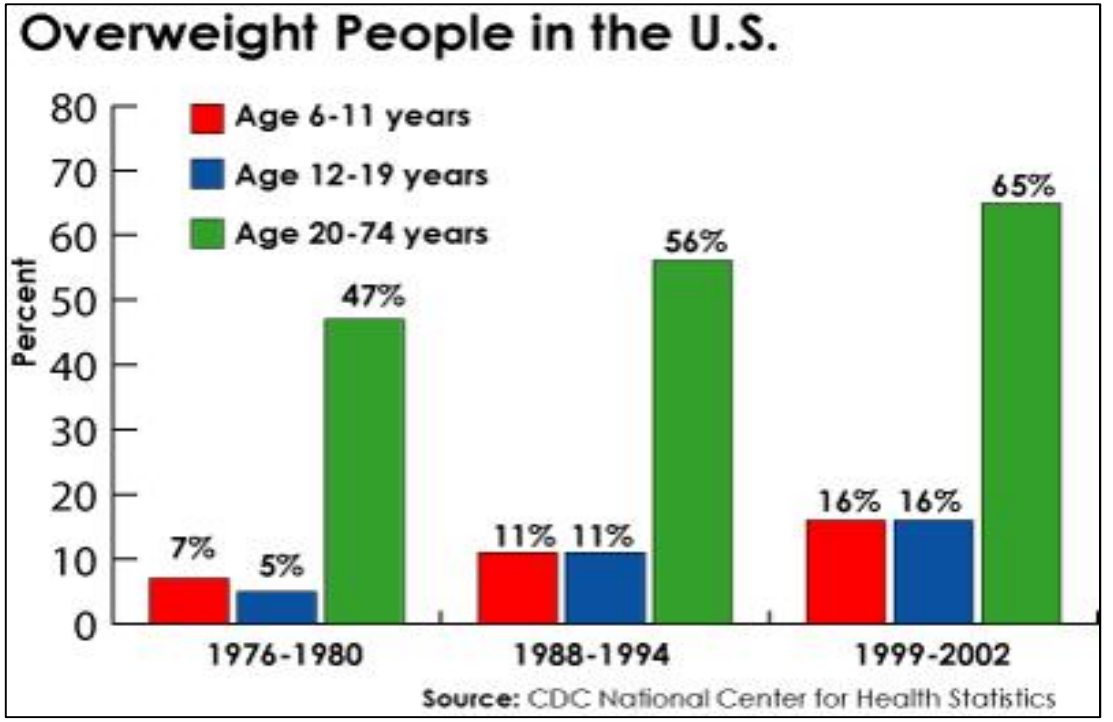


"Age- and sex-adjusted regression analyses revealed temporal declines over the full period (1981-2004) for high-grade disease, any disease, and grade of coronary disease. Declines in the grade of coronary disease ended after 1995 (*P*<.01 for every artery) and possibly reversed after 2000 (*P*=.06 for LCx)."

