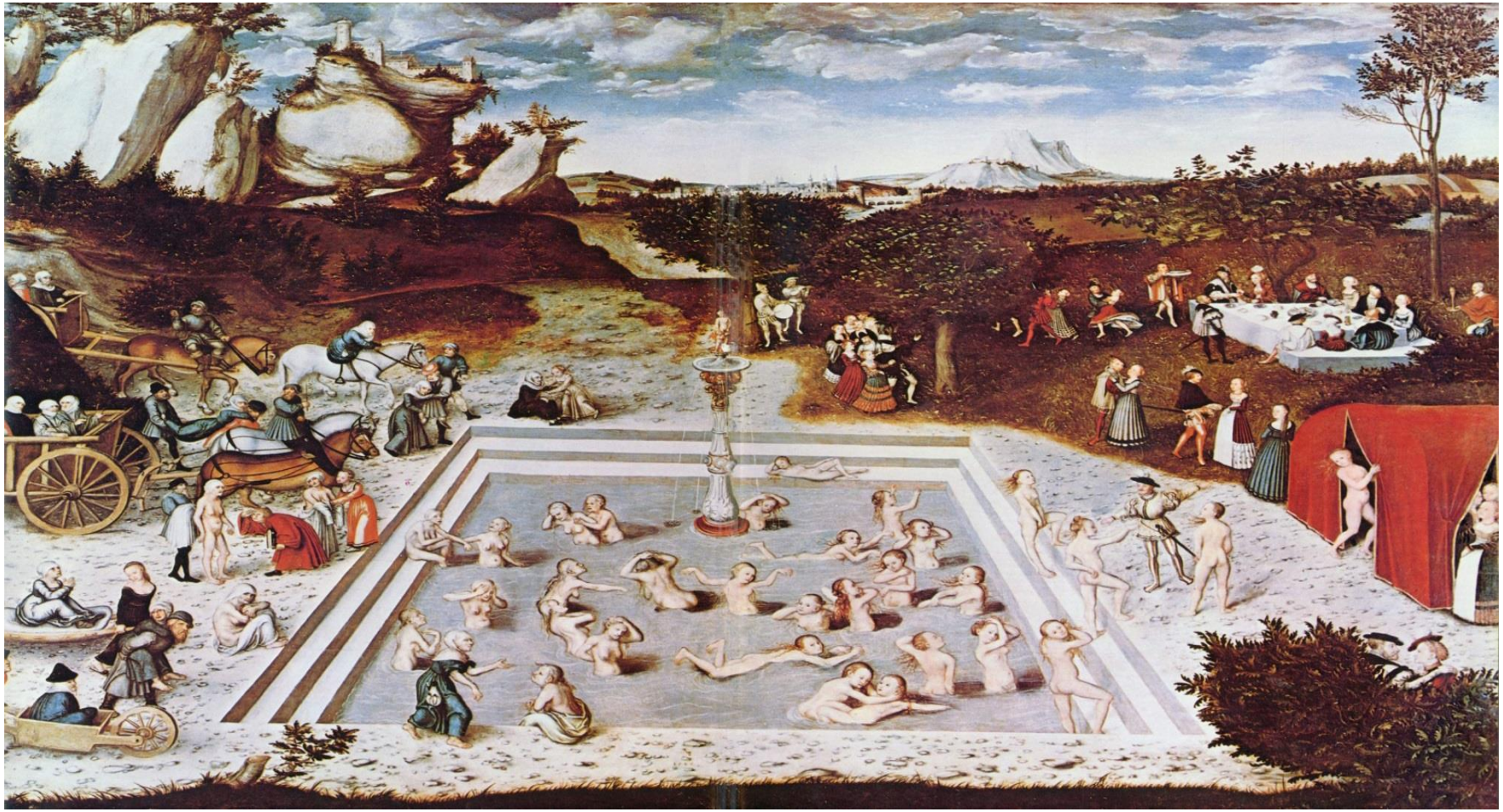
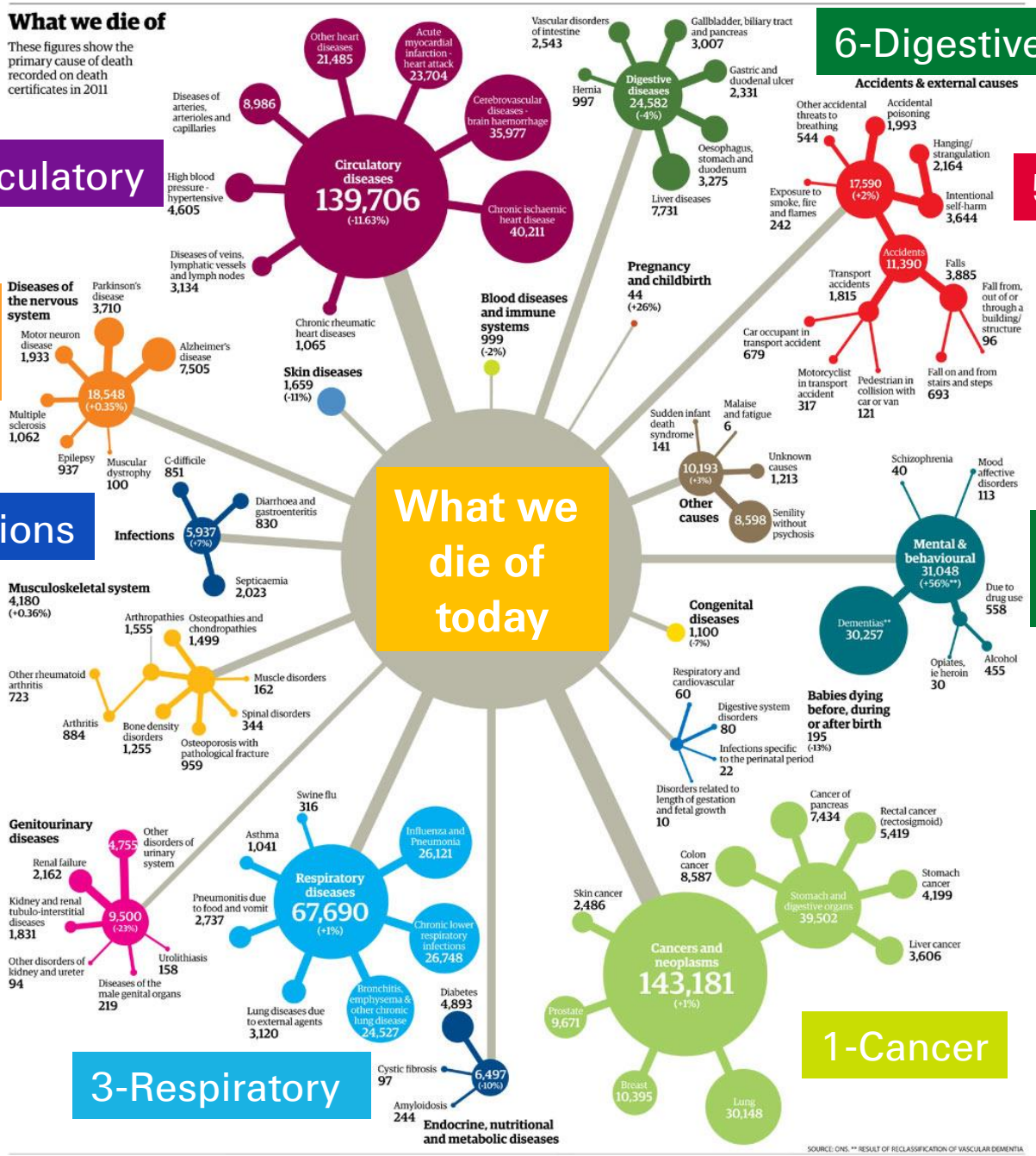
Swiss Re Institute

Towards a clearer understanding of mortality: where expertise meets data

Dan Ryan, Head Risk Research
8 May 2019

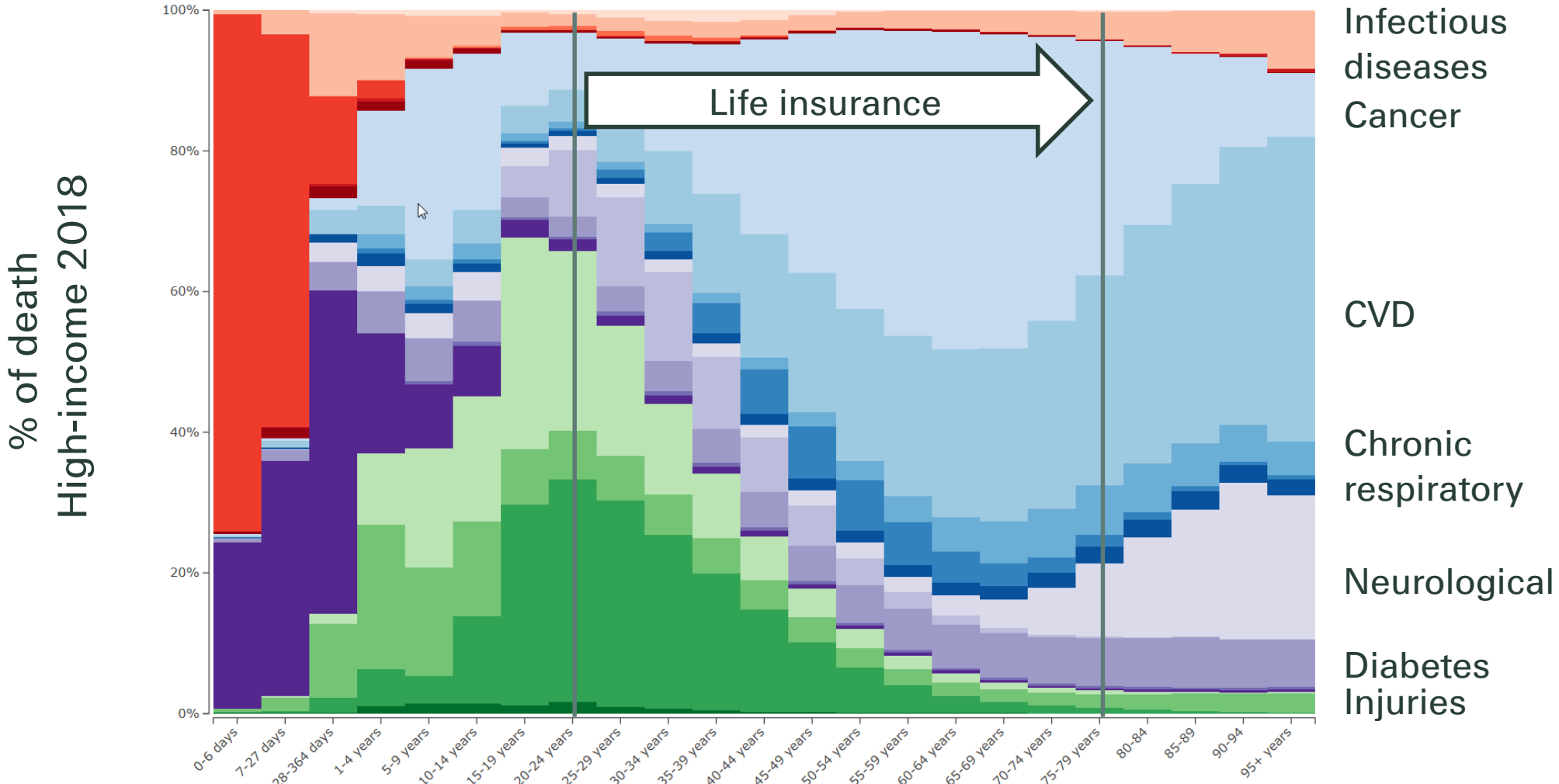
The expert view of future longevity - 500 years ago (Cranach & Cranach)





Source: The Guardian

Cancer and cardiovascular diseases - leading causes of death in life insurance relevant age groups



