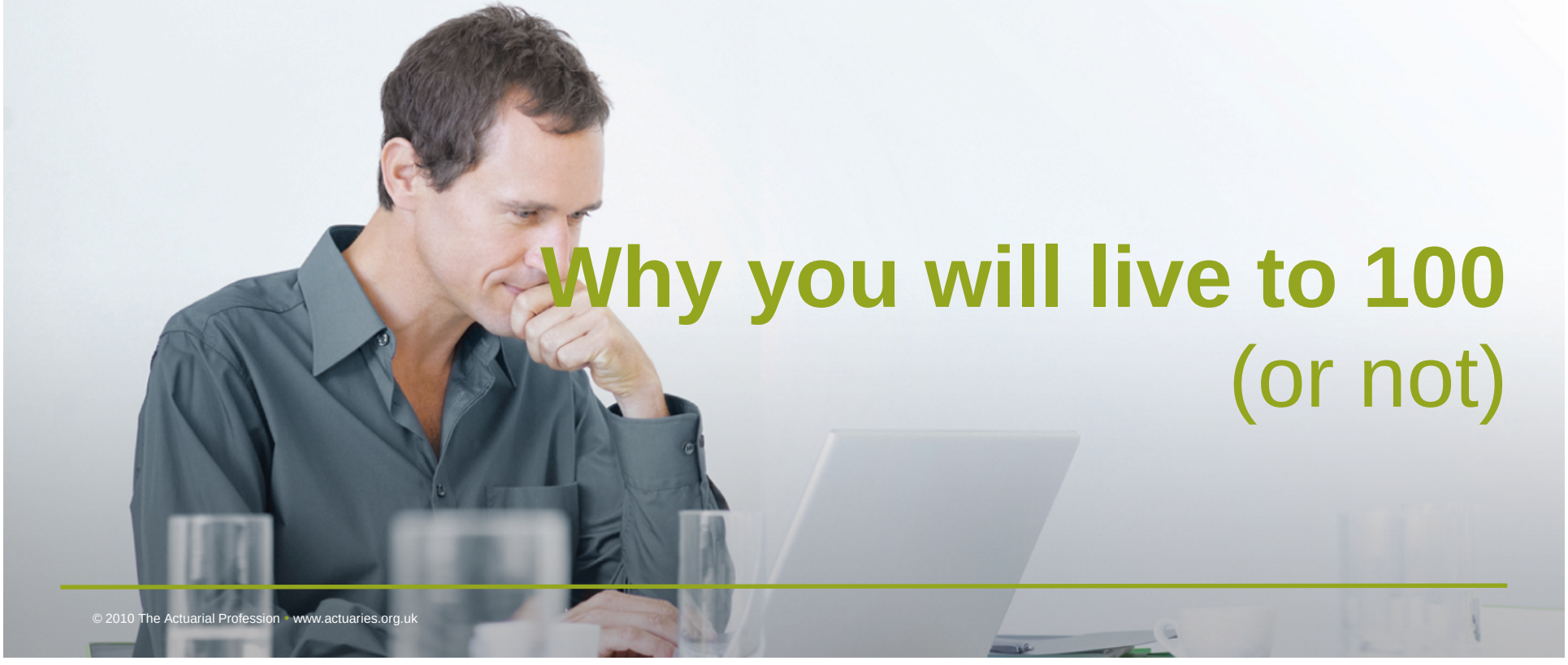
The Actuarial Profession
making financial sense of the future

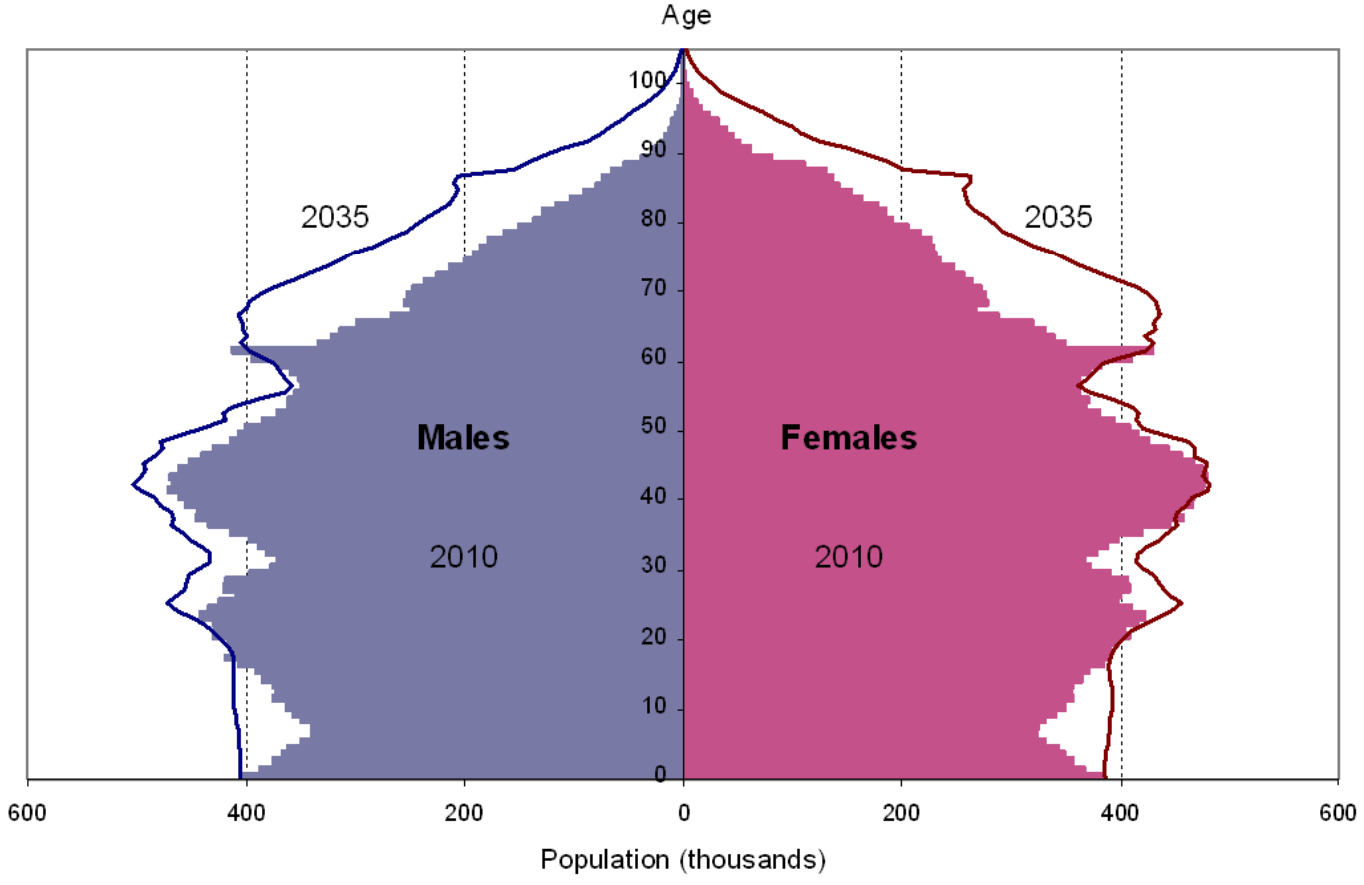
Momentum conference 2011: for Actuaries of Today and Tomorrow
Daniel Ryan



Why you will live to 100
(or not)

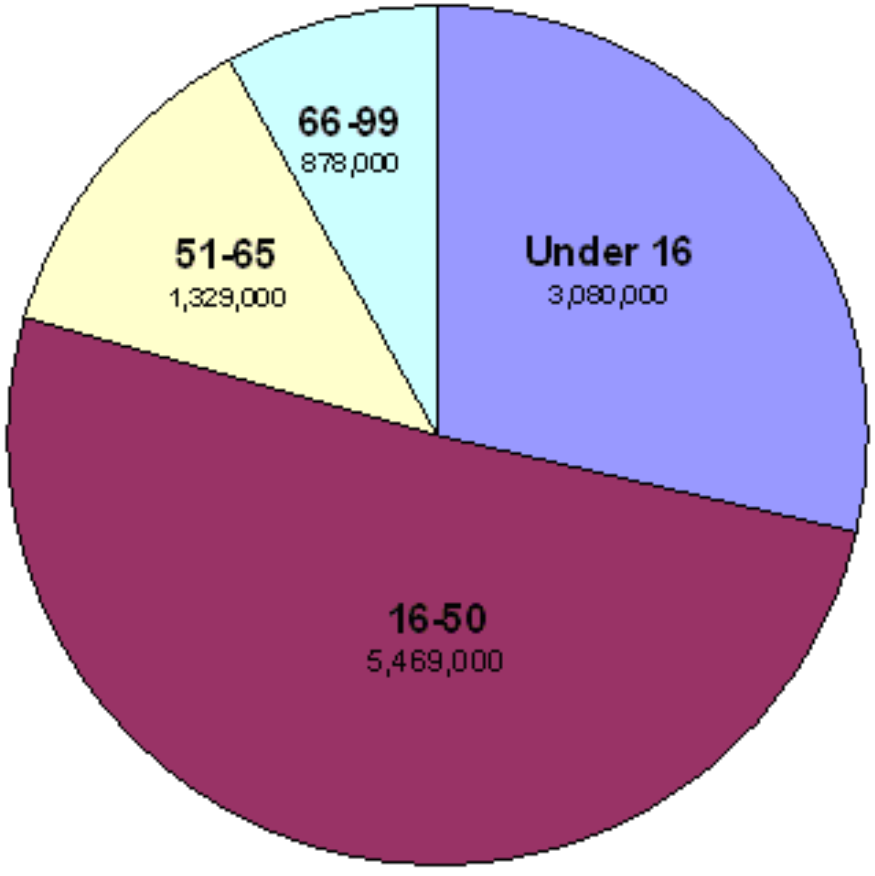
The future shape of our population

Estimated and projected age structure of the United Kingdom population, mid-2010 and mid-2035



Source: Office for National Statistics – 2010-based projections

Who are our future centenarians?



Source: Office for National Statistics, 2008-based Population Projections (UK)

Why you will live to 100 (or not)

- Genes
- Behaviours
- Environment
- Societal pressures
- Accidents
- Medical interventions
- Stochastic variation
- Historical trends
  - New England Centenarian study suggested dominant impact of genes in extreme longevity