Nemetz P et al., Arch Int Med, 2008

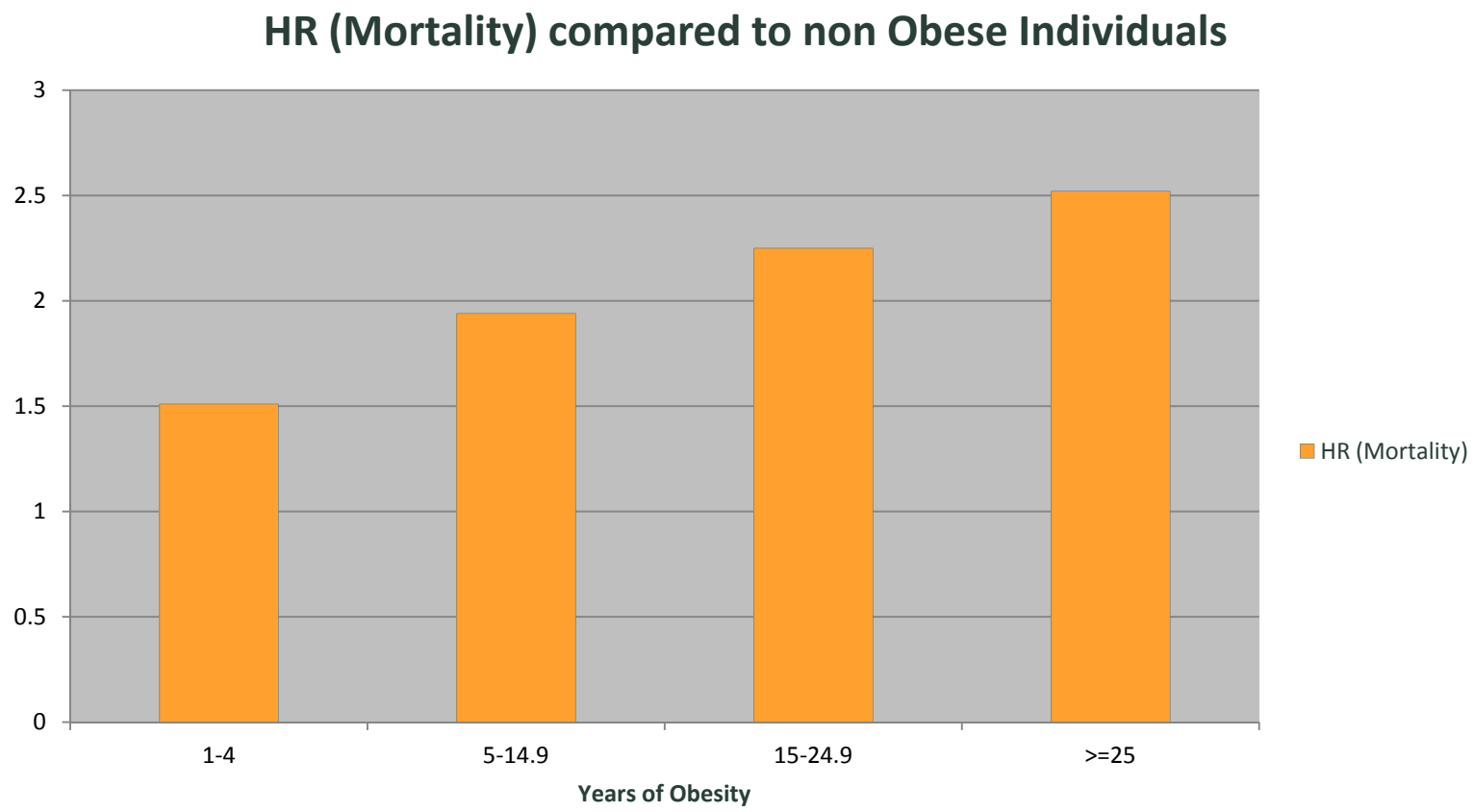
Obesity