Source: Institute for Health Metrics and Evaluation (IHME). **GBD Compare**. http://ihmeuw.org/4re5

Learning from our research collaborations
Harvard School of Public Health

Home > Events > The future of human longevity: focusing on you

Home > Events > The future of human longevity: regenerative medicine in focus

Home > Events > Impact of cardiovascular risk factors on healthy lifespan and mortality in Brazil and Mexico

Impact of cardiovascular risk factors on healthy lifes
and mortality in Brazil and Mexico

15 - 16 Oct 2013 Add to calendar

Location: Cambridge, MA, United States; organised by the Harvard School of Public Healt
Re and swissnex Boston

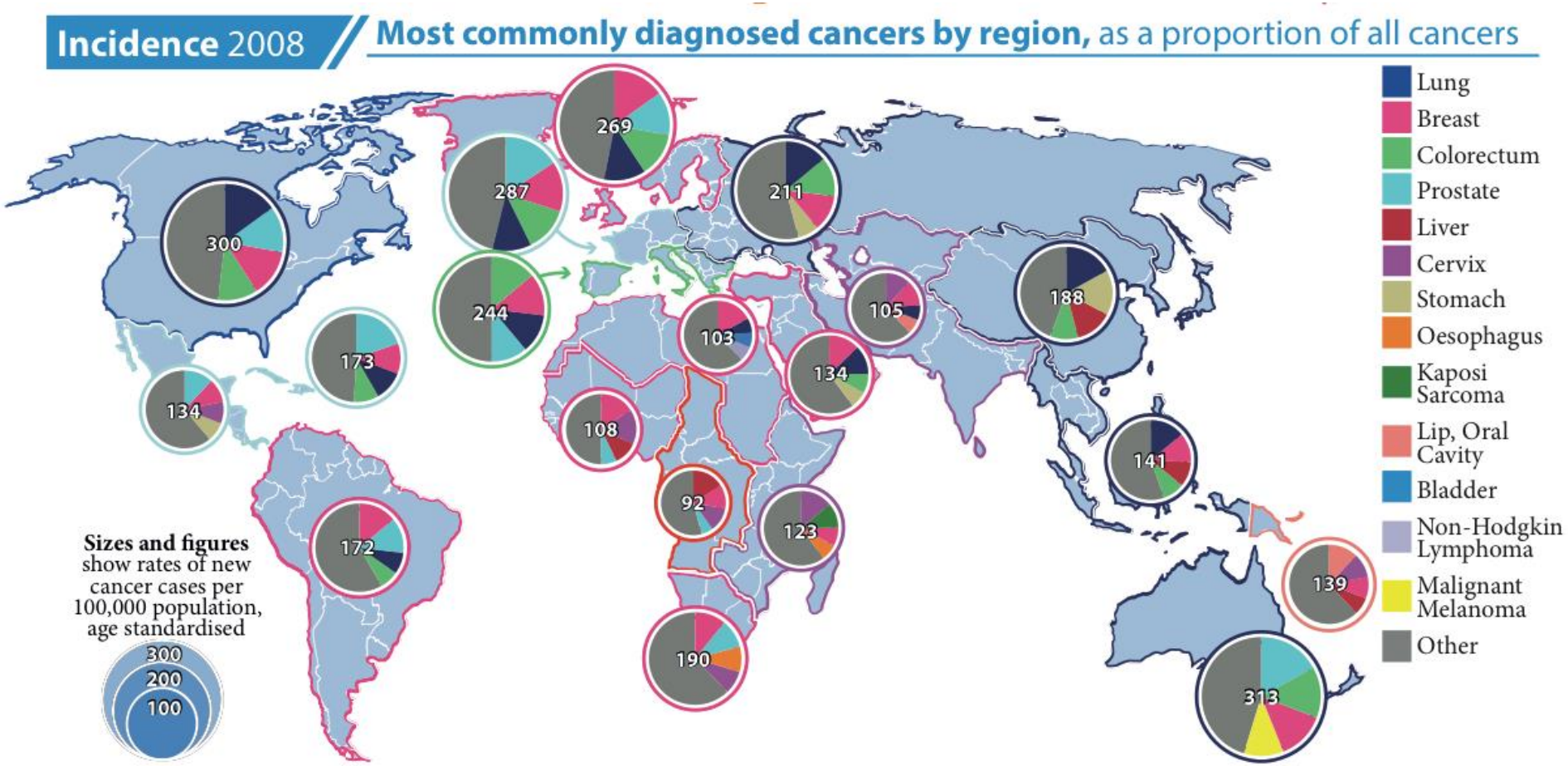
Home > Events > The future of human longevity: cardiovascular health, longer lives

The future of human longevity: cardiovascular health, longer lives

10 - 12 Nov 2013 Add to calendar

Organised by: Swiss Re Centre for Global Dialogue

Learning from our research collaborations
CONCORD II



Global Burden of Disease
Annual review of global impact of risk factors

Ranking legend
1–5 | 6–10 | 11–15
16–20 | 21–25 | 26–30
31–35 | 36–40 | >40

Risk factor	Global	High-income Asia Pacific	Western Europe	Australasia	High-income North America	Central Europe	Southern Latin America	Eastern Europe	East Asia	Tropical Latin America	Central Latin America	Southeast Asia	Central Asia	Andean Latin America	North Africa and Middle East	Caribbean	South Asia	Oceania	Southern sub-Saharan Africa	Eastern sub-Saharan Africa	Central sub-Saharan Africa	Western sub-Saharan Africa
High blood pressure	1	1	2	3	4	1	2	2	1	2	4	1	1	2	1	1	3	6	2	6	5	6
Tobacco smoking, including second-hand smoke	2	2	1	2	1	3	3	3	2	4	5	2	3	5	3	3	2	3	5	7	12	10
Alcohol use	3	3	4	4	3	2	4	1	6	1	1	6	2	1	11	5	8	5	1	5	6	5
Household air pollution from solid fuels	4	42	..	..	..	14	23	20	5	18	11	3	12	7	13	9	1	4	7	2	2	2
Diet low in fruits	5	5	7	7	7	5	6	5	3	6	7	4	5	10	6	8	5	9	8	8	11	13
High body-mass index	6	8	3	1	2	4	1	4	9	3	2	9	4	3	2	2	17	2	3	14	18	15
High fasting plasma glucose	7	7	6	6	5	7	5	10	8	5	3	5	7	6	4	4	7	1	6	10	13	11
Childhood underweight	8	39	38	37	39	38	38	38	38	32	23	13	25	18	21	14	4	8	9	1	1	1
Ambient particulate matter pollution	9	9	11	26	14	12	24	14	4	27	19	11	10	24	7	19	6	32	25	16	14	7
Physical inactivity and low physical activity	10	4	5	5	6	6	7	7	10	8	6	8	9	8	5	7	11	7	11	15	15	16
Diet high in sodium	11	6	10	11	11	9	11	9	7	9	13	7	6	13	8	15	14	16	13	21	17	18
Diet low in nuts and seeds	12	11	9	8	8	8	8	8	12	10	8	15	8	12	9	10	13	13	16	22	16	21
Iron deficiency	13	20	32	21	35	22	17	21	19	14	12	12	17	4	12	6	9	11	10	4	4	4
Suboptimal breastfeeding	14	..	..	..	..	..	27	..	24	22	15	14	16	9	15	13	10	10	4	3	3	3
High total cholesterol	15	12	8	9	9	10	9	6	13	11	10	16	14	16	10	16	20	14	19	28	27	30
Diet low in whole grains	16	10	16	16	17	11	12	11	11	12	14	26	13	17	14	12	15	15	32	24	19	24
Diet low in vegetables	17	14	13	12	13	13	10	12	15	16	20	10	11	14	18	11	16	12	15	23	23	20
Diet low in seafood omega-3 fatty acids	18	17	15	13	16	16	14	13	17	17	18	19	15	23	16	17	18	20	23	27	25	25
Drug use	19	13	14	10	10	20	13	17	18	13	16	18	20	11	19	18	22	19	12	19	24	22
Occupational risk factors for injuries	20	24	24	20	25	26	16	25	20	19	22	23	21	21	23	31	12	22	22	20	22	17

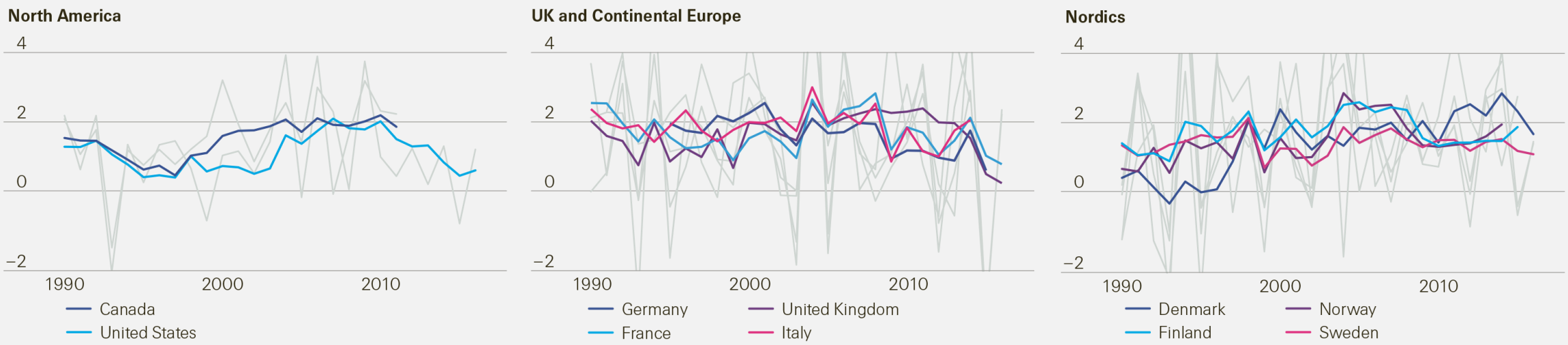
Mortality improvement: understanding the past and framing the future

Mortality improvements slowed recently

There are signs that mortality improvements have slowed recently in many countries... but not everywhere