Tips for healthy ageing
National Institute of Ageing

- Eat a balanced diet.
- Exercise regularly.
- Get check-ups on a regular basis.
- Do not smoke.
- Practice safety habits at home to prevent falls and bone fractures. Wear a seatbelt in the car.
- Stay in contact with family and friends.
- Avoid too much exposure to the sun or cold weather.
- Drink alcohol only in moderation.
- Keep personal and financial records in good order.
- Keep a positive attitude toward life. Do the things that bring happiness.
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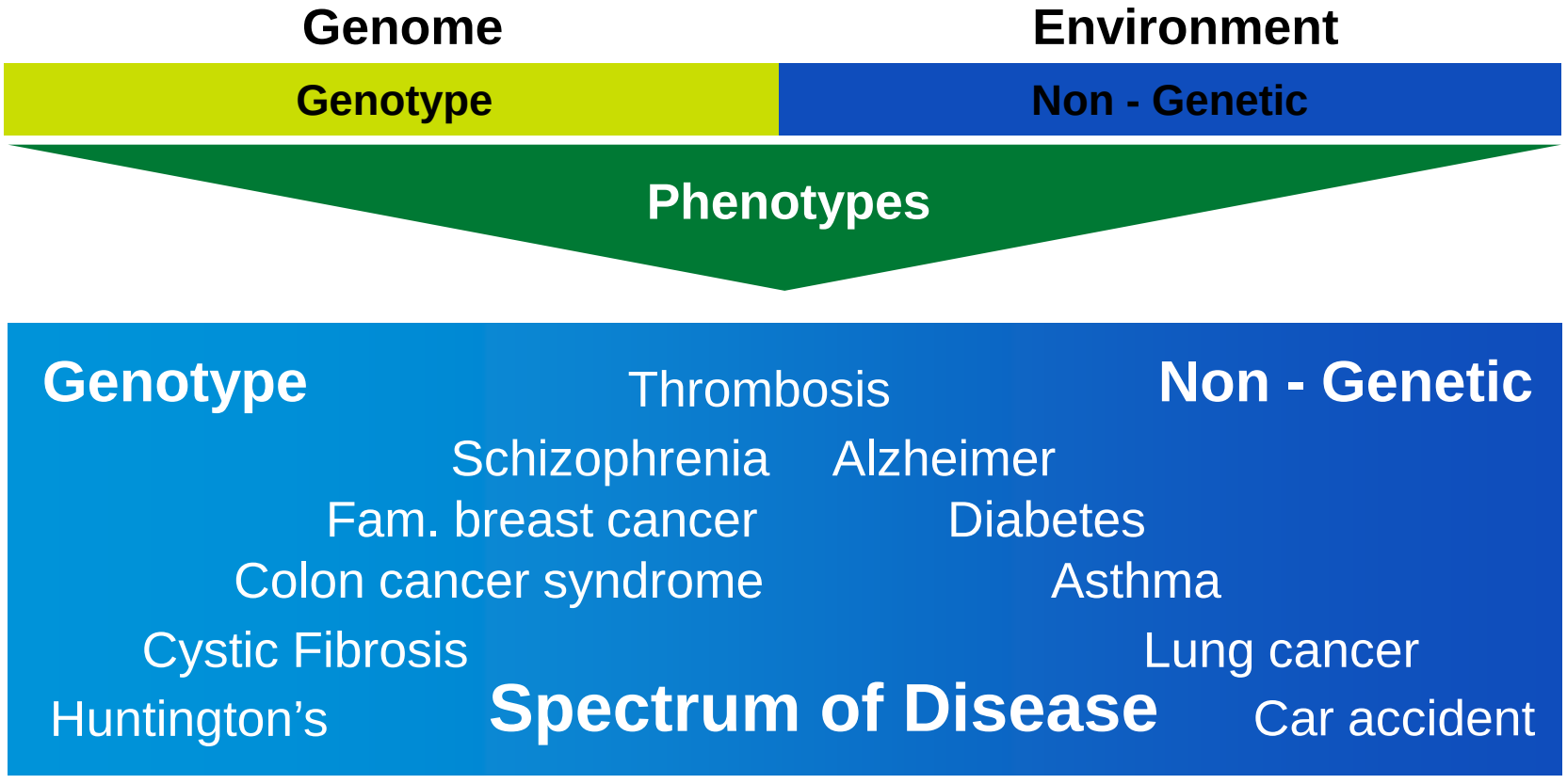
Relative importance of genes and environment



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Genes associated with increased risk of disease

Cancer site	Relative Risk ≥5.0 Family studies	Relative Risk ≥1.5 and >5.0 Resequencing	Relative Risk ≥1.01 and >1.5 Genome-wide association studies
Lung	RB1, TP53		rs1051730, rs8034191 (CHRNA3, CHRNB4, CHRNA5)
Breast	BRCA1, BRCA2, TP53, PTEN, SK11, CDH1	CHEK2, ATM, PALB2, BRIP1	CASP8, FGFR2, MAP3K1, 8q24, 5p, TOX3, 2q, 6q22, LSP1
Colon and rectum	APC, MLH1, MSH2, MSH6, PMS2	APC (I1307K), BLM	MUTYH, CASP8, 8q24, 8q23 (EIF3H), 10p14, 11q23, CRAC1, SMAD7
Prostate	BRCA2	8q24	rs6501455, rs721048, NBS1, EHBP1, TCF2, CTBP2, JAZF1, MSMB, LMTK2, KLK3, SLC22A3
Pancreas	BRCA2, CDKN2A, STK11, TP53, PRSS1, SPINK1	BRCA1, MSH2, MLH1	

Source: Foulkes W; N Engl J Med; 2008;359:2143-2153

Different approaches to considering the future
Converging or Diverging?

- "Projectionists" e.g. Vaupel – no current evidence of restrictions to improvements in life expectancy leading to expectations that medical advances will deliver – up to 0.25 years per calendar year
- "Realists" e.g. Olshansky – treatment of disease without affecting ageing process has limited potential to expand life expectancy, and not clear how "less healthy" cohorts will develop
- No current treatments affect ageing process and no biomarkers to determine effectiveness of treatments
- Acceptance of the possibility of future treatments that could slow ageing process

Understanding the potential for further improvements from disease-elimination models

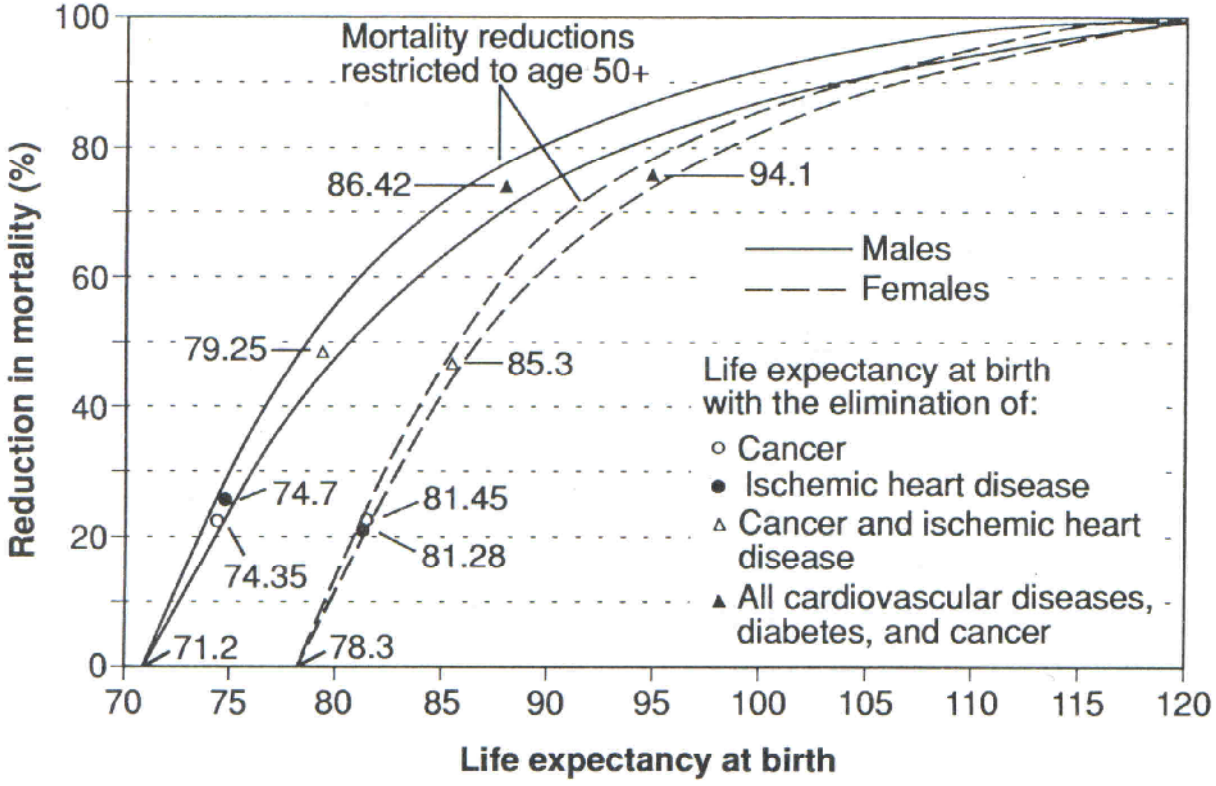


Fig. 2. Percentage of reduction in the conditional probability of death for the United States (from 1985 levels) required to produce a life expectancy at birth from 80 to 120 years.

Source: Olshansky, Carnes and Cassel, 1990. Science.

The impact of the ageing process

- Hand grip strength reduces by 45% by age 75
- Blood flow to brain reduces by 15-20% by age 70
- Sense of smell reduces to 50% of peak by age 80
- Maximum heart rate reduces by 15-20% by age 70
- Blood pressure of 50% population at age 65 is mild or worse hypertension
- Maximum breath capacity reduces by 40% by age 80
- Dementia affects 10% of those over age 65; 20% of those over age 85

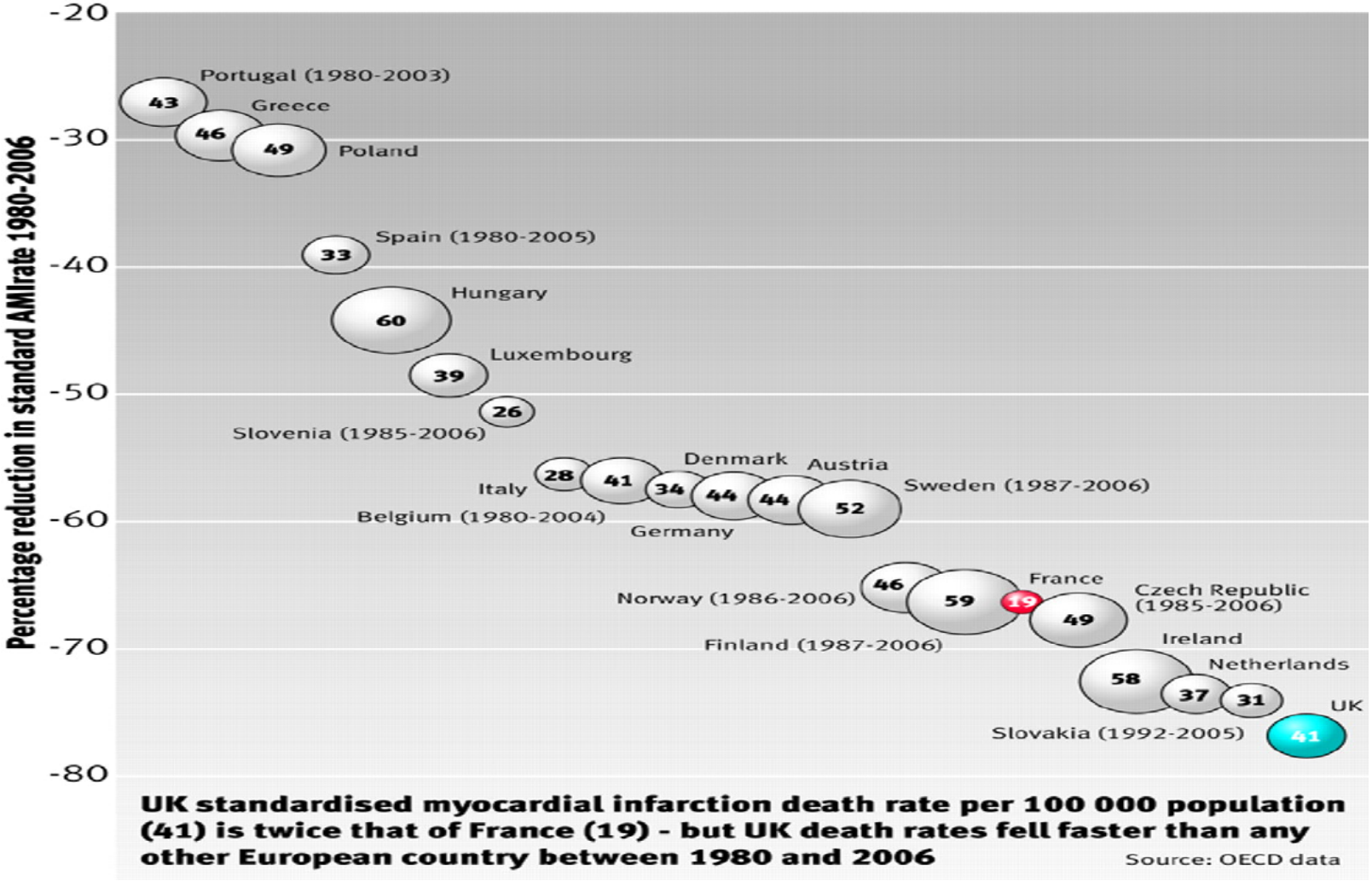
Potential benefits from disease elimination and slowing of ageing process