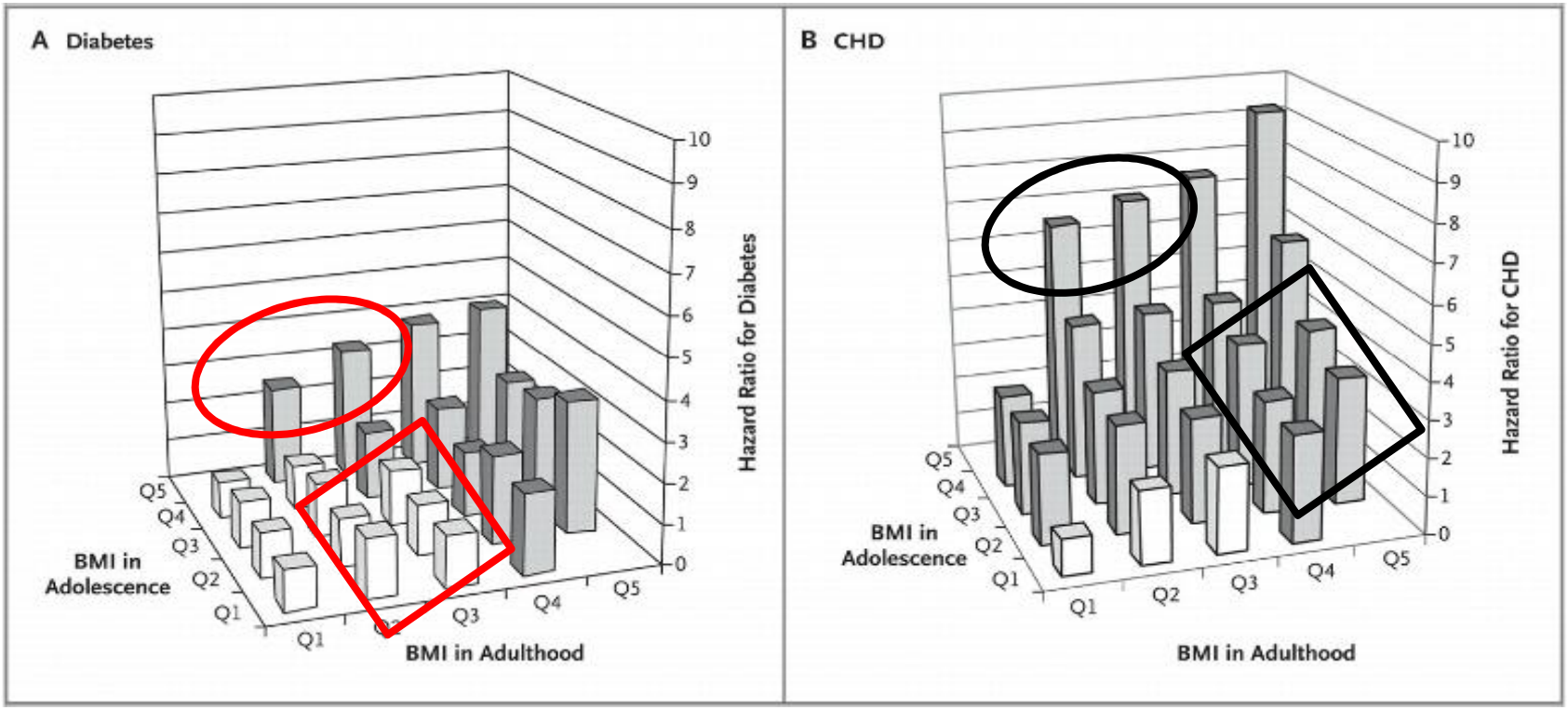
WHO and CDC

Years lived with obesity