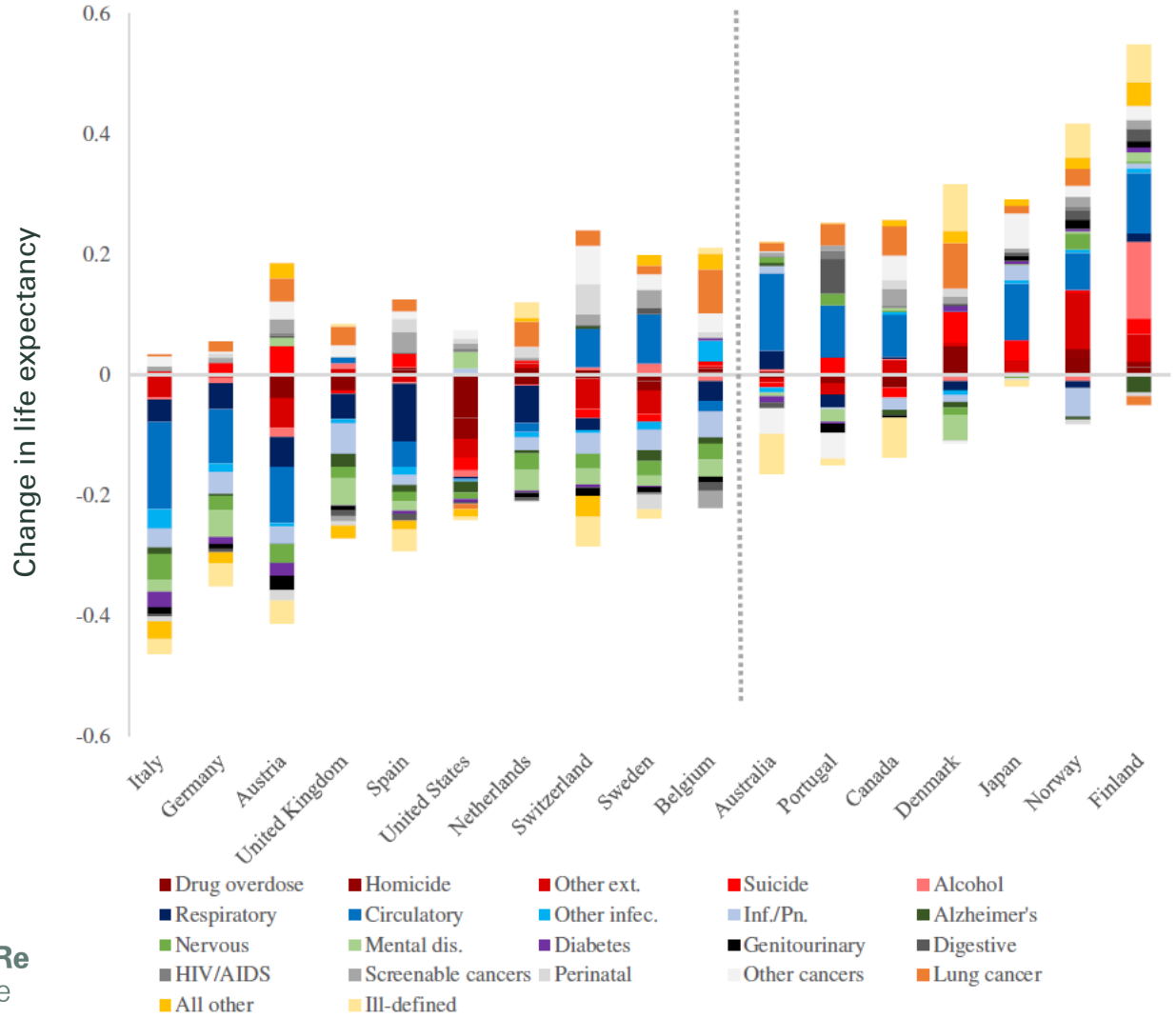
5-year backward-looking moving averages of annual improvements in mortality rates

In percent, age-standardised rates



Notes: Coloured lines are 5-year backward-looking moving averages. Grey lines show the high volatility of annual rates of improvement. Rates were standardised using the US population in 2016.
Sources: Swiss Re Institute, Human Mortality Database

Mortality improvement and life gains vary widely across different countries and are driven by different death categories



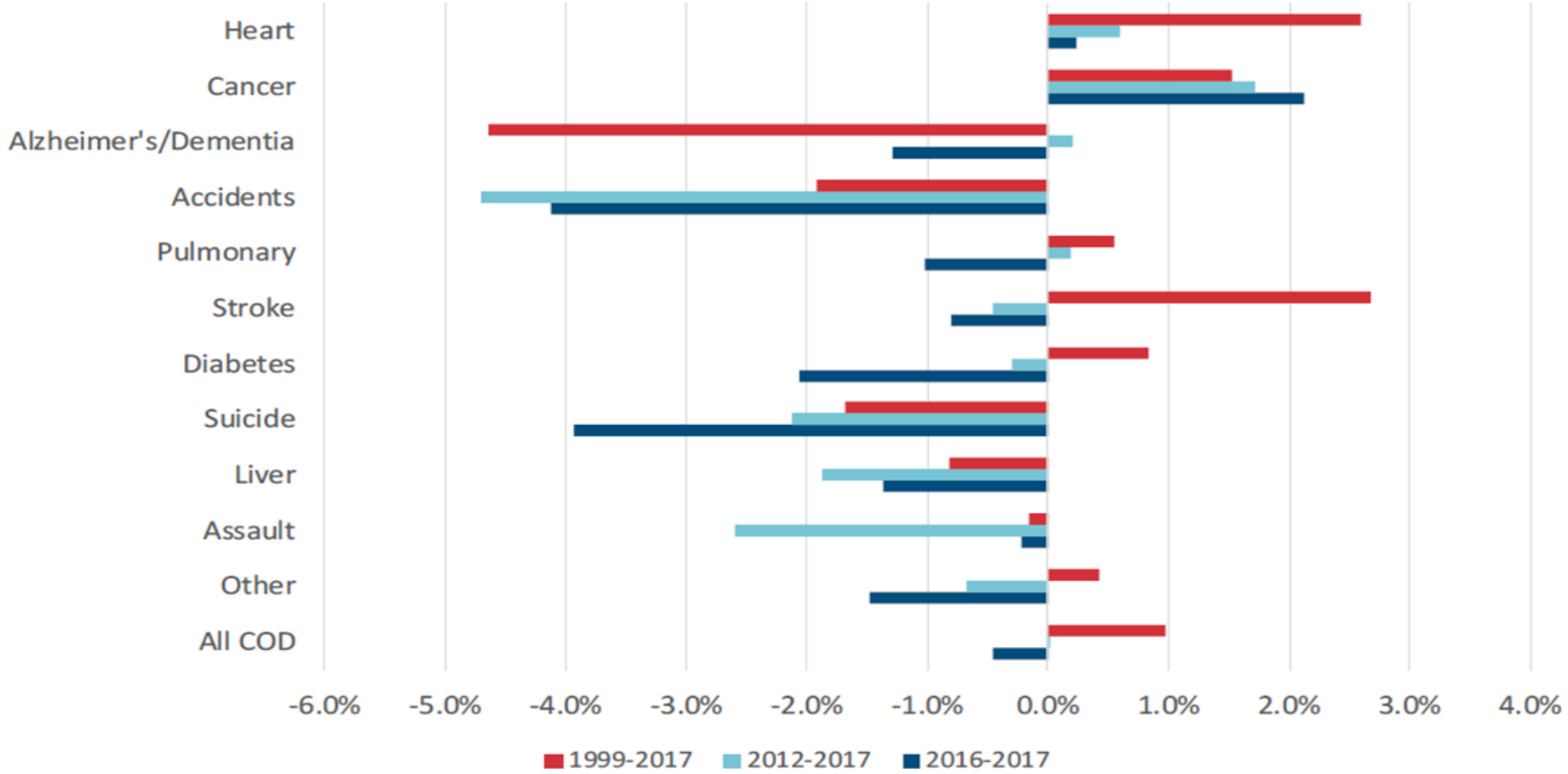
Contribution of 22 cause of death categories to changes in life expectancy at birth between 2014 and 2015 for men

Source: J Ho, BMJ 2018

Swiss Re Institute

General population death rates have slowed in the US which is driven by an interplay of different disease trends

Age-adjusted annual mortality improvement rates

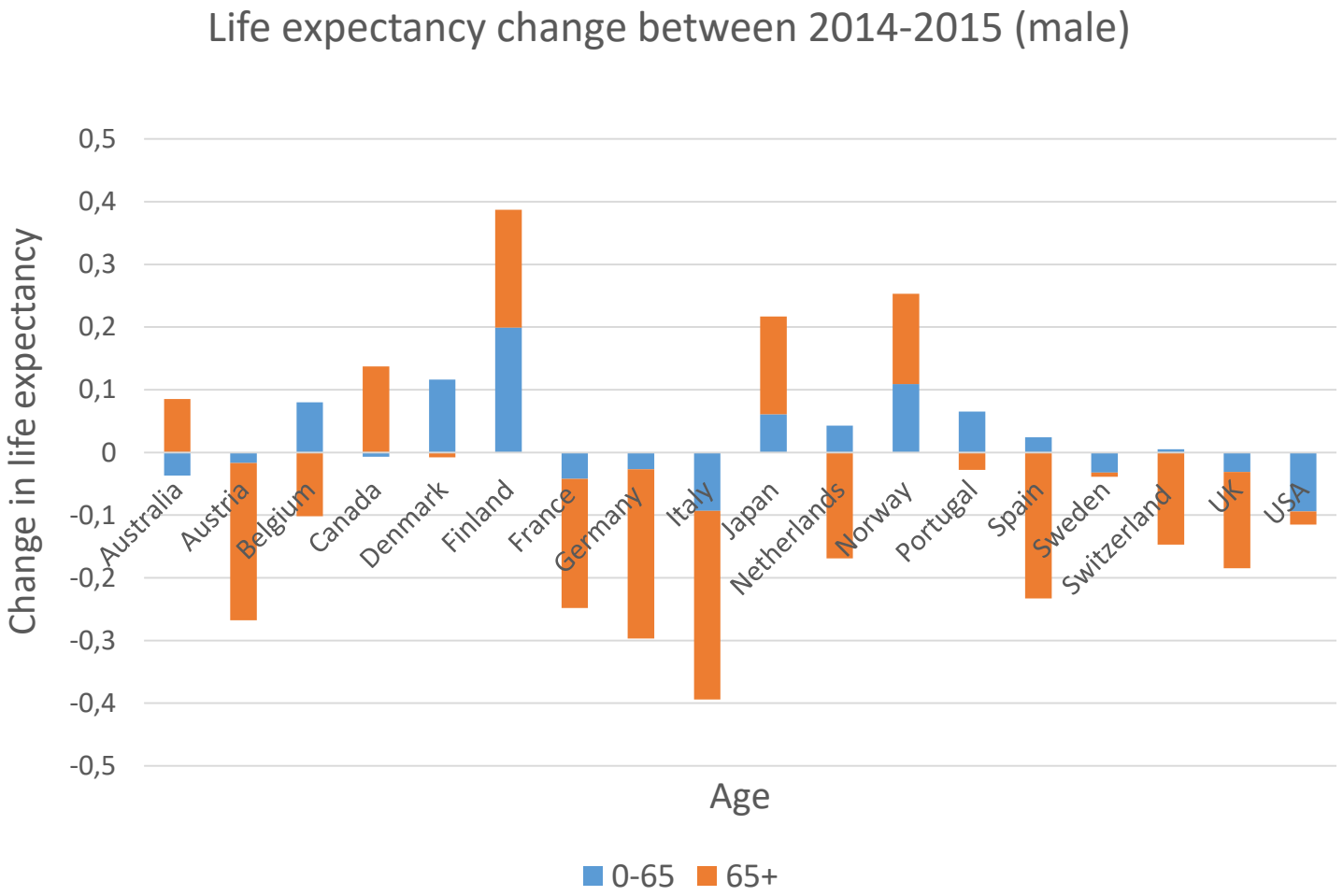


Key trend observations:

- Flatten for heart disease
- More improvement to come from cancer
- Stagnation from stroke
- Increased deaths from accidents and Alzheimer's

Source: US population mortality observation, SOA, Jan 2019

Importance of 65+ age group in driving trend in life expectancy



- High-income countries with improvements in life expectancy (Japan, Canada) had gains at the older age groups (<65+)
- Similarly for most high-income countries (UK, USA, Germany) that had decline to life expectancy it was mostly from the older age groups
- USA decline was more pronounced in younger men