TABLE 2
U.S. Social Security Administration, U.S. Census Bureau, and the Network Observed (2000) and Projected (2030, 2050) Life Expectancy at Birth and at Ages 65 and 85 for U.S. Males and Females

	2000	2030				2050			
		SSA	CB	Network A (lower disease mortality)	Network B (slow aging)	SSA	CB	Network A (lower disease mortality)	Network B (slow aging)
				Life Expectancy at Birth					
Males	74.0	78.0	78.4	79.4	80.4	80.0	80.9	83.2	85.9
Females	79.4	81.8	83.1	85.1	86.3	83.4	85.3	89.2	93.3
Total	76.7	79.9	80.8	82.3	83.4	81.7	83.1	86.2	89.6
				Life Expectancy at Age 65					
Males	15.9	18.2	19.0	20.2	21.8	19.3	20.6	23.4	27.1
Females	19.0	20.3	21.7	23.7	25.5	21.4	23.2	27.4	32.4
Total	17.4	19.2	20.4	22.0	23.7	20.4	21.9	25.4	29.8
				Life Expectancy at Age 85					
Males	5.2	6.0	6.8	7.6	9.2	6.5	7.6	9.7	13.6
Females	6.4	7.1	8.0	9.5	11.5	7.6	8.9	12.3	17.8
Total	5.8	6.6	7.4	8.6	10.4	7.1	8.3	11.0	15.7

Source Olshanskyet al. Aging in America in the 21st century. The Millbank Quarterly (2009)

International trends in cause-specific mortality
Myocardial infarction (1980-2006)



UK standardised myocardial infarction death rate per 100 000 population (41) is twice that of France (19) - but UK death rates fell faster than any other European country between 1980 and 2006

Source: OECD data

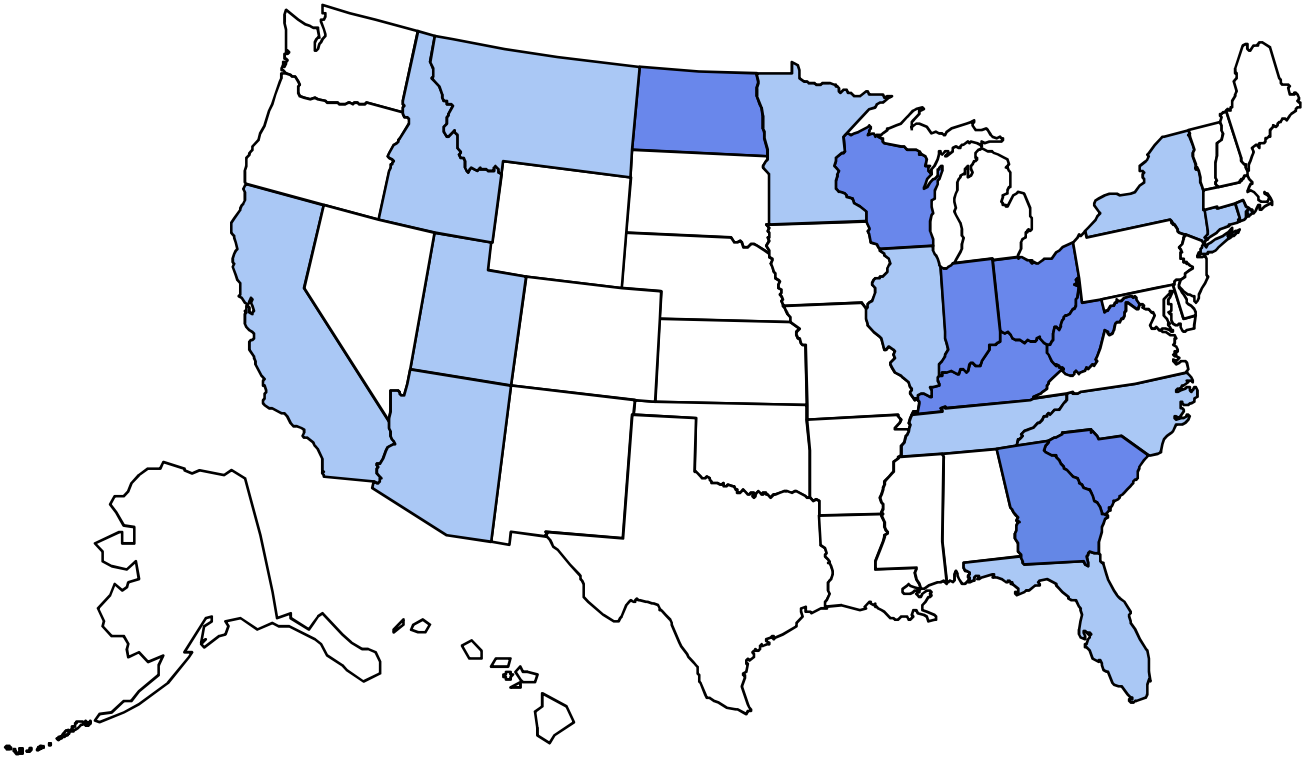
Relative importance of risk factors and treatment

Risk Factor	Effect	Treatments	Effect
Obesity	+3%	AMI	-8%
Diabetes	+5%	Secondary prevention	-11%
Blood Pressure	-10%	Heart failure	-13%
Smoking	-48%	Angina: CABG/PTCA	-7%
Cholesterol	-9%	Hypertension therapy	-3%
Physical activity	+4%		
Deprivation	-3%		
Total	-58%		-42%

Source: CHD Impact model – University of Liverpool – England & Wales

Obesity trends among U.S. adults
1985

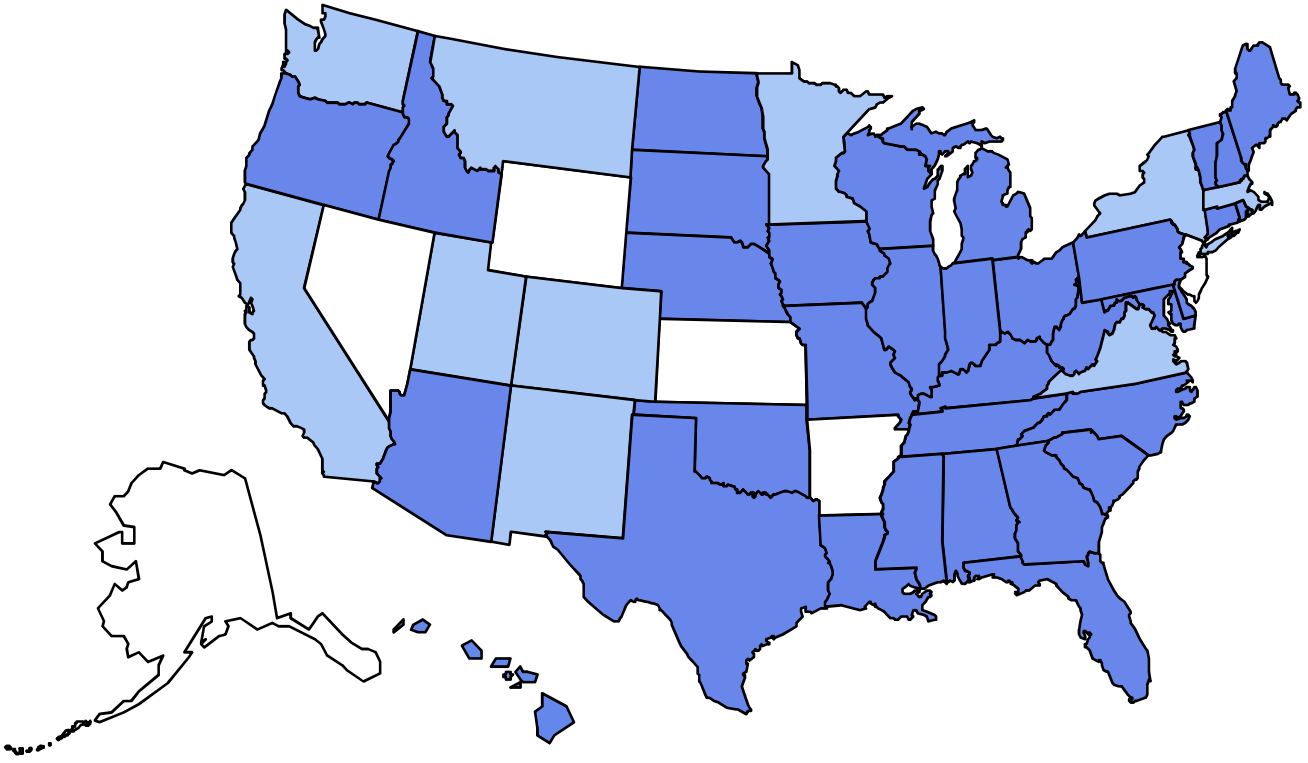
(*BMI ≥30, or ~ 30 lbs overweight for 5’ 4” person)