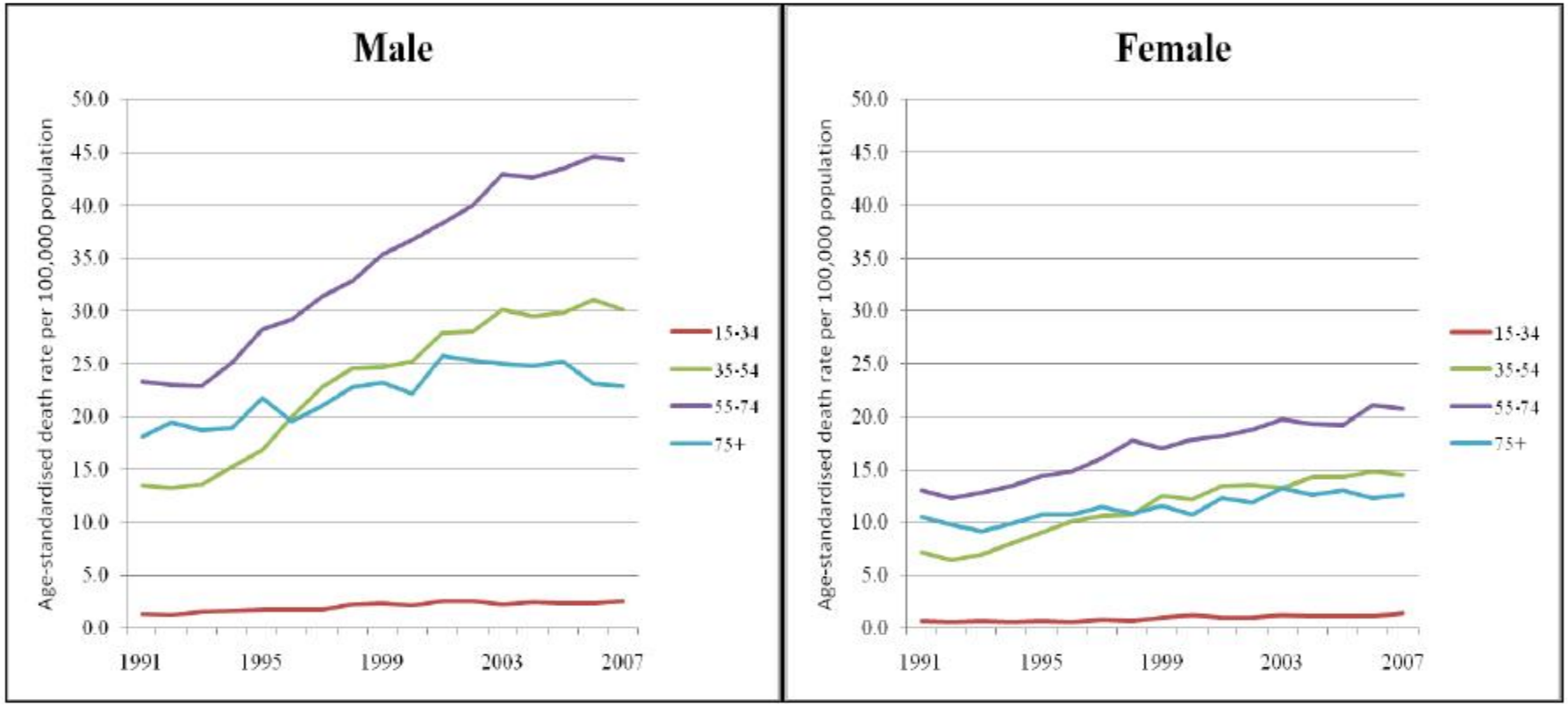
Int. J. Epidemiol. (2011) 40 (4): 985-996.