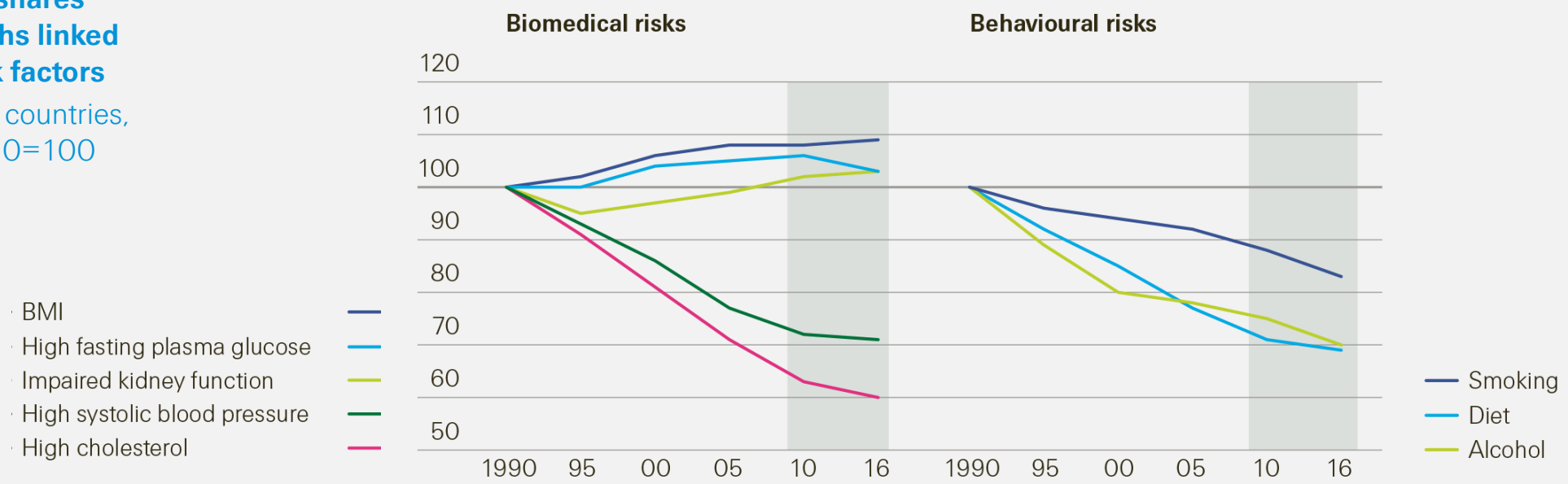
Source: J Ho, BMJ 2018

Deconstructing the mortality improvement slowdown

Lifestyle choices over diet and physical exercise are more likely explanations rather than smoking or alcohol

Changes in shares of total deaths linked to major risk factors

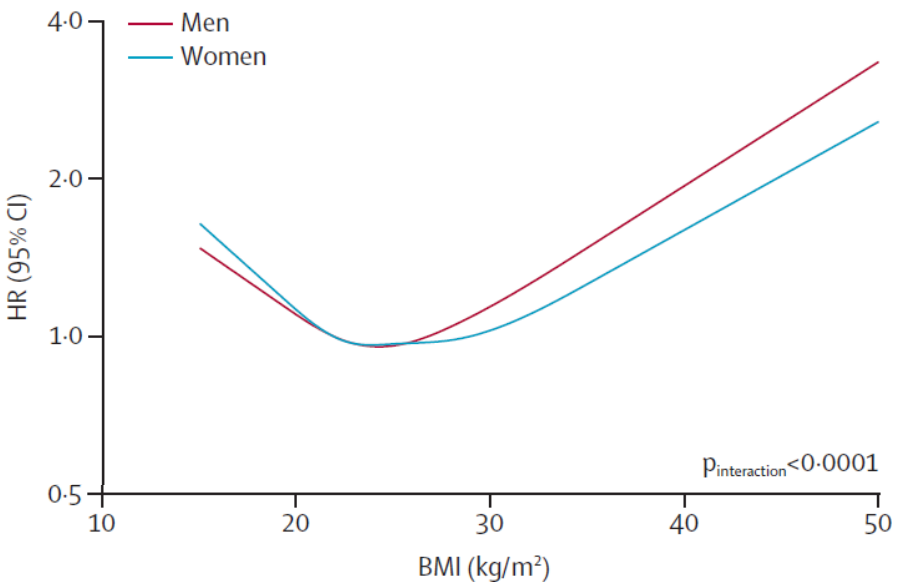
High-income countries, indexed: 1990=100

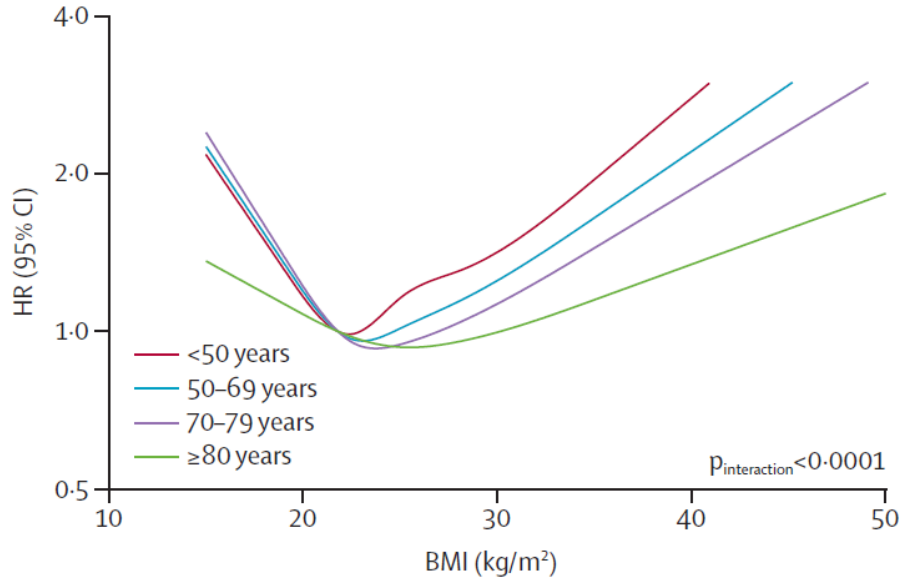


Sources: Institute for Health Metrics and Evaluation (IHME), Swiss Re Institute calculations

Obesity is increasing rapidly in the developed world

Association between BMI and all-cause mortality among never-smokers, by sex and age



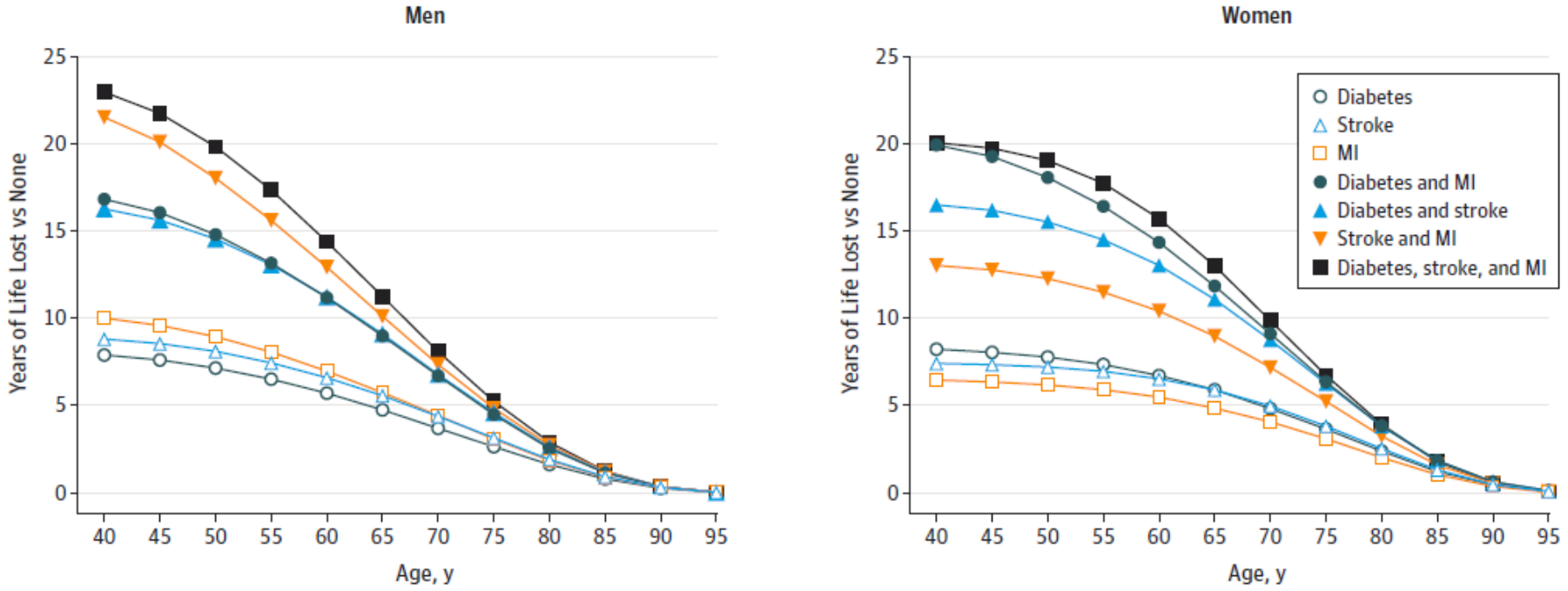


Source: Lancet 2018, K. Bhaskaran et al.

	Male exp. age of death at age 40 years	Reduction in years for males	Female exp. age of death at age 40 years	Reduction in years for females
Underweight (<18.5 kg/m^2)	77.9	4.3	79.8	4.5
Healthy weight (18.5-24.9 kg/m^2)	82.2	...	84.3	...
Overweight (25-29.9 kg/m^2)	81.2	1.0	83.5	0.8
Obese (all, ≥30 kg/m2)	78.0	4.2	80.9	3.5

Multimorbidity changes the dynamic of mortality improvement rates

Modelling of years of life lost by disease status of participants at baseline compared with those free of diabetes, stroke, and Myocardial Infarction (MI)



The estimates of cumulative survival from 40 years of age onward among the 8 baseline disease groups were calculated by applying hazard ratios (specific to age at risk and sex) for all-cause mortality associated with baseline disease status to US cause-specific death rates at the age of 40 years or older.

Source: Association of Cardiometabolic Multimorbidity With Mortality (2015) http://jamanetwork.com/journals/jama/fullarticle/2382980


Mortality improvement:
understanding the past and
framing the future

Transformative effect of identifying smoking as a key risk factor

The British Doctors Study identified «never smokers» as a desired target population in the 1950s

Contribution to annual mortality improvement from change in smoker status

UK males, 1972-2004

Annual mortality improvement (by age group, in percent)