No Data | <10% | 10%–14% | 15%–19% | 20%–24% | ≥25%

Source: CDC

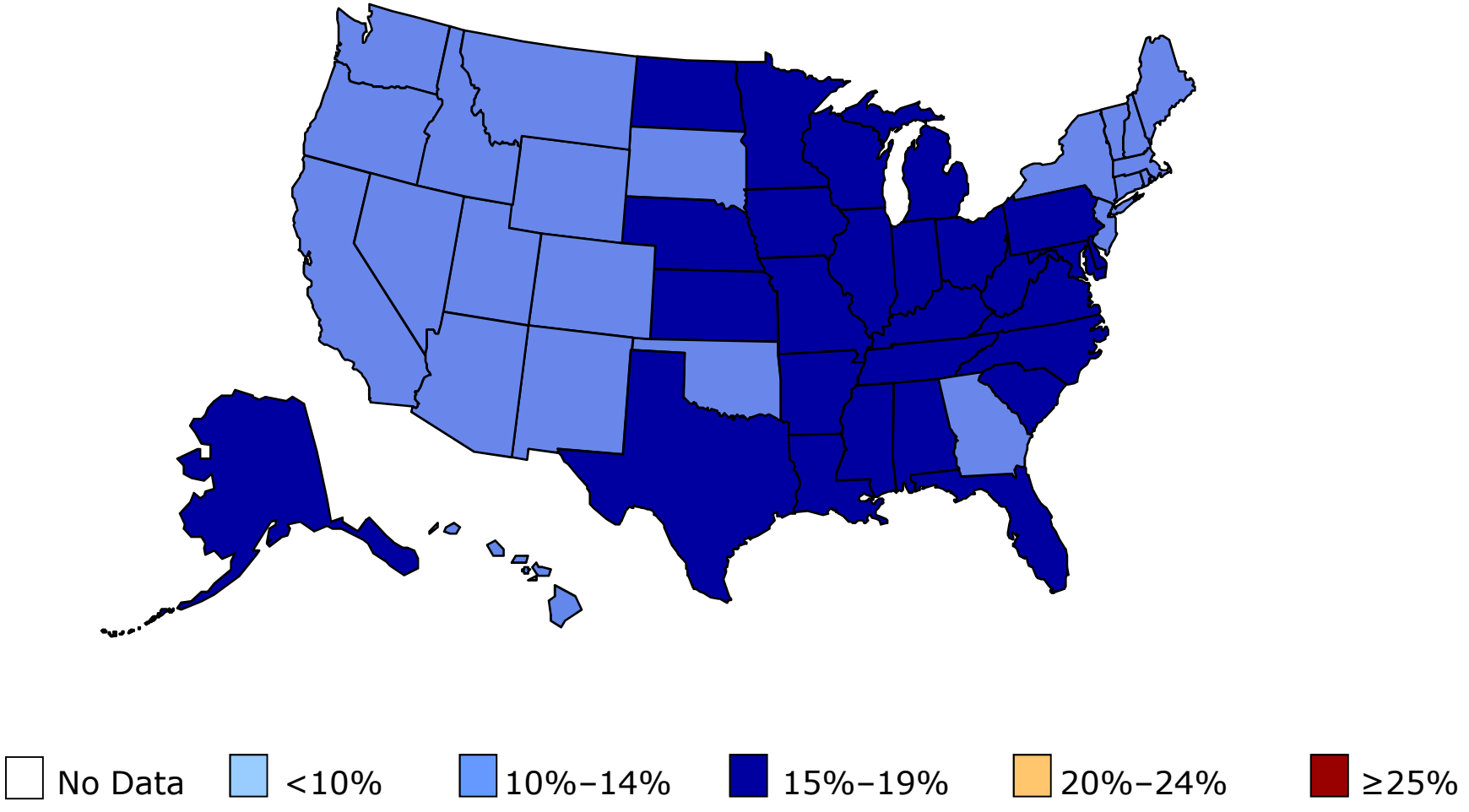
Obesity trends in U.S. adults
1990



No Data <10% 10%–14% 15%–19% 20%–24% ≥25%

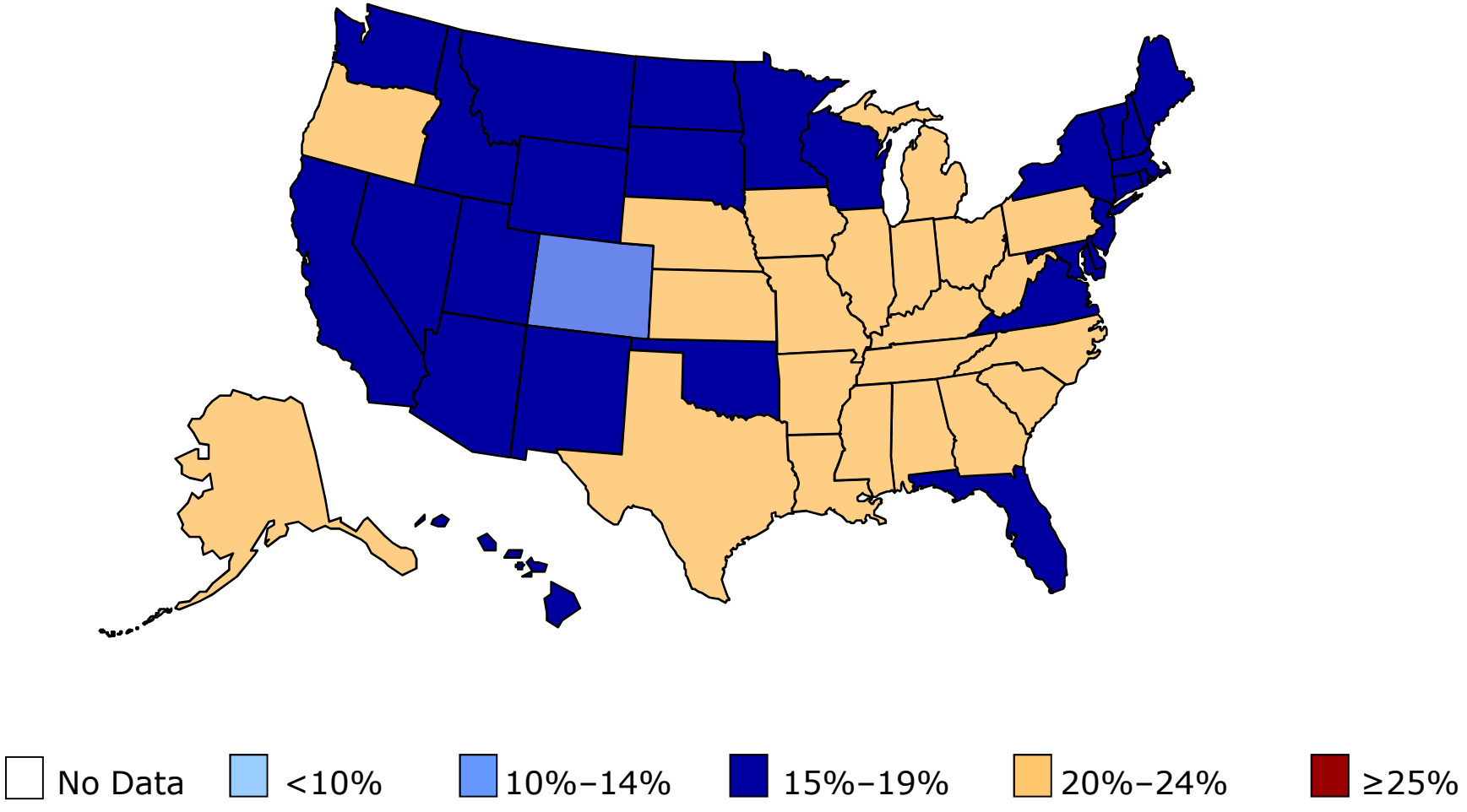
Source: CDC

Obesity trends in U.S. adults
1995



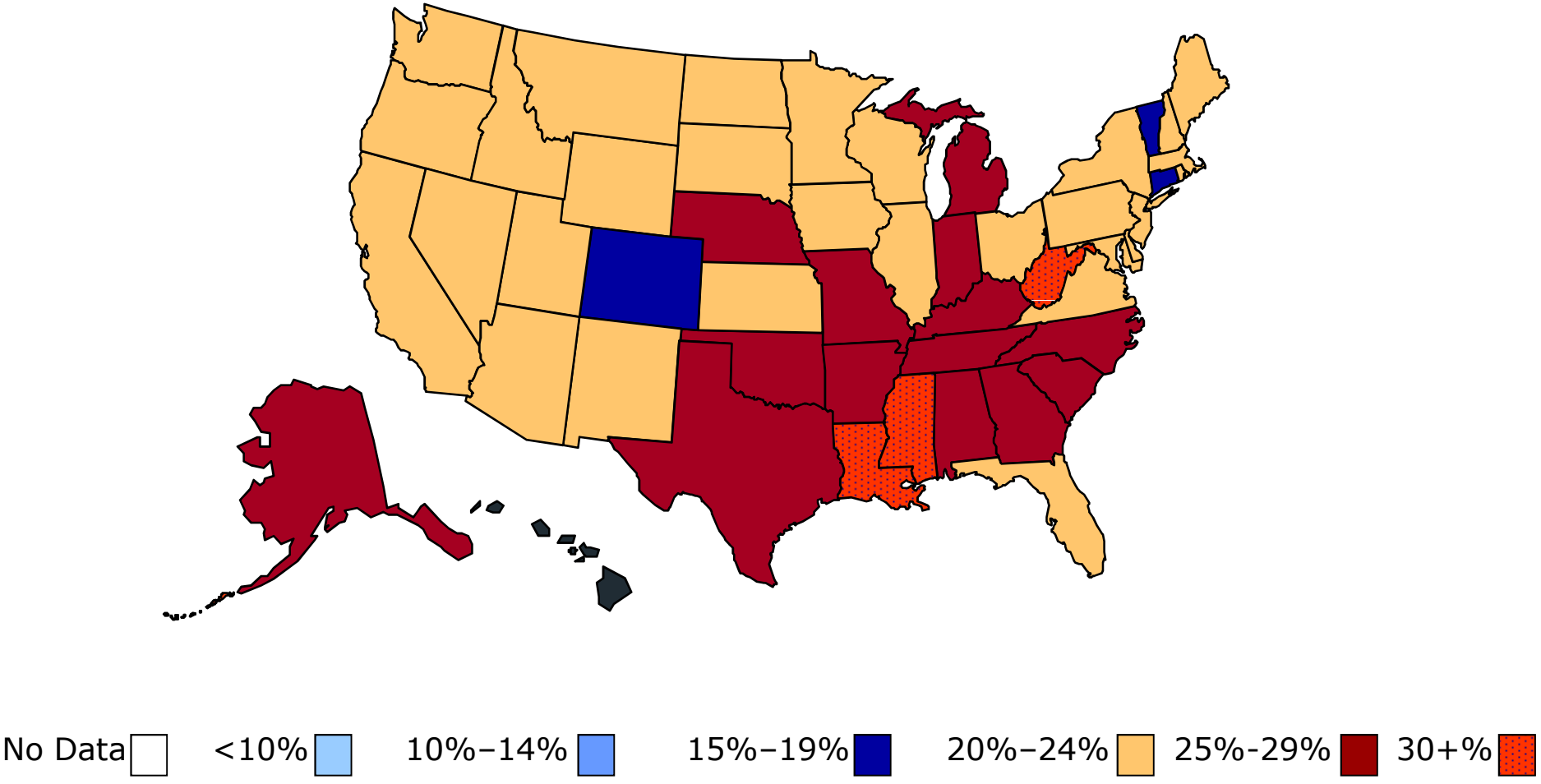
Source: CDC

Obesity trends in U.S. adults 2000



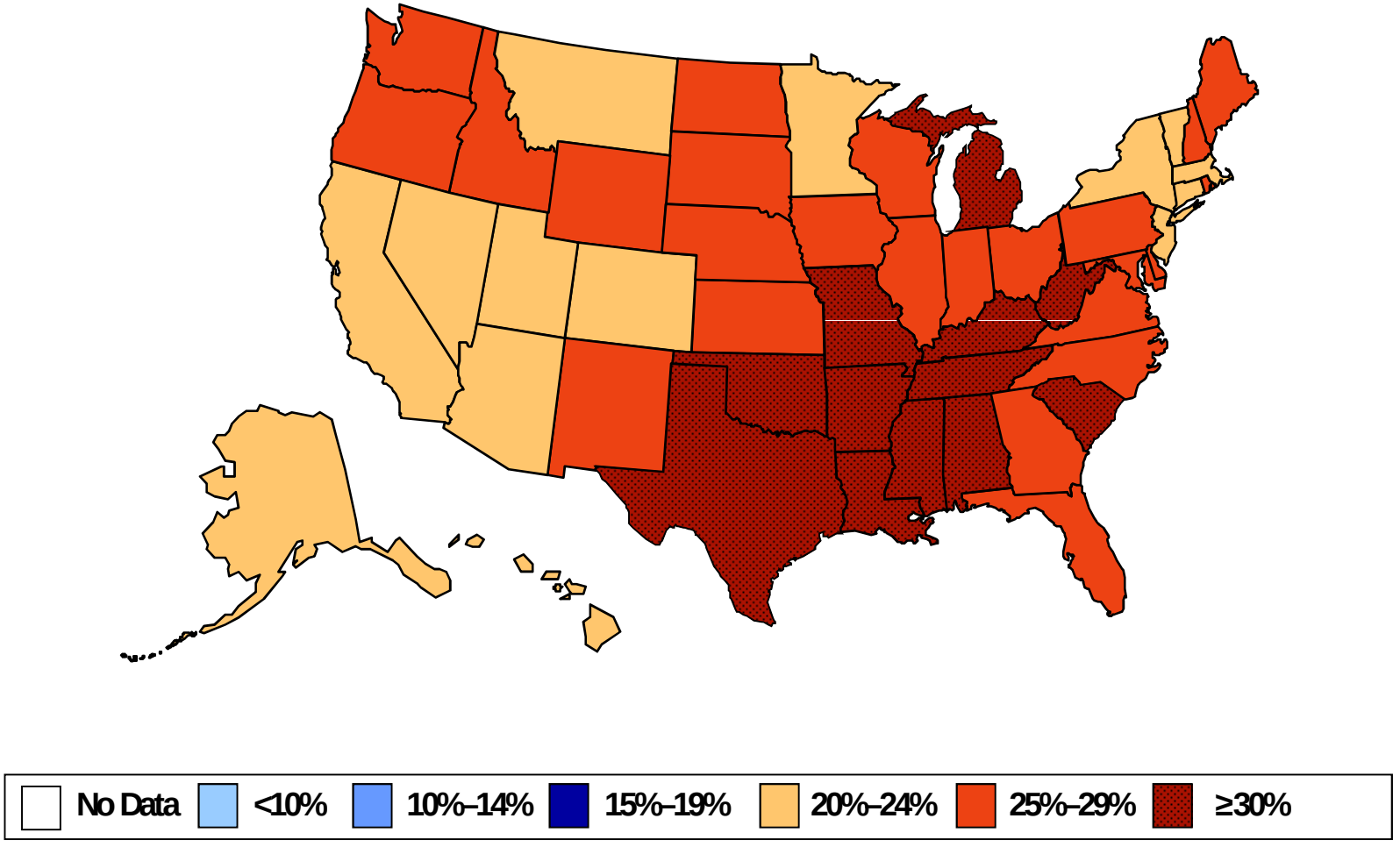
Source: CDC

Obesity trends in U.S. adults 2005



Source: CDC

Obesity trends in U.S. adults 2010



Source: CDC

Germany: The Melander family of Bargteheide
Food expenditure for one week: 375.39 Euros or $500.07