Age at time of obesity



N Engl J Med; 364 (14):1315-25

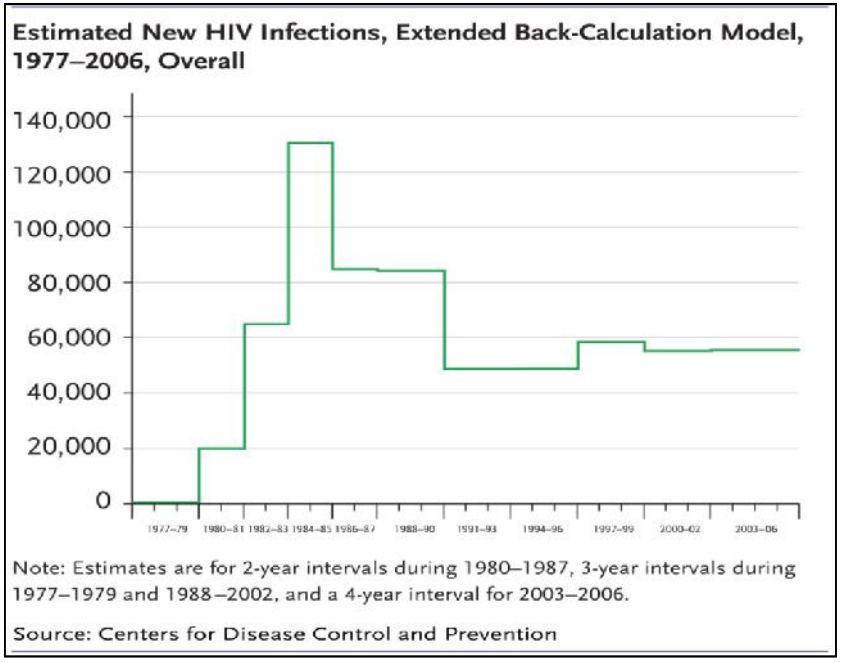
UK trends in alcohol-related deaths

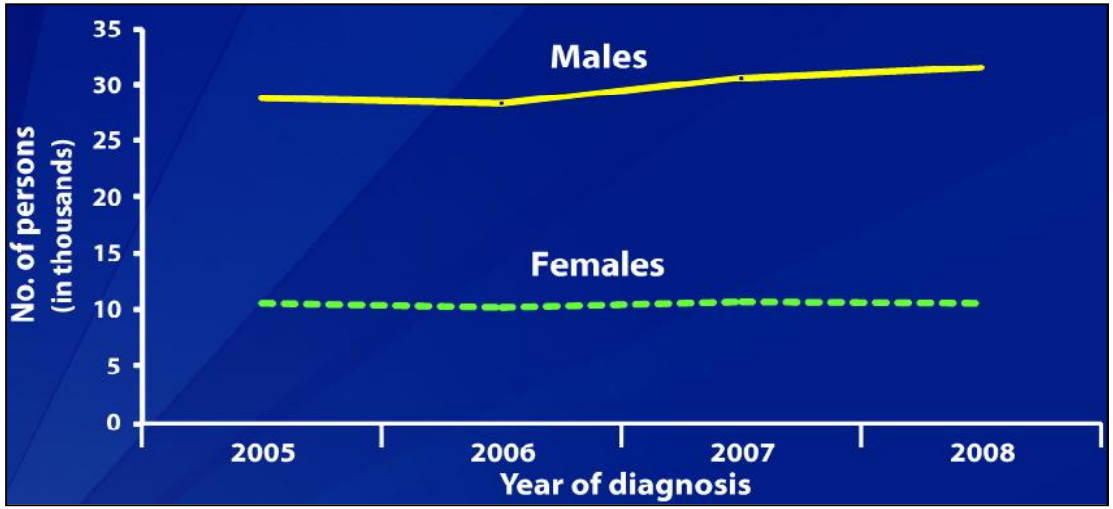