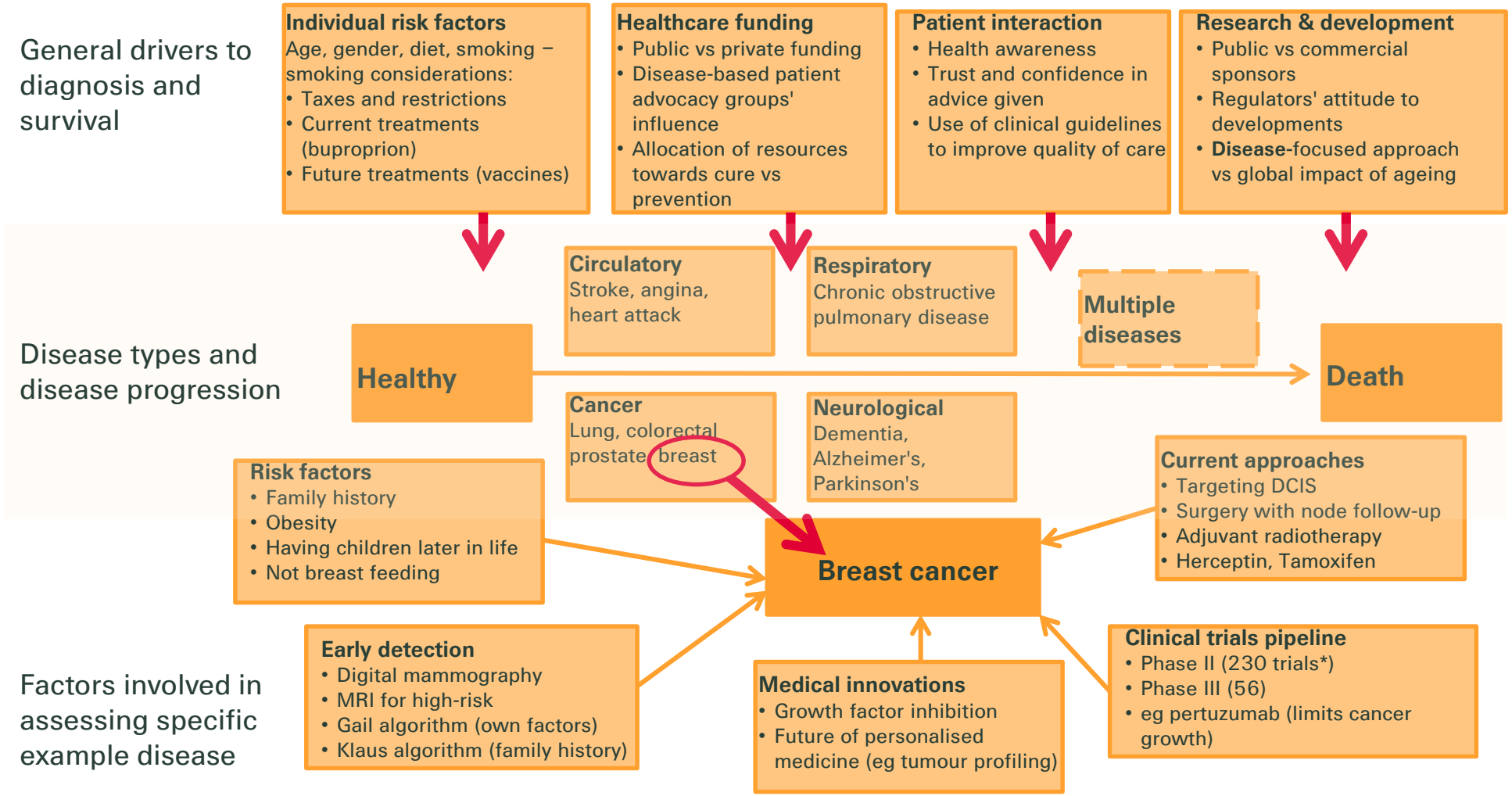
					Average		
	1970s	1980s	1990s	2000s	Total [1]	From change in smoker status [2]	Contribution from status change [=1/2]
20-29 years	1.2%	-0.1%	0.2%	3.0%	0.7%	0.1%	**16%**
30-39 years	1.6%	0.0%	-0.1%	1.5%	0.5%	0.2%	**44%**
40-49 years	2.2%	2.0%	1.0%	0.9%	1.6%	0.7%	**45%**
50-59 years	1.4%	3.0%	2.4%	2.2%	2.3%	0.9%	**39%**
60-69 years	1.5%	2.0%	3.2%	3.4%	2.4%	0.8%	**34%**
70-79 years	1.3%	1.7%	2.3%	3.8%	2.1%	0.7%	**32%**
80-89 years	0.6%	1.2%	1.3%	2.5%	1.3%	0.2%	**19%**

Source: Swiss Re Institute

Using scenarios to predict future longevity
Integrated Risk factors and Impairment Scenarios

- Complementary approach to
  - stochastic mortality models
  - blending between current mortality improvements and long-term assumptions over defined horizons
- Bringing together:
  - Swiss Re experience (data and expert knowledge)
  - Large patient medical databases in different countries
  - External networks capturing expert opinion
- Causal-based mortality predictions, evaluating factors such as:
  - Promotion and adoption of healthy lifestyle choices
  - Advances in screening and diagnostic technology
  - Pharmaceutical pipeline and its likely impact

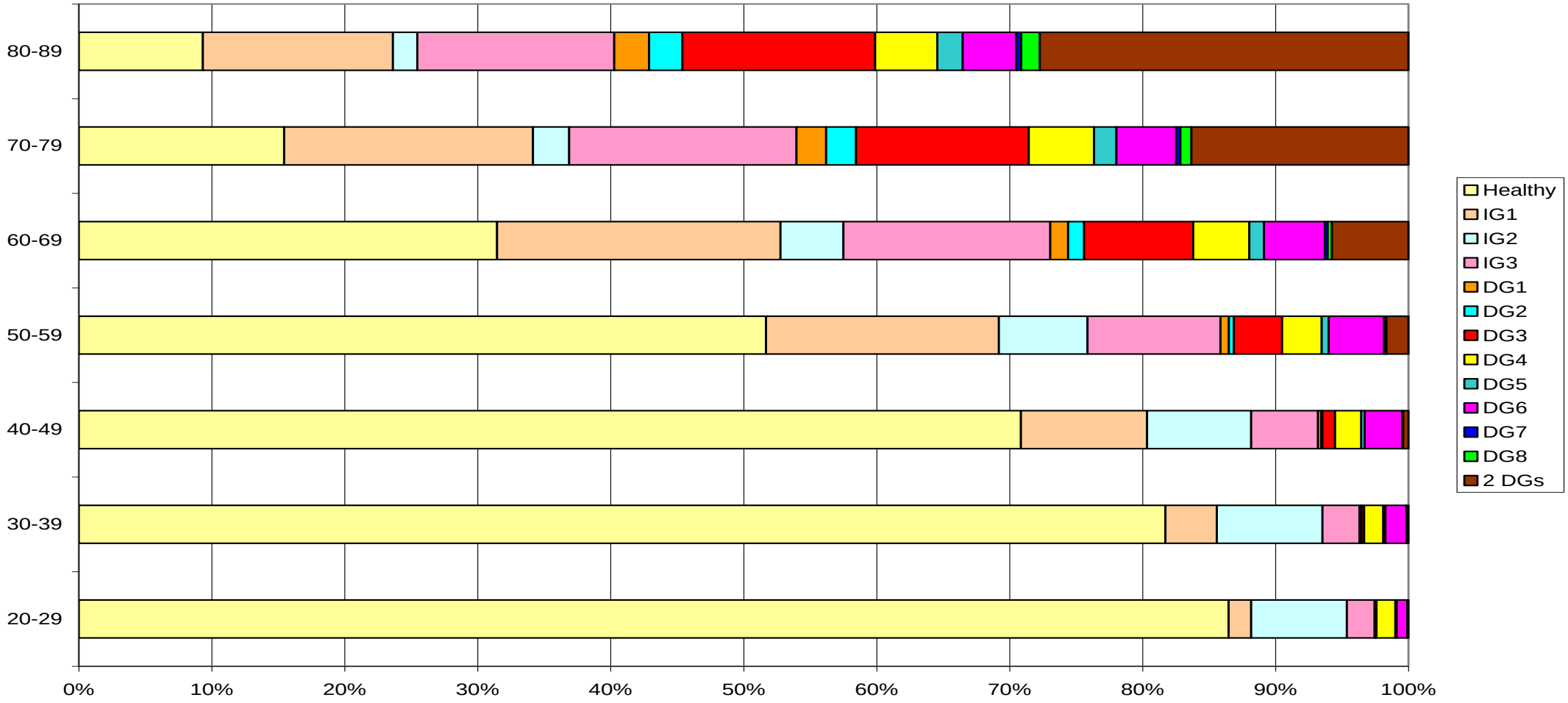
IRIS – holistic view of disease & mortality
Different layers in disease-centred mortality model



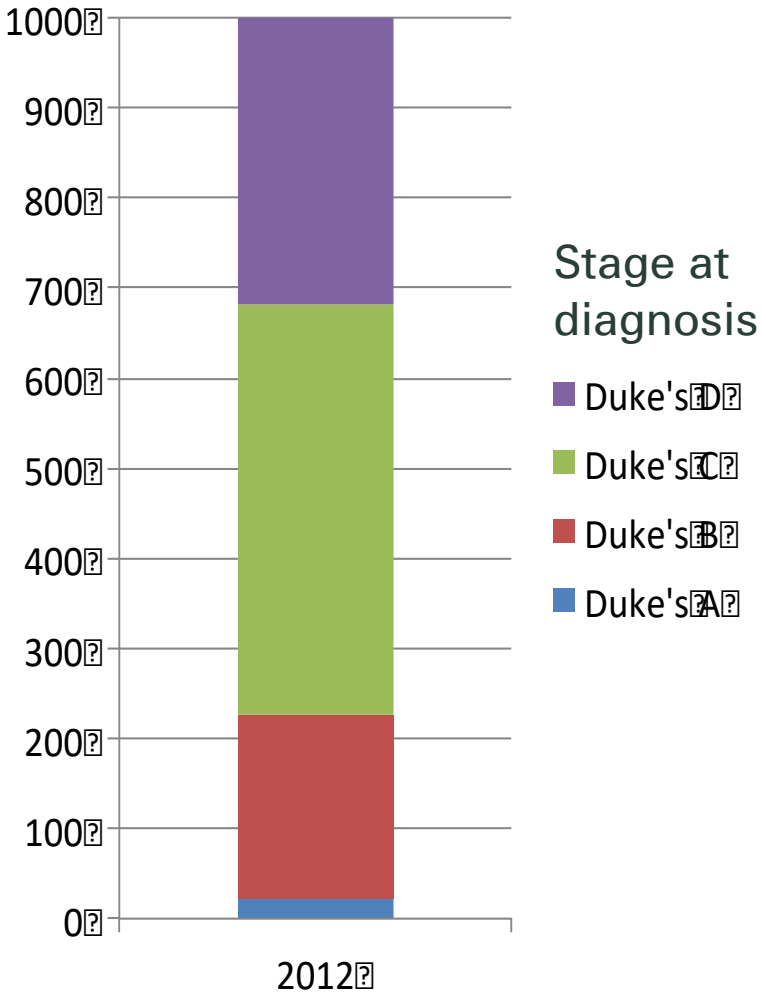
IRIS Population Transition Model
Disease groupings used to track transitions