United States: The Revis family of North Carolina
Food expenditure for one week $341.98

Italy: The Manzo family of Sicily
Food expenditure for one week: 214.36 Euros or $260.11

Egypt: The Ahmed family of Cairo
Food expenditure for one week: 387.85 Egyptian Pounds or $68.53

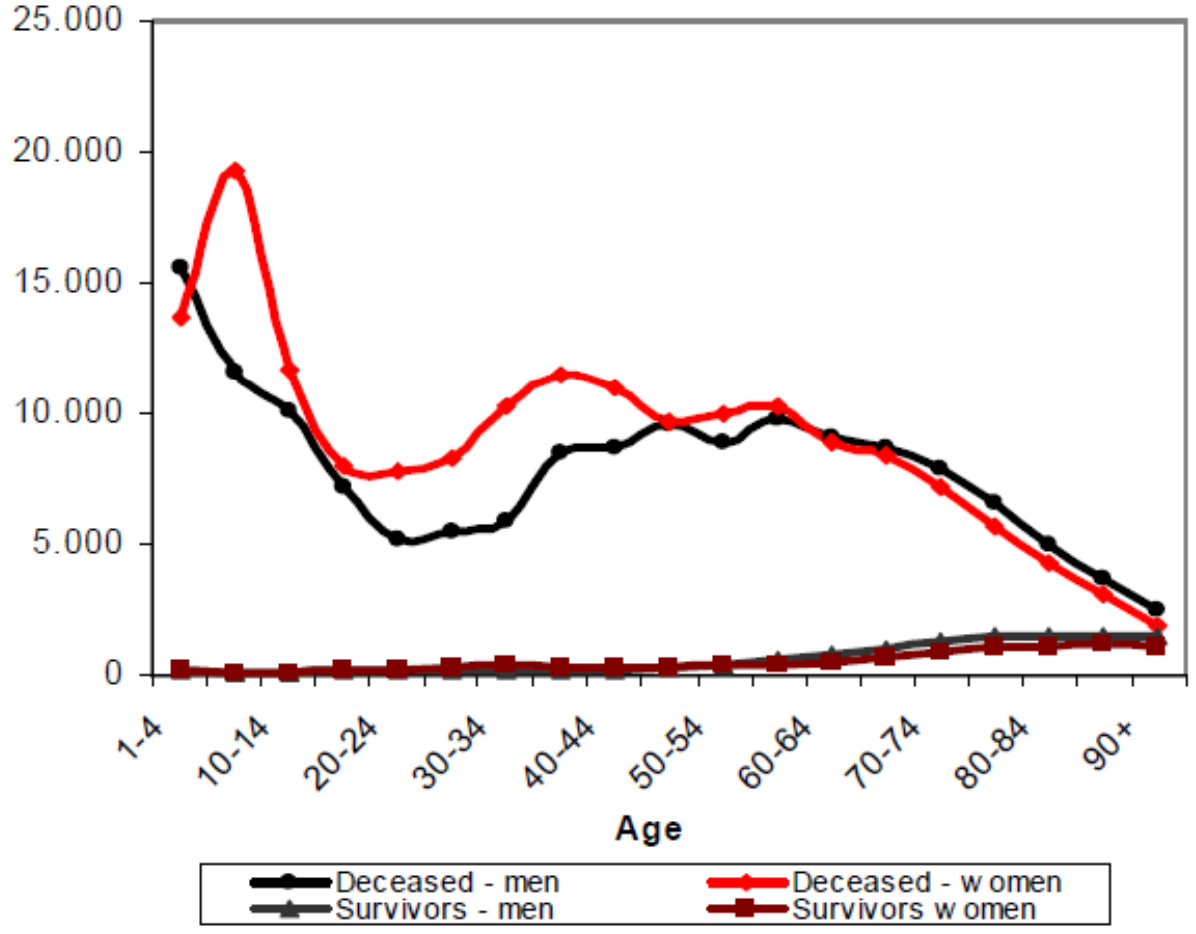
Bhutan: The Namgay family of Shingkhey Village
Food expenditure for one week: 224.93 ngultrum or $5.03

What do we want from our healthcare systems

- Fast access to reliable health advice
- ***Effective treatment delivered by trusted professionals***
- Involvement in decisions and respect for preferences
- Clear, comprehensible information and support for self-care
- Attention to physical and environmental needs
- Emotional support, empathy and respect
- Involvement of, and support for, family and carers
- Continuity of care and smooth transitions

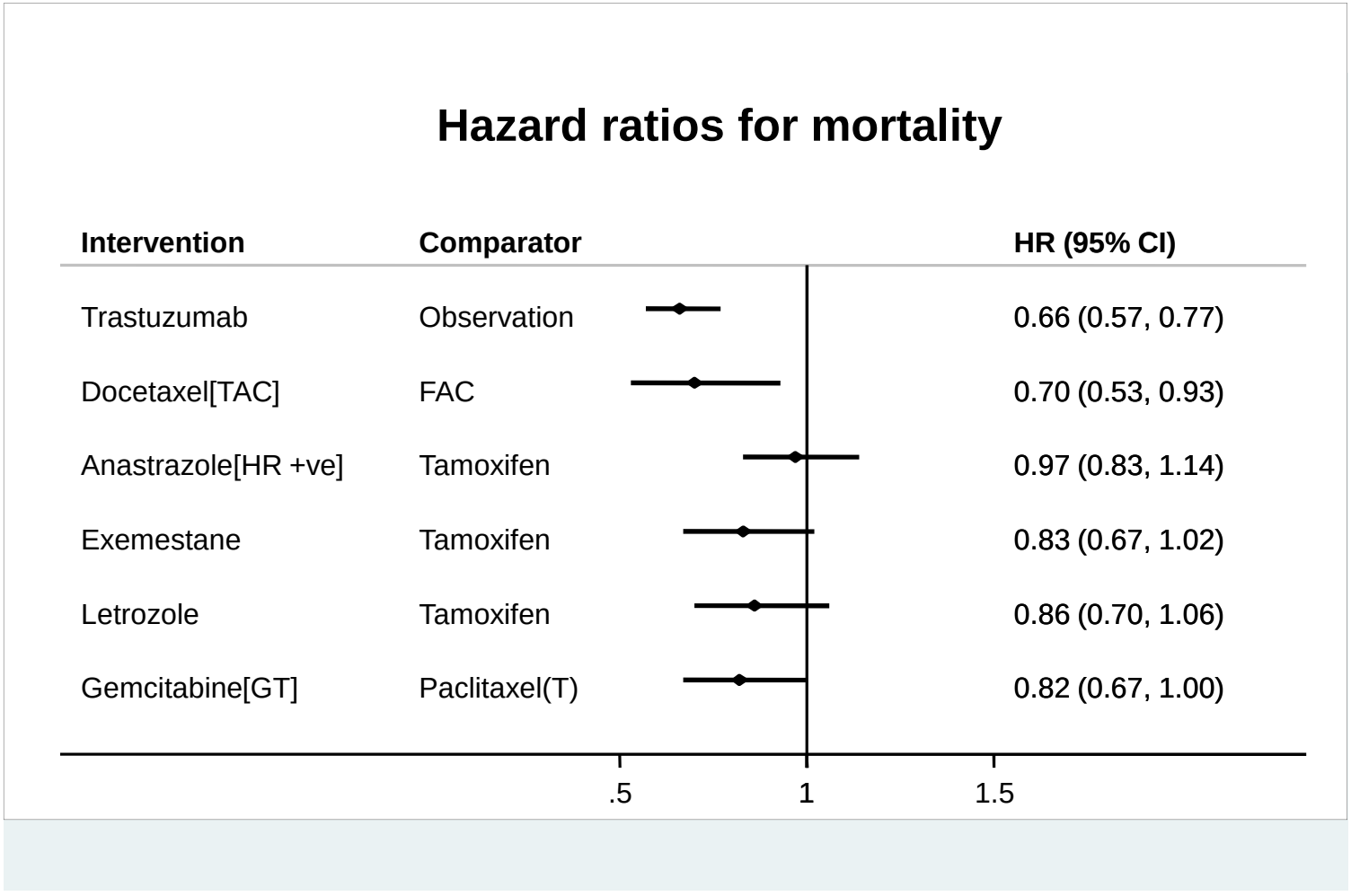
Source: Picker Institute Europe based on patient interviews

Healthcare expenditure at end of life
Survivors and deceased in regional study in Italy



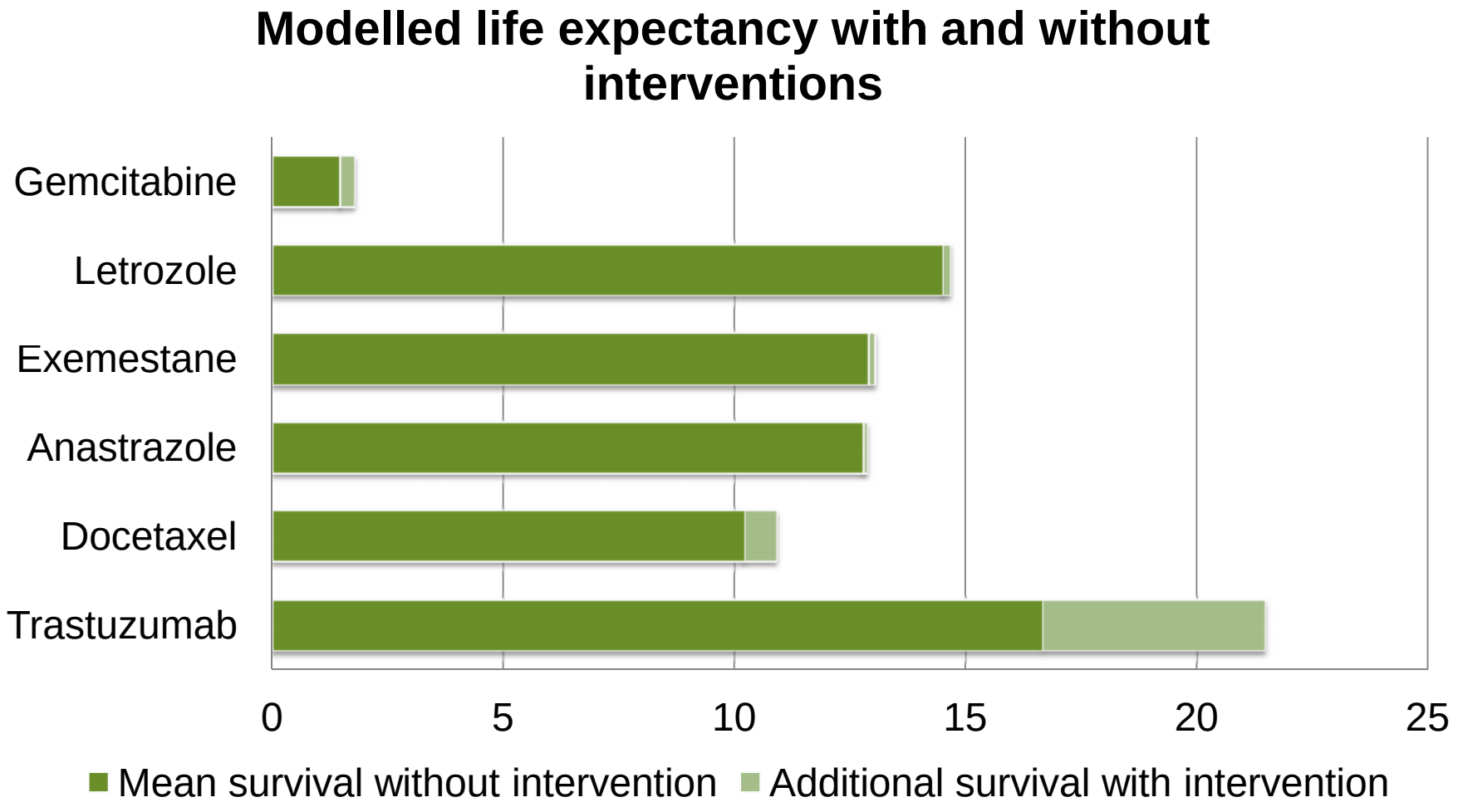
Source: AHEAD, European Network of Economic Policy Research Institutes (2007)