ONS (2009b), Health Statistics Quarterly 41

HIV diagnosis in the US

- 50,000 new cases annually in US





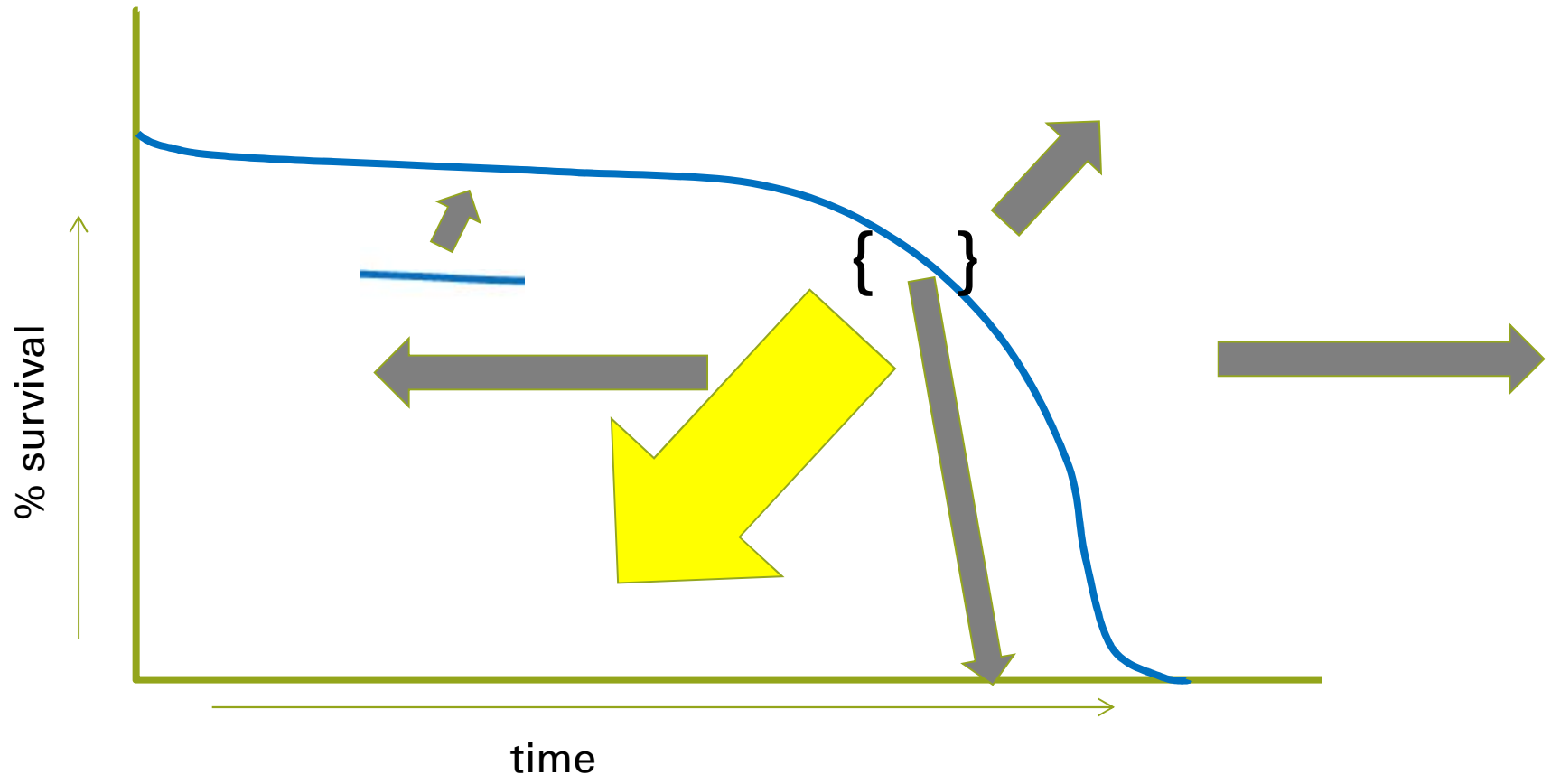
What tomorrow holds…

Medical Science

vs.