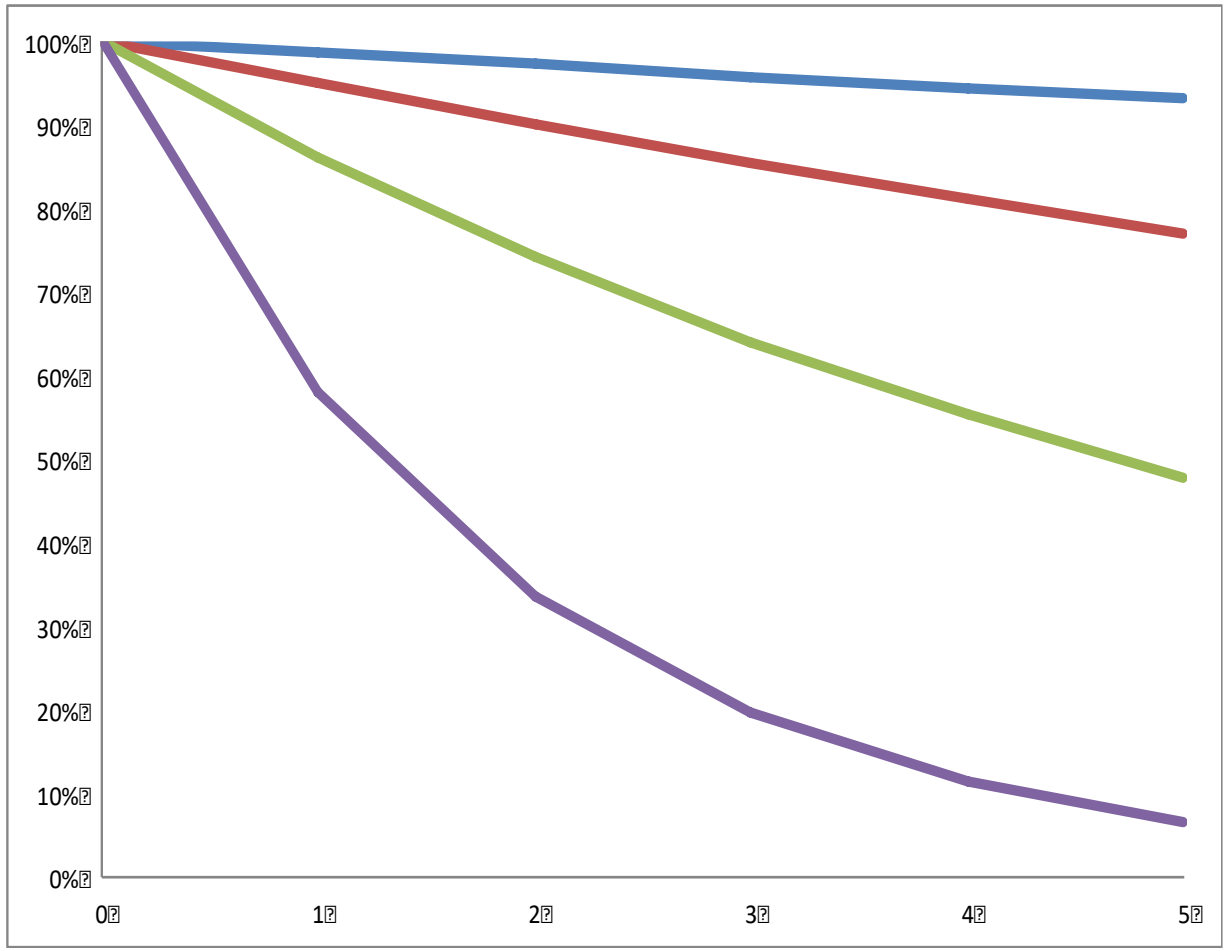
Disease Groups	Diseases considered
Minor Group 1 (IG1)	**atherosclerosis, cardiac arrhythmias, cardiomyopathy, diabetes, hypercholesterolaemia, hypertension, transient ischaemic attacks, valvular disease**
Minor Group 2 (IG2)	**benign neoplasms, malignant skin cancers other than malignant melanoma**
Minor Group 3 (IG3)	**epilepsy, motor neurone disease, MRSA, multiple sclerosis, osteoporosis, osteoarthritis, rheumatoid arthritis**
Principal Group 1 (DG1)	Stroke
Principal Group 2 (DG2)	cancers of breast, **cervix, larynx**, prostate and **uterus**, plus **malignant melanoma**
Principal Group 3 (DG3)	**aneurysms**, ischaemic heart disease, **heart failure**
Principal Group 4 (DG4)	chronic obstructive pulmonary disease, pneumonia and **tuberculosis**
Principal Group 5 (DG5)	cancers of colon, ovary, rectum and urinary system, plus **oral cancers**, **leukaemias** and **lymphomas**
Principal Group 6 (DG6)	**Crohn's disease**, gastric and duodenal ulcers, **clostridium difficile infection, ulcerative colitis**, and **kidney** and liver disease
Principal Group 7 (DG7)	cancers of **brain**, lung, oesophagus, pancreas and stomach, and **multiple myeloma**
Principal Group 8 (DG8)	**Alzheimer's disease, dementia, Parkinson's disease**

Mapping disease in the population
Clinical Practice Research Dataset - Men in 2010



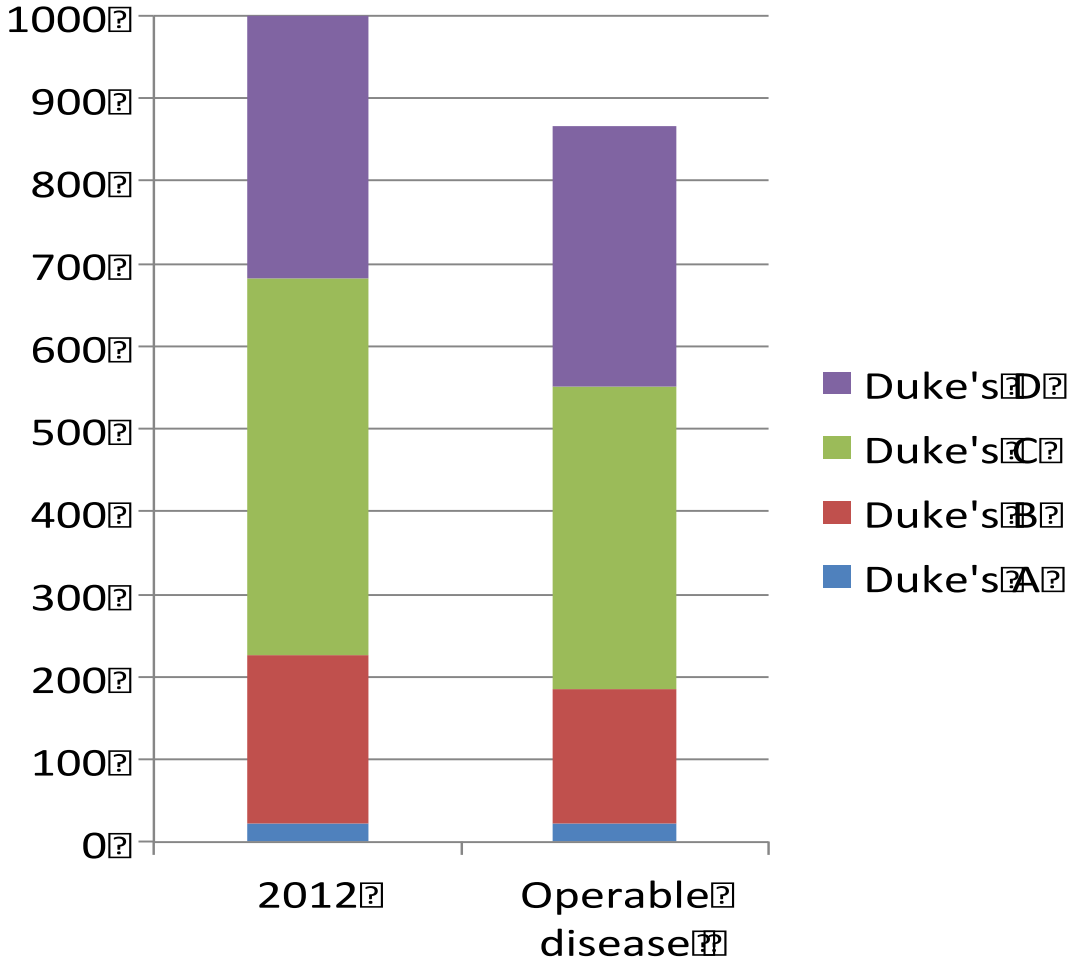
Colo-rectal cancer – developing a scenario
Start with deaths now in those with cancer

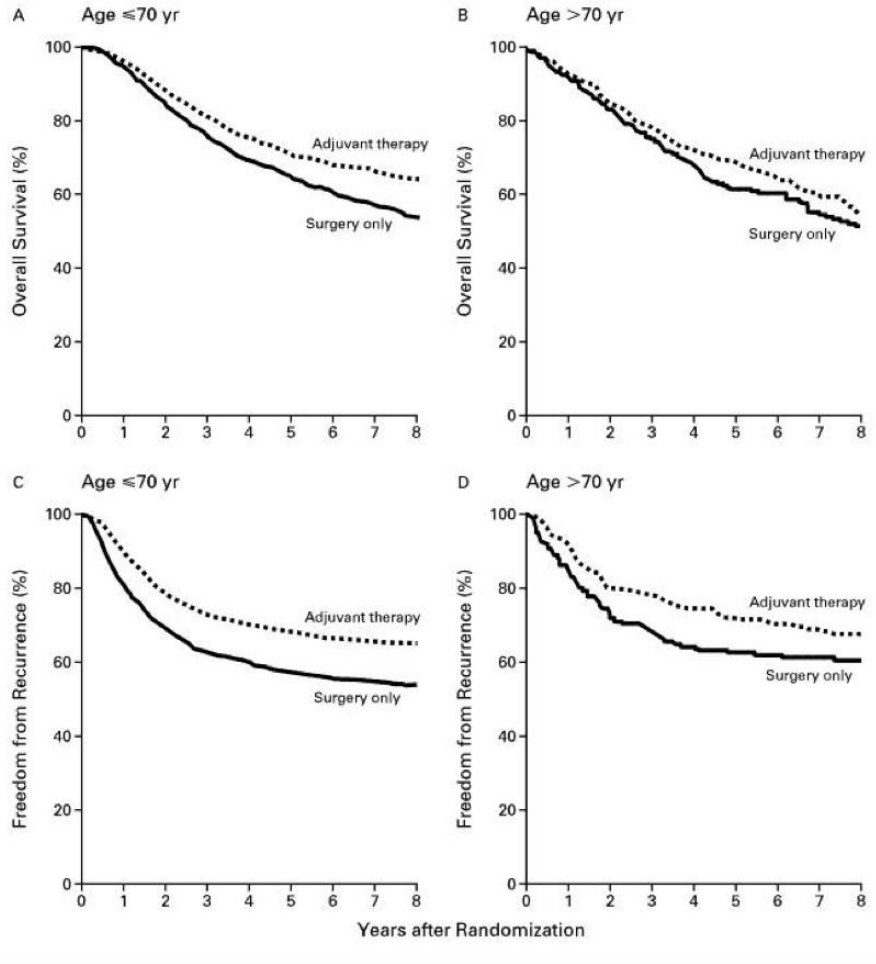




Relative survival by stage at diagnosis

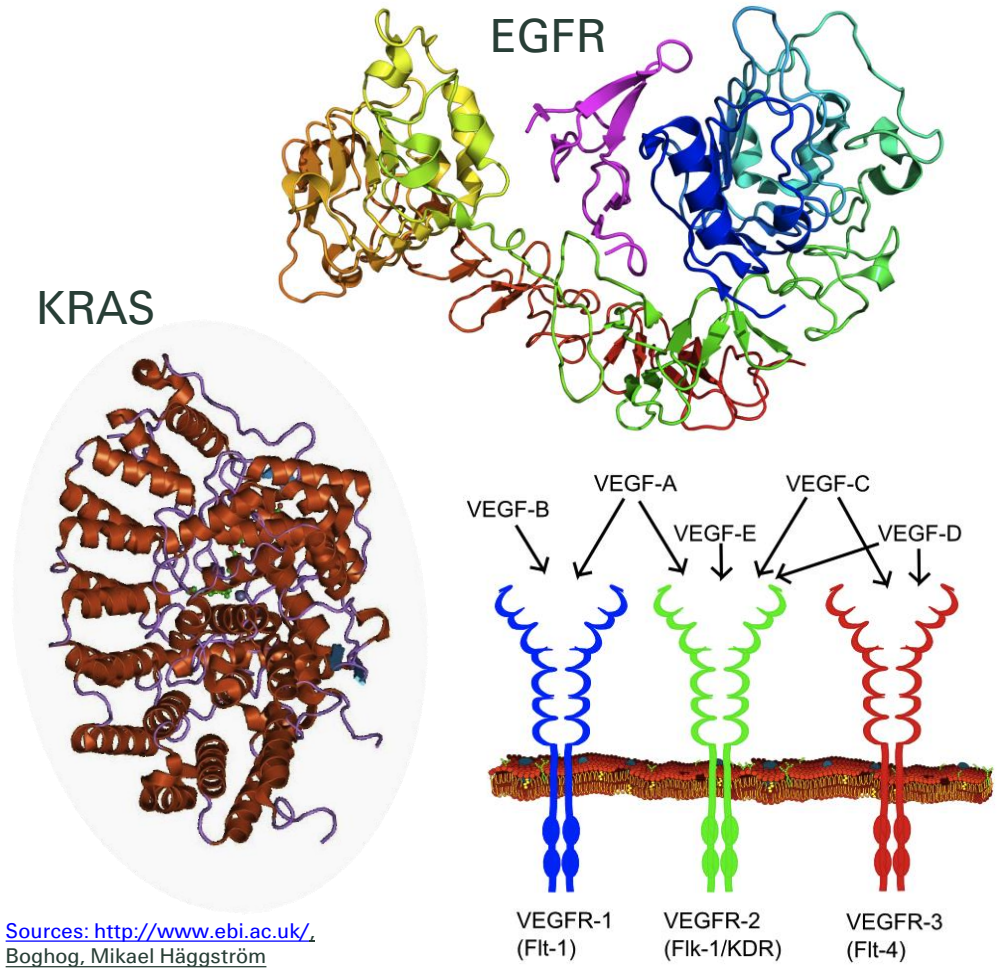
Colo-rectal cancer – developing a scenario
Operable disease: how may advances impact?