Comparisons of different treatments
Breast cancer



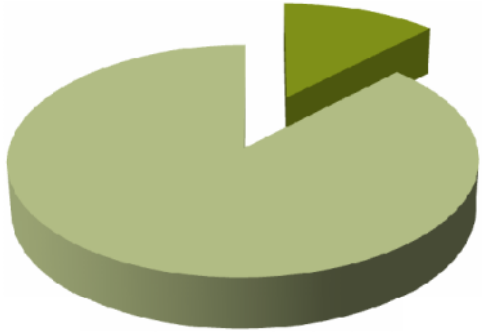
Based on: NICE Technology Appraisals, 2005 to 2010

Comparisons of different treatments
Breast cancer

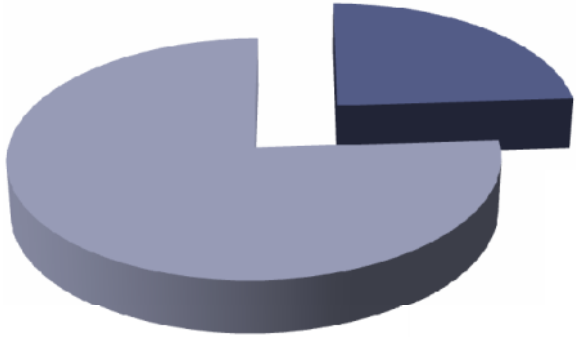


Based on: NICE Technology Appraisals, 2005 to 2010

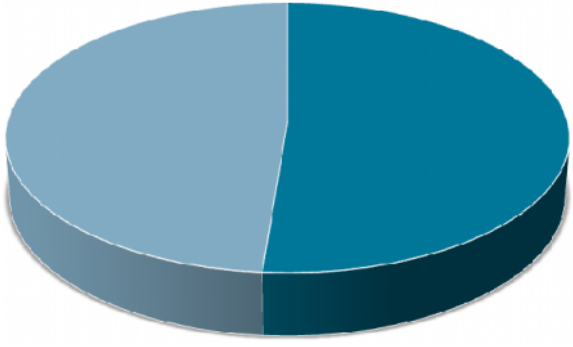
Guidance over use of different treatments
% of breast cancers



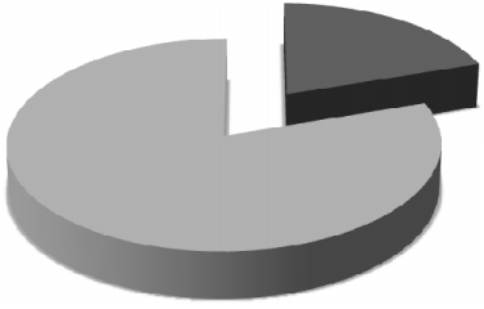
Trastuzumab



Docetaxel



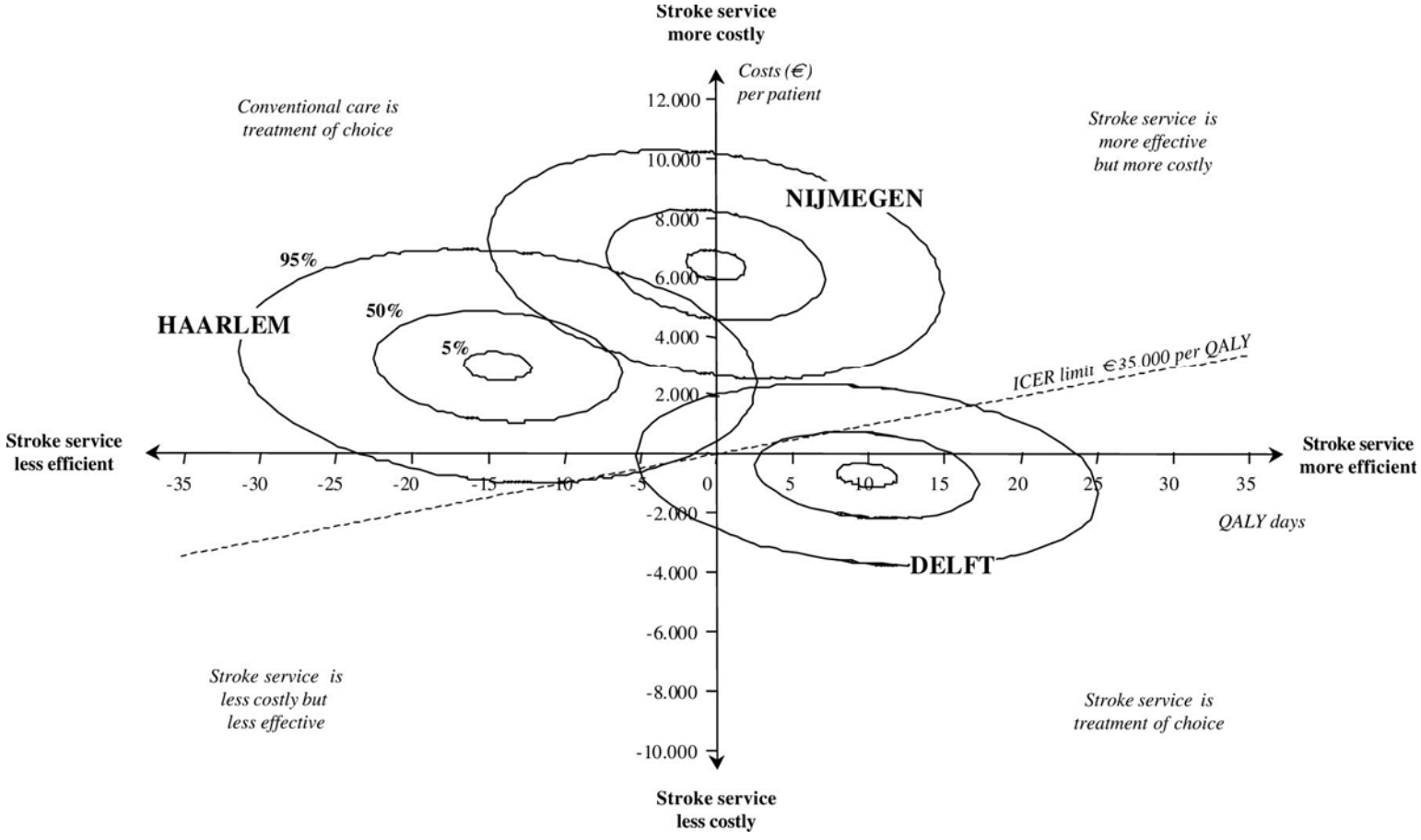
Aromatase Inhibitors



Gemcitabine

Based on: NICE Technology Appraisals, 2005 to 2010

Evaluating cost-effectiveness of treatments
Co-ordinated stroke care in different locations



Source: van Exel N et al. QJM 2005;98:415-425

Clinical trials – scope and timeframe

	Preclinical testing	Phase I Trials	Phase II Trials	Phase III Trials	Filing/ approval	Phase IV
Time	3 – 5 years	1 year	2 years	3 years	2 years	open
Study subject	Laboratory and animal studies	20 - 80 healthy volunteers	100 – 300 patient volunteers	1'000 – 3'000 patient volunteers	–	open, according to indication
Study aim	Assess safety & biol. activity	Determine safety & max. dose	Evaluate effective dose, side effects	Verify efficacy, monitor long term	Review process	Post marketing safety monitoring
	➡ IND[1] Submission					

Source: CDC

Clinical trials – approval rates by therapeutic class

Table 3 Phase transition and clinical approval probabilities by therapeutic class for self-originated compounds first tested in humans from 1993 to 2004

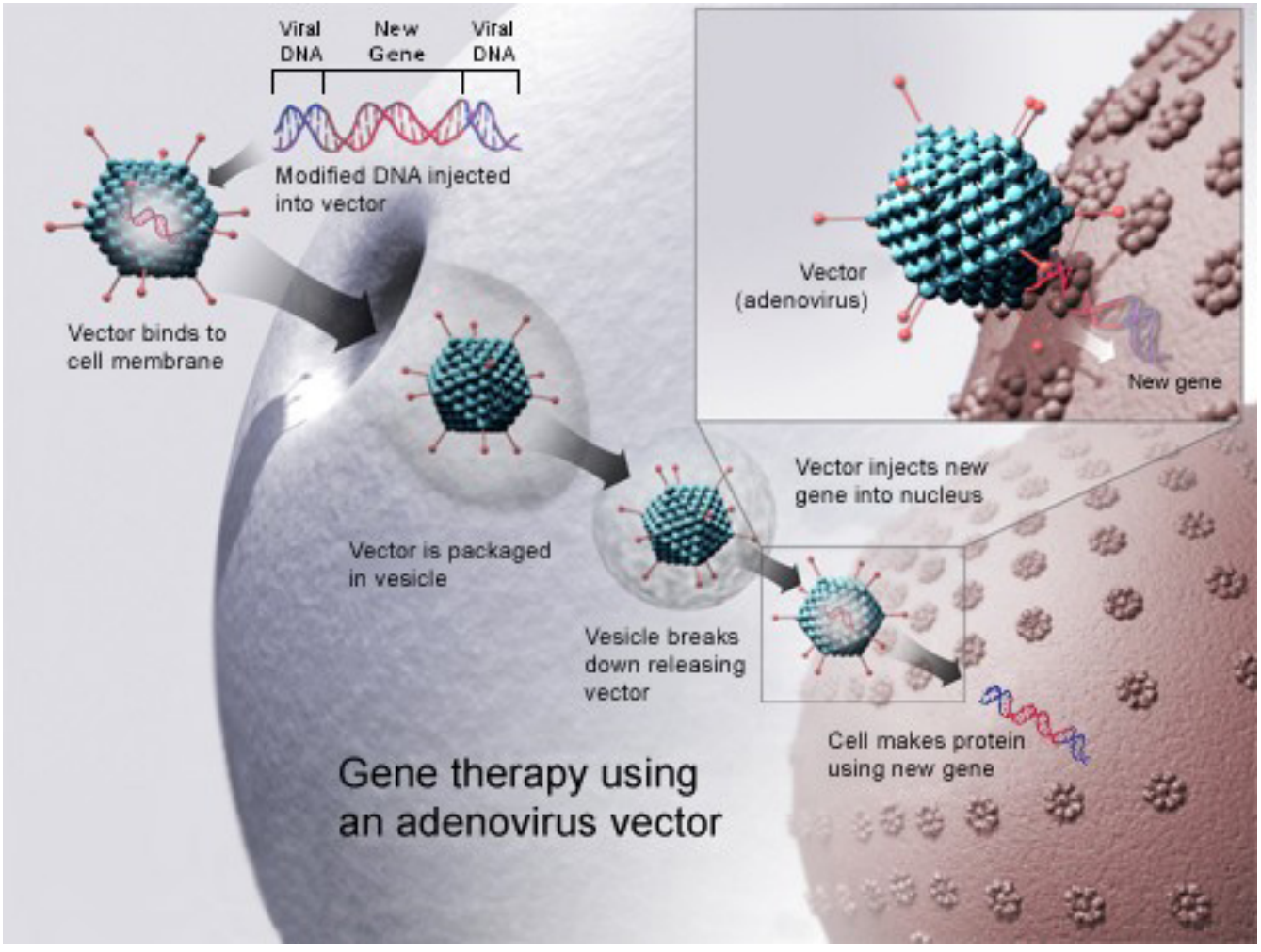
Therapeutic class	Phase I–II (%)	Phase II–III (%)	Phase III–RR (%)	RR–approval (%)	Clinical approval success rate (%)
Antineoplastic/immunologic	71.8	49.0	55.3	100	19.4
Cardiovascular	62.9	32.4	64.3	66.7	8.7
CNS	59.6	33.0	46.4	90.0	8.2
GI/metabolism	67.5	34.9	50.0	80.0	9.4
Musculoskeletal	72.4	35.2	80.0	100	20.4
Respiratory	72.5	20.0	85.7	80.0	9.9
Systemic anti-infective	58.2	52.2	78.6	100	23.9
Miscellaneous	62.8	48.7	69.8	91.3	19.5