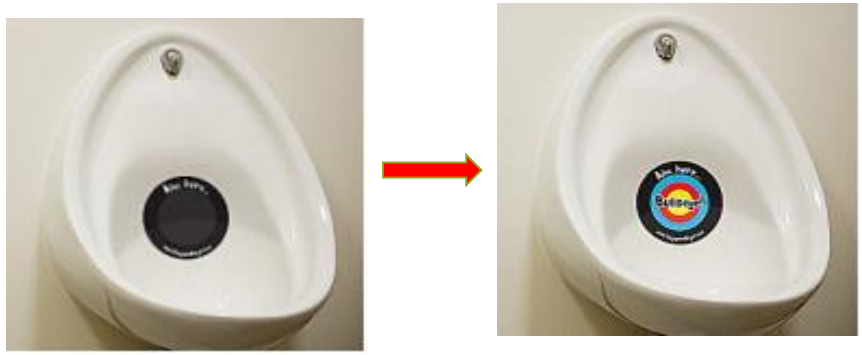
Behavioural Science

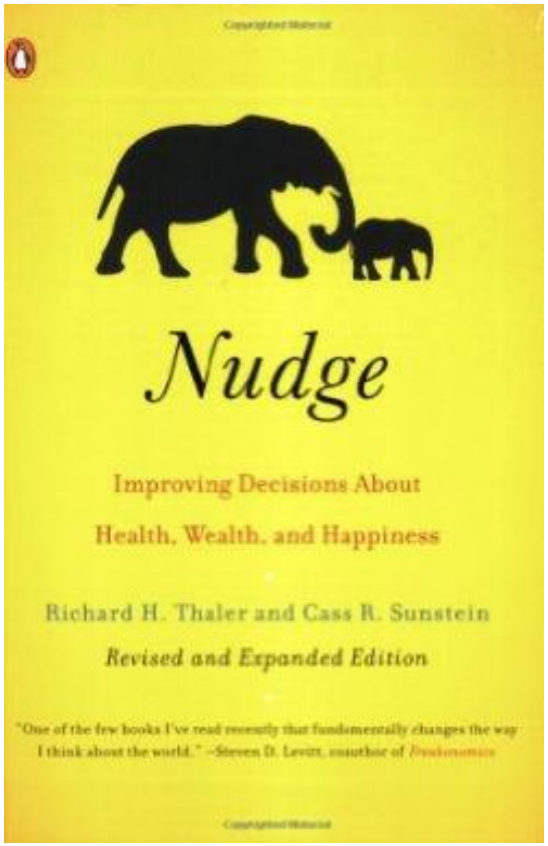
Survival curve : shift 6



how big might it be, and what can we do about it?

"Choice architecture" (Nudging)