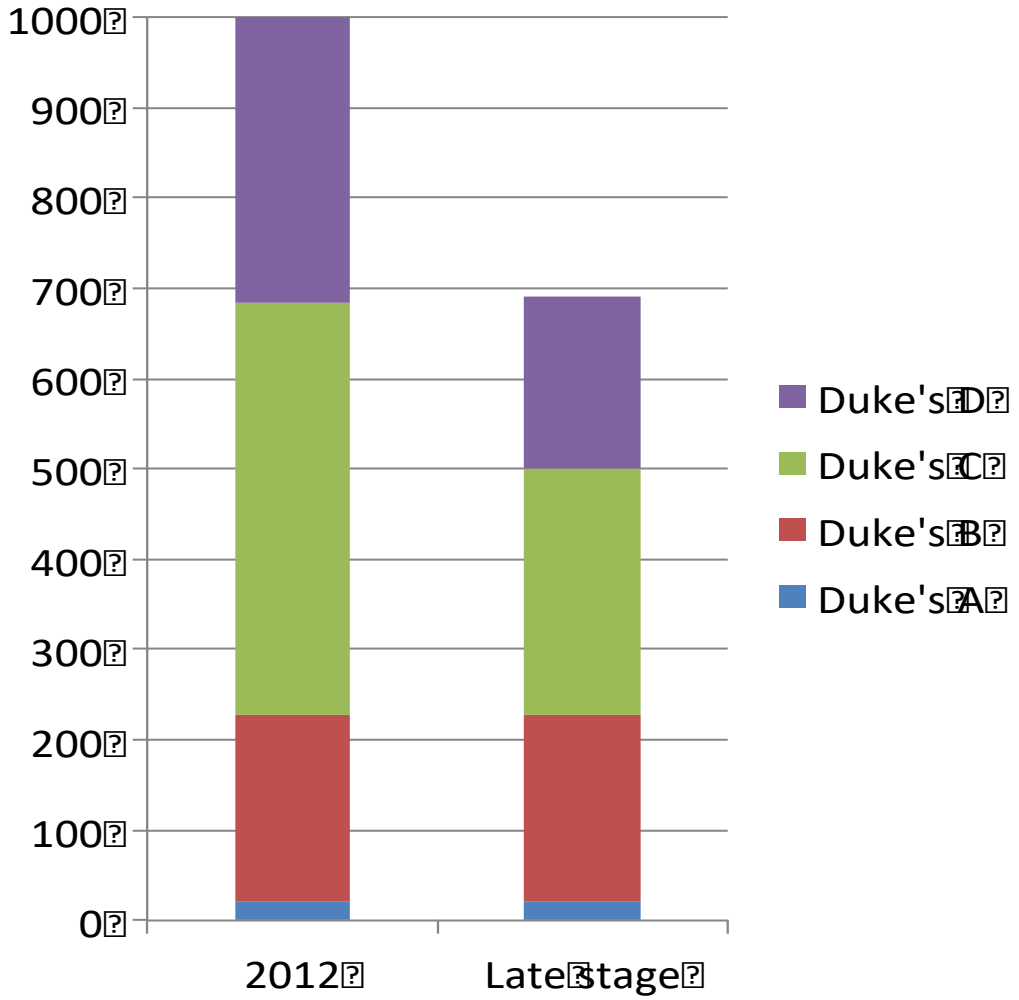


Source: Sargent DJ et al. N Engl J Med 2001;345:1091-1097.

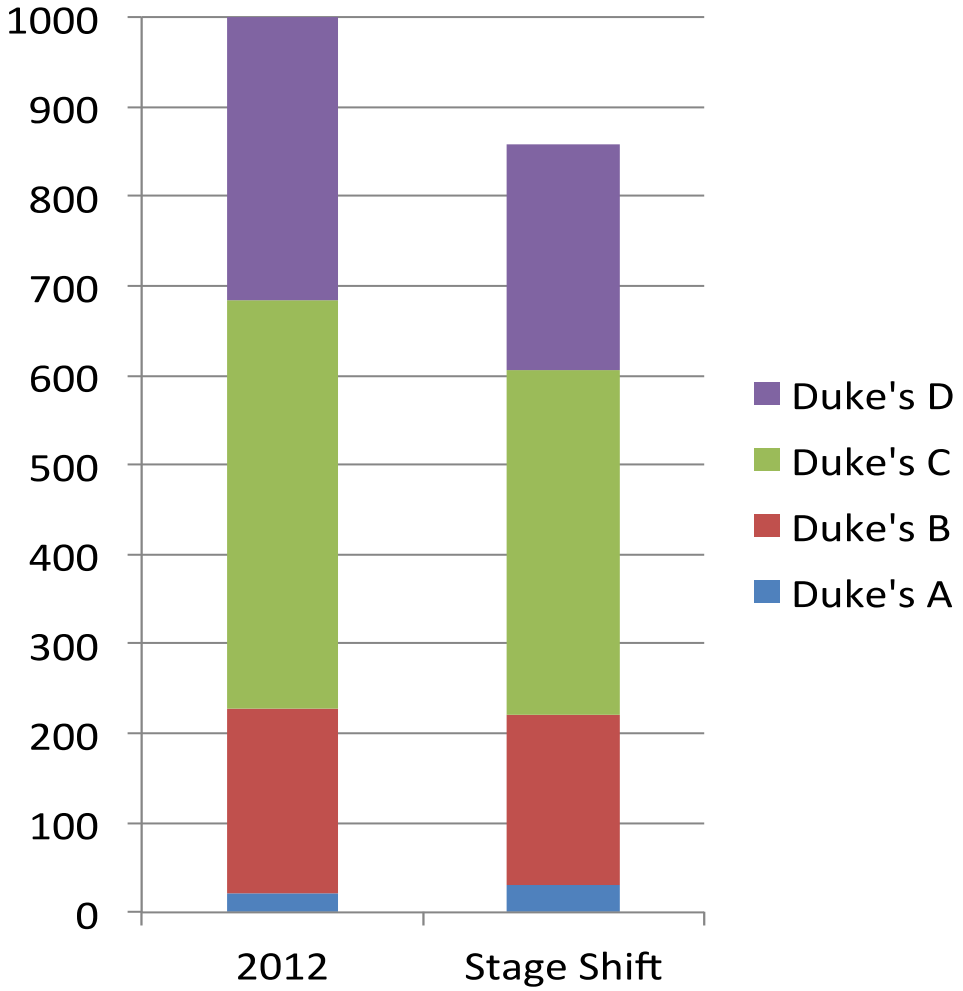
Colo-rectal cancer – developing a scenario
Late stage disease: how may advances impact?

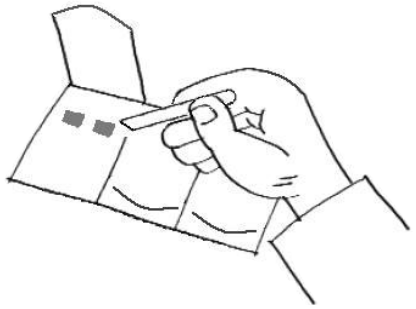


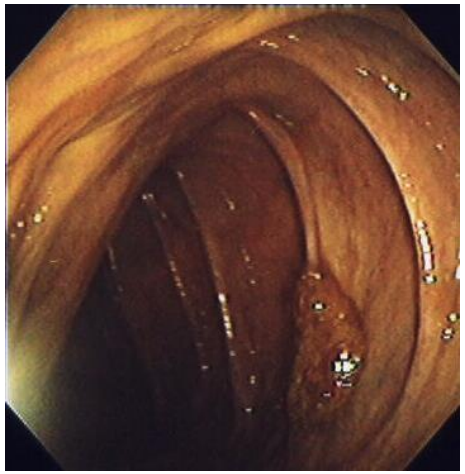
Sources: http://www.ebi.ac.uk/, Boghog, Mikael Häggström

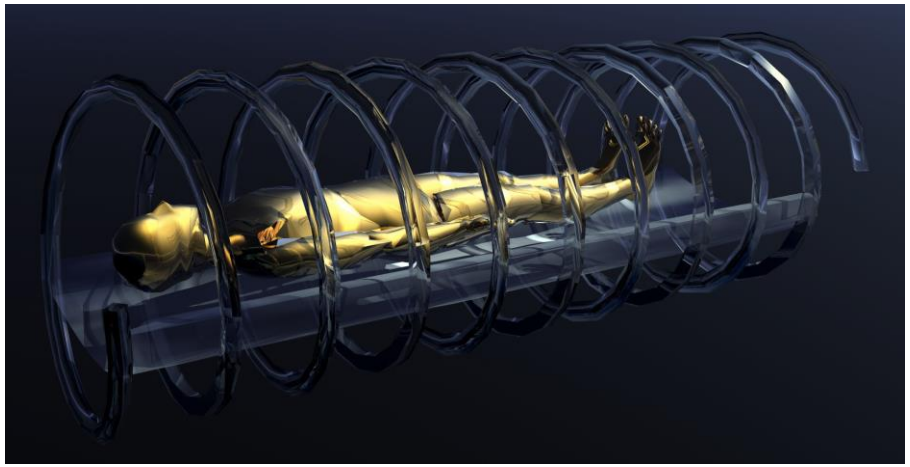


Colo-rectal cancer – developing a scenario
Earlier detection & stage shift: how may advances impact?