Through June 2009.

CNS, central nervous system; GI, gastrointestinal; RR, regulatory review.

Source: DiMasi et al. Nature (March 2010), 87, 3, 272-7

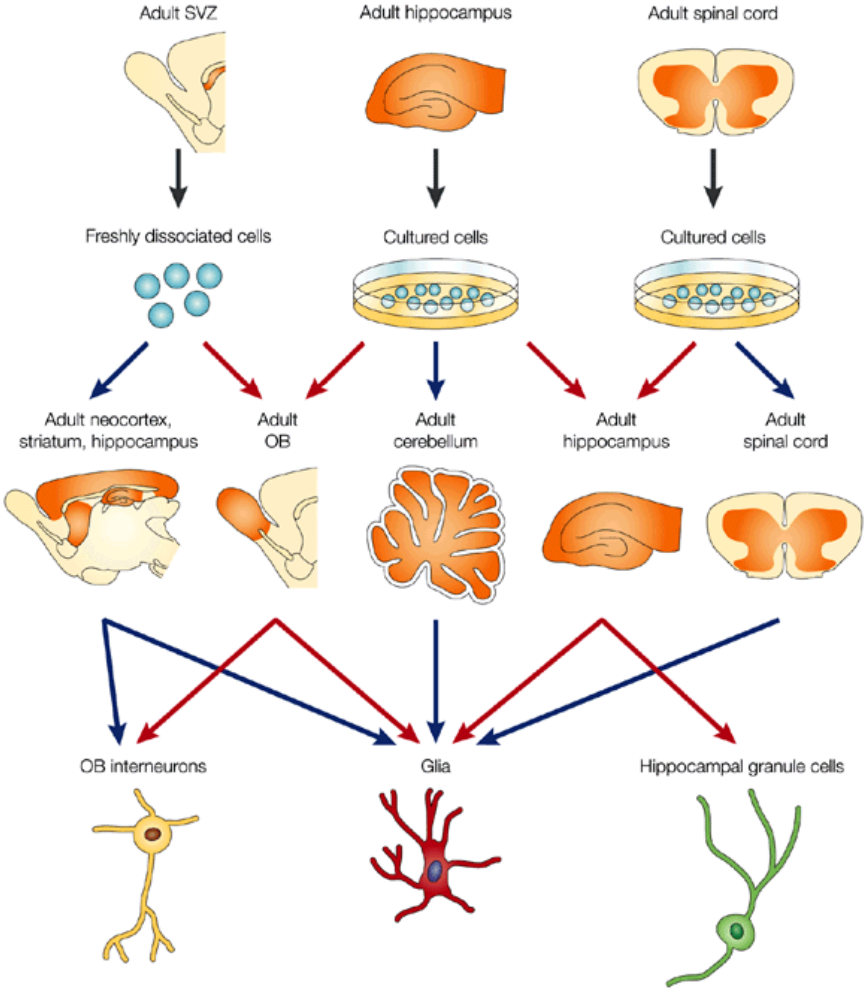
Regenerative medicine: gene therapy



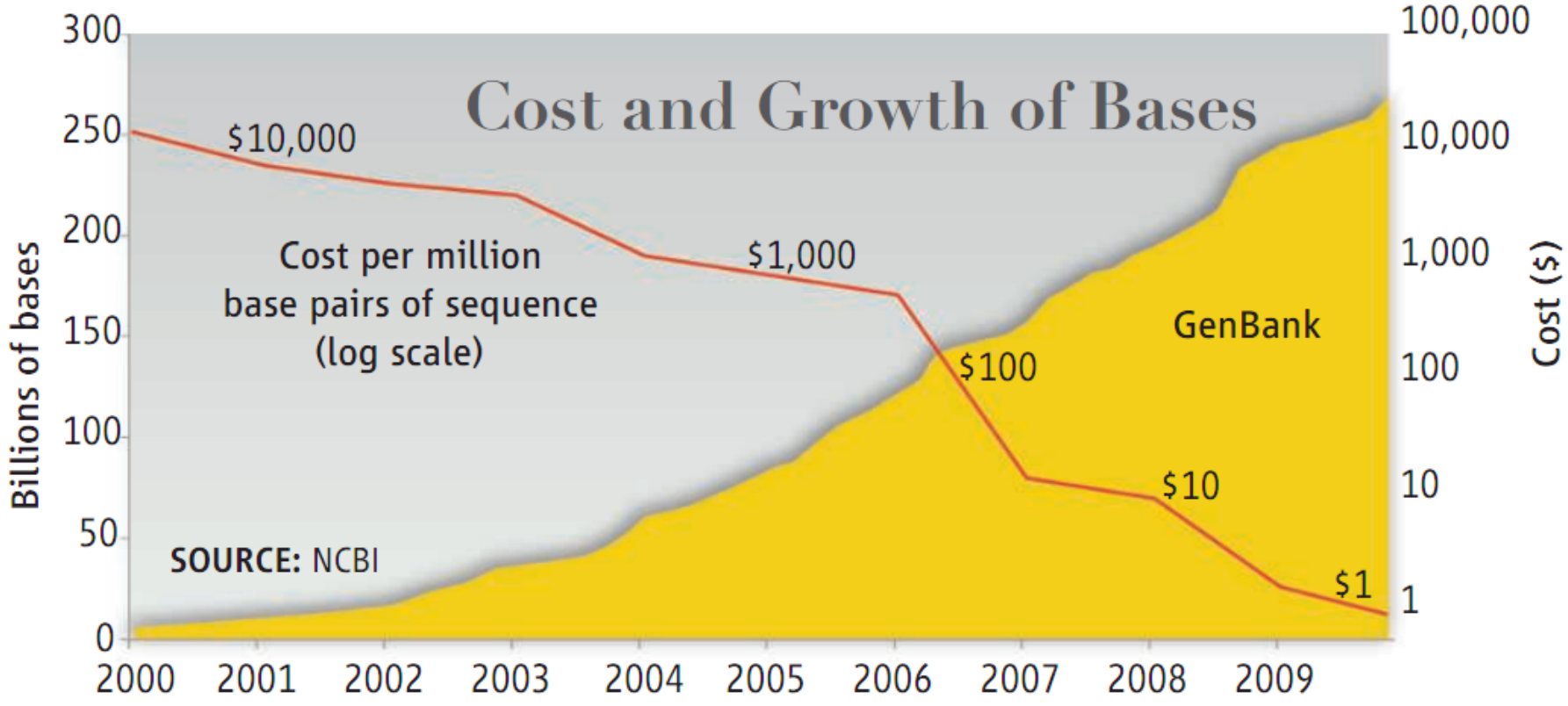
http://en.wikipedia.org/wiki/Gene_therapy