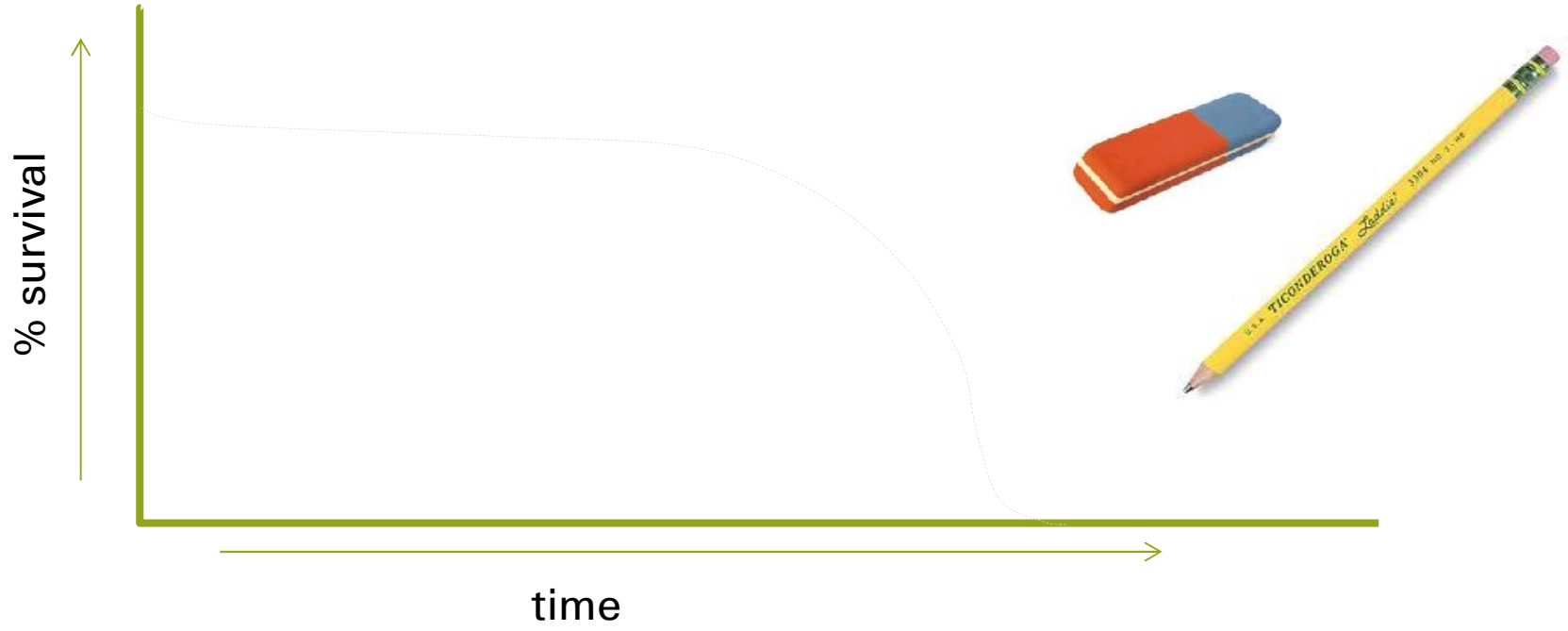




Thaler and Sunstein

Final message

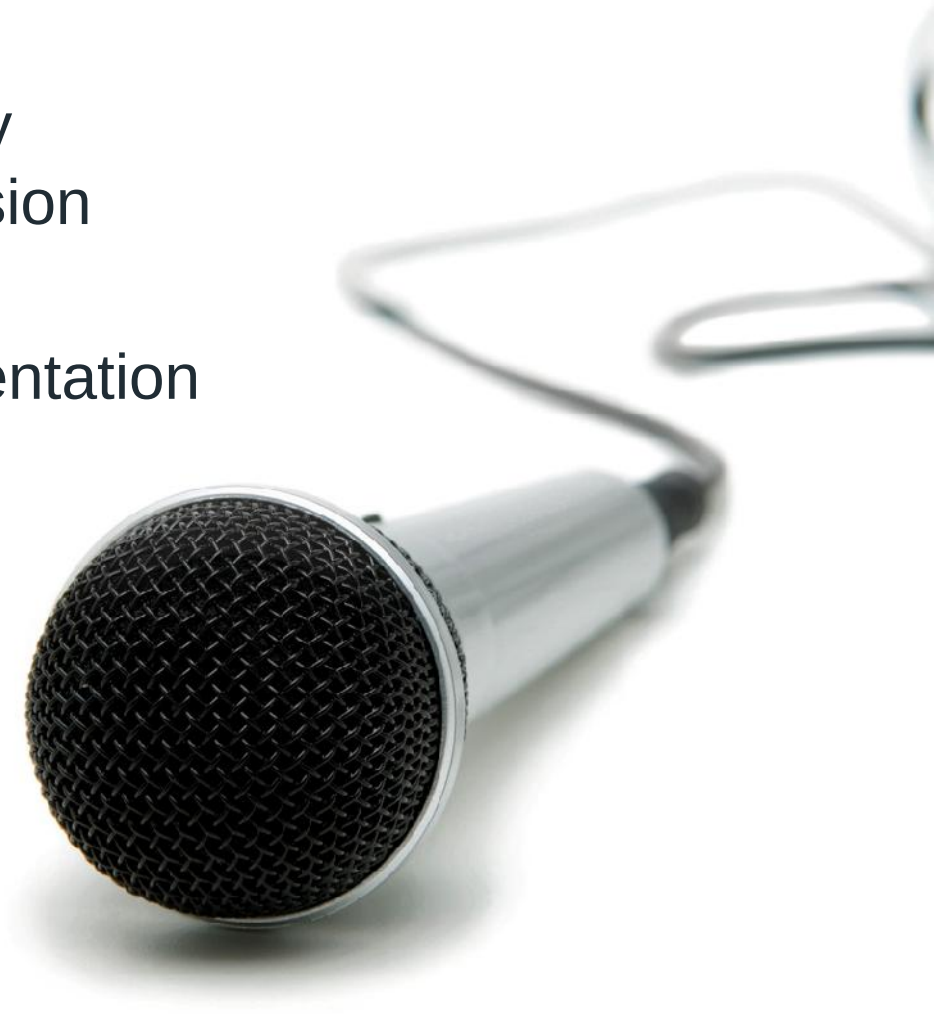
- we have to work hard to correctly predict this...there are no more guarantees of a rosier/older future
- time to sharpen our pencils....



Questions or comments?

Expressions of individual views by members of The Actuarial Profession and its staff are encouraged.

The views expressed in this presentation are those of the presenter.



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