Regenerative medicine: cell therapy

Nature Reviews Neuroscience 2002

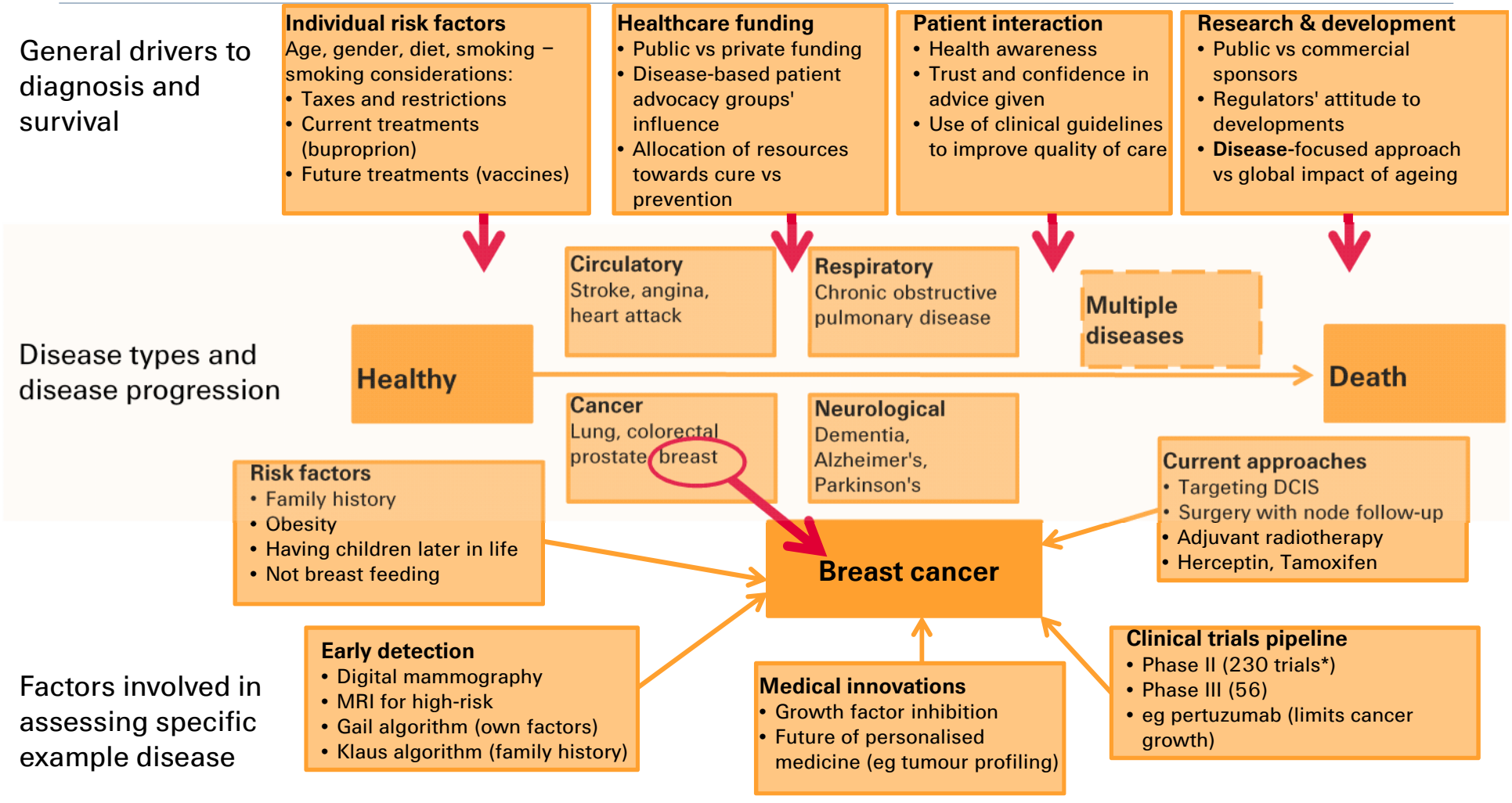


Genetic information:
Revolutionary developments from DNA sequencing

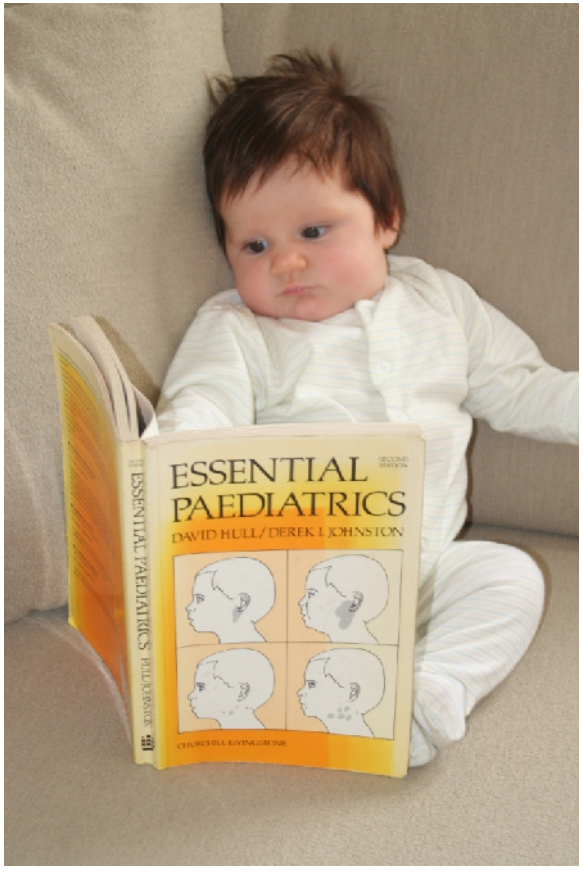


Source: E. Pennisi, Science 2011, 331, 666-8

Combining different elements in a forward-looking approach to assessing future mortality



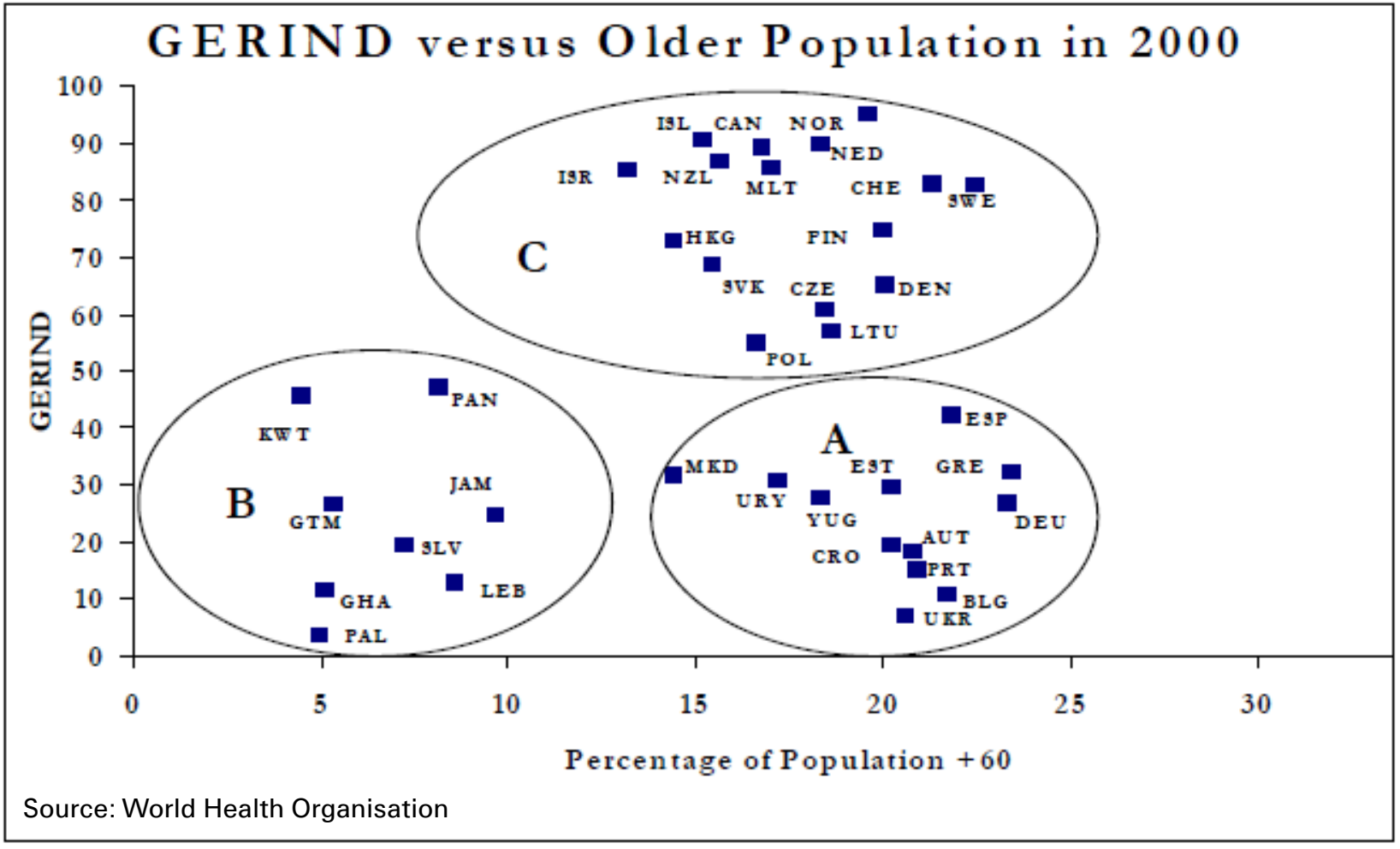
Education of future medical professionals
Implications of an ageing society



Teaching Geriatric in Medical Education study (TeGeMe)

- Collaborative study of WHO and International Federation of Medical Students' Associations
- WHO intends healthy/active ageing and promotion of long term health to form education of all future young doctors
- Promotion of life course in graduate training and later
- 41% of medical school curricula refer explicitly to geriatrics
- GERIND index calculated by medical school and averaged across country –separation of geriatrics teaching and quality of ageing science being taught
- Central hypothesis is that countries with higher percentage of older persons are more likely to have separate high-quality teaching on geriatric medicine – not always true

TeGeMe – GERIND index vs. age of population



Source: World Health Organisation

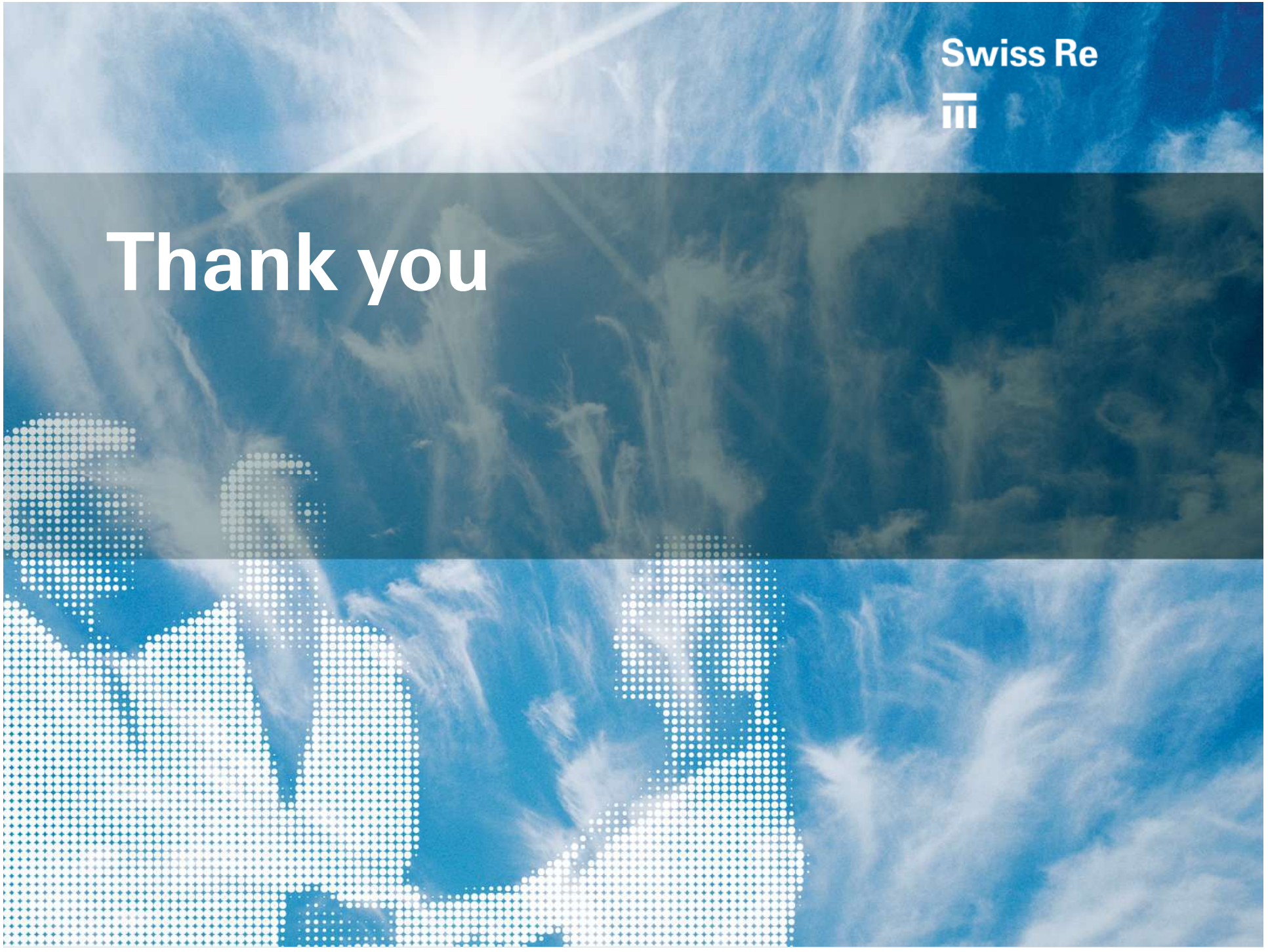
A new relationship between doctor & patient

- Classic asymmetrical relationship based on knowledge
- Medical and surgical specialisation driven or required because of technical information & procedures
- Doctors facing information overload
- Transforming effects of internet as clinical guidance becomes more comprehensive
- Two key roles for doctors
  - Patient advocate – facilitate patient-based healthcare and act as guide to new technological breakthroughs
  - Scientist/technician – maintain pace of development

A new functional divide across the profession

Some thoughts for holders of longevity risk

- Continuing differences in schools of thought over future longevity
- Conflicting forces between risk behaviours and treatment
- Impending revolution in genetic information
- Increasing demands from regulators for justification
- No market as yet in longevity risk
- Holders of longevity risk have several options –
  - Transfer risk
  - Invest in further research and understanding
  - Wait and see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Thank you