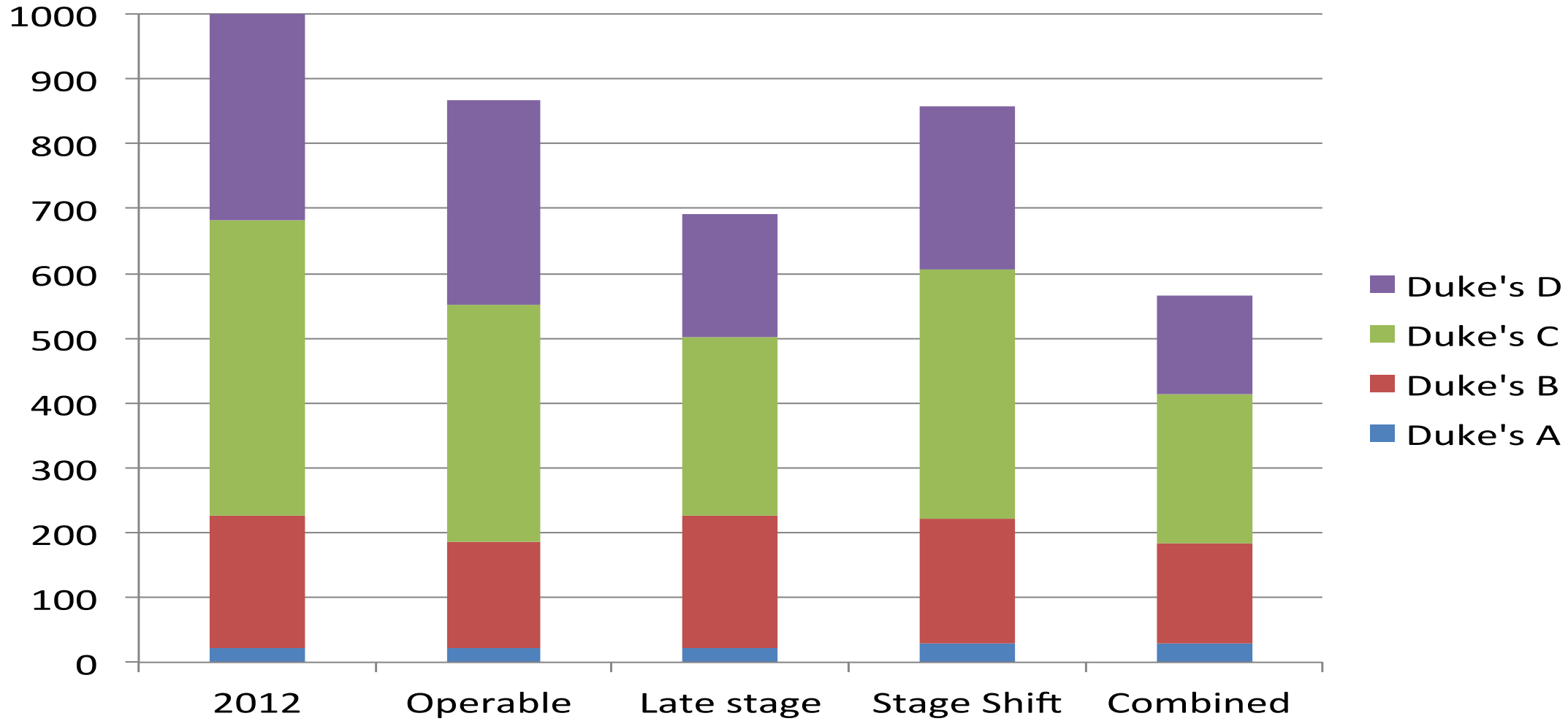




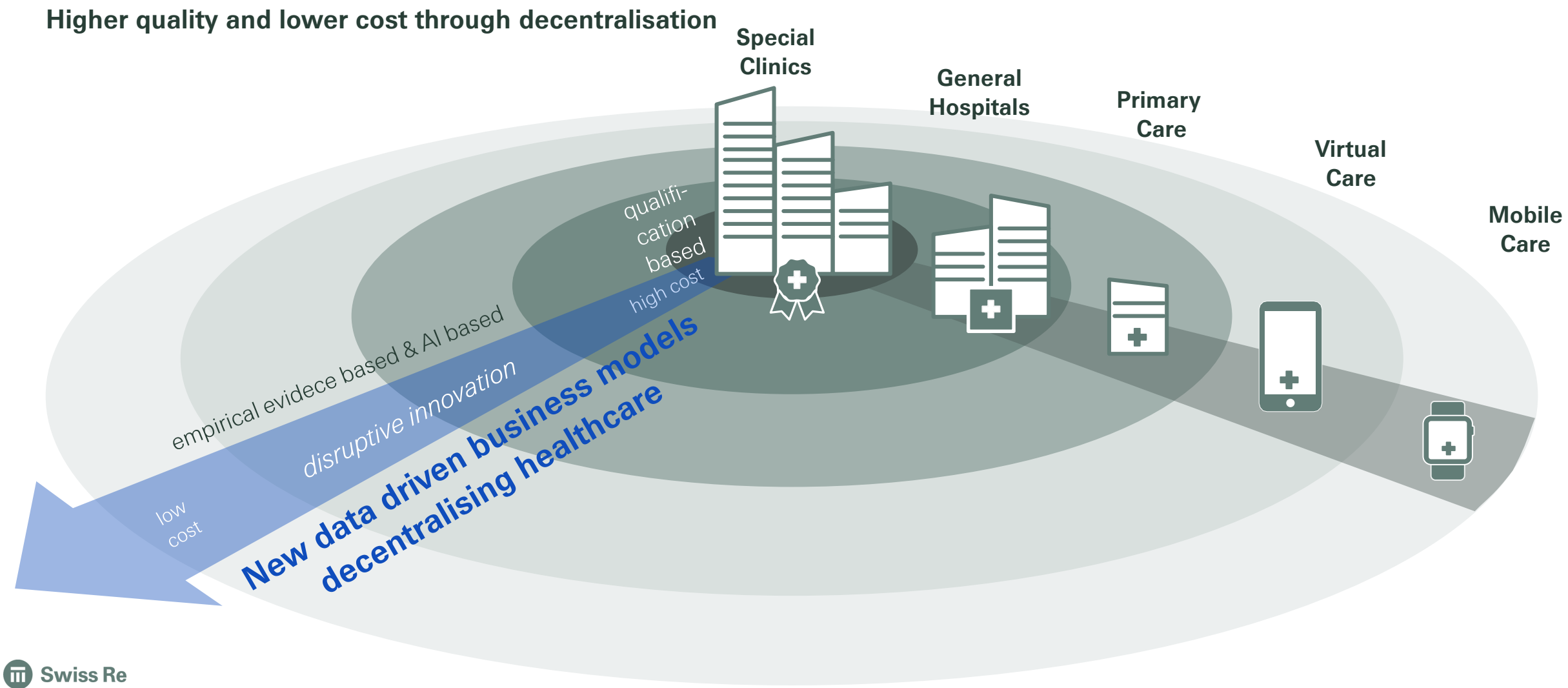


Nhs bowel cancer screening programme, Stephen Holland, MD, Image: © Nevit Dilmen found at Wikimedia commons, Richard Wheeler at en.Wikipedia

Colo-rectal cancer – developing a scenario
Combined effect of changes



Technology as the antidote to escalating healthcare costs

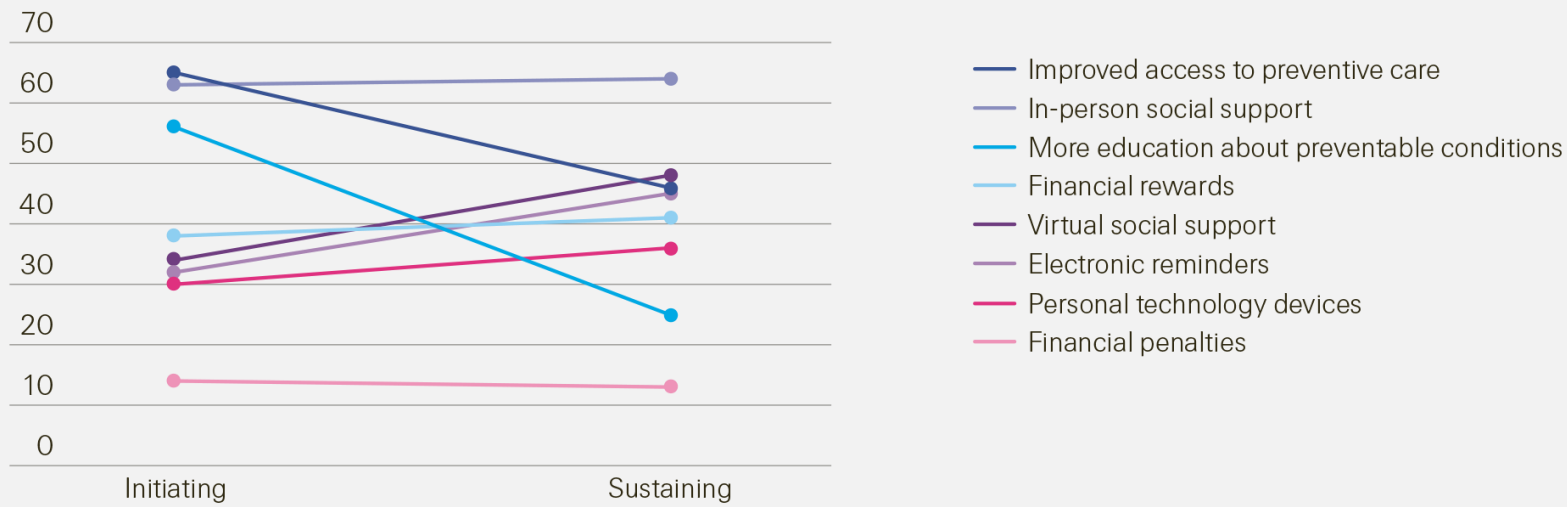


Influencing consumer behaviour will be key

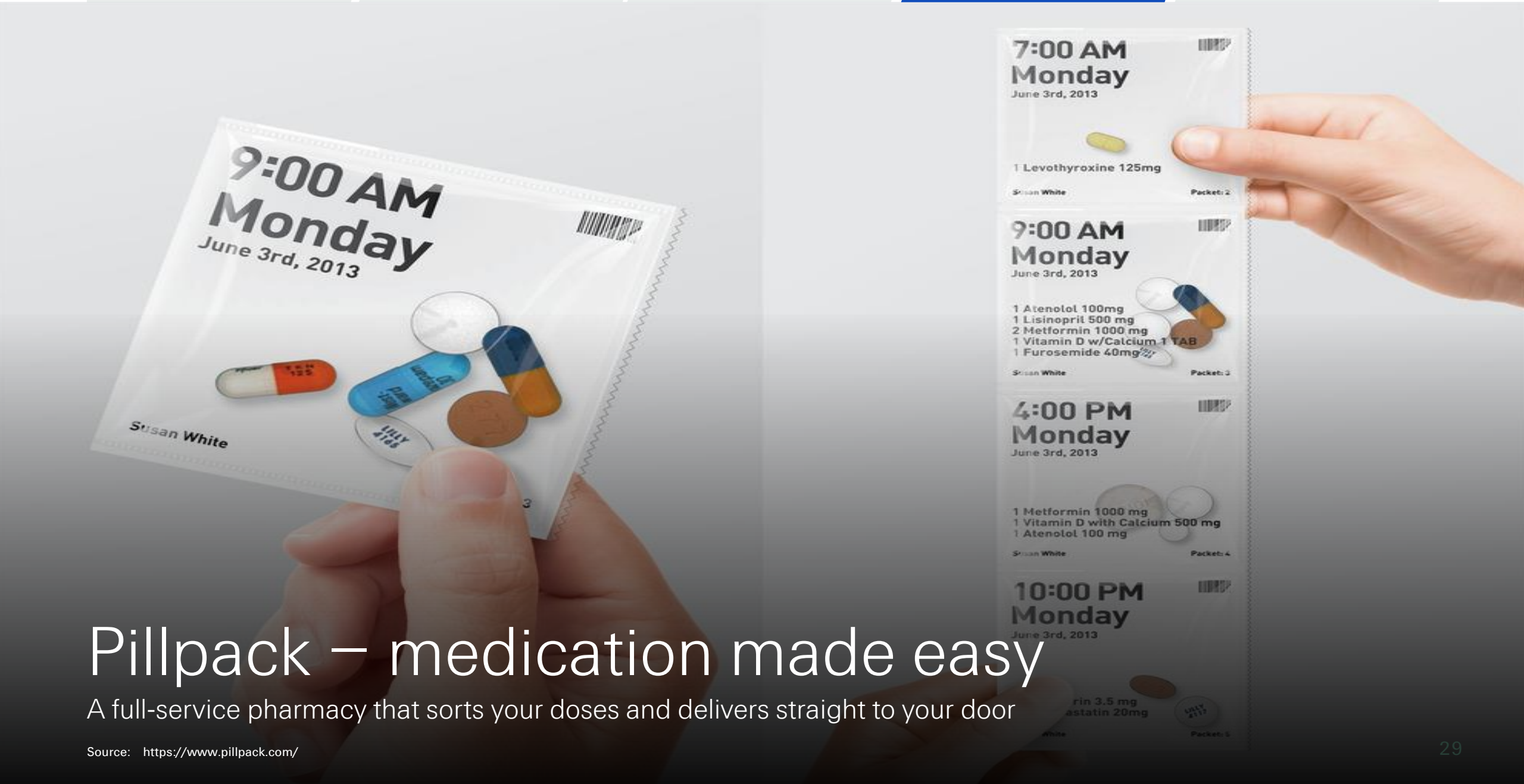
Our choices and behaviours continue to have an adverse effect on future health gains

Different ways of initiating and sustaining behavioural change

In percent of survey respondents



Source: *«What creates behavior change may not sustain it»,* NEJM Catalyst, May 2018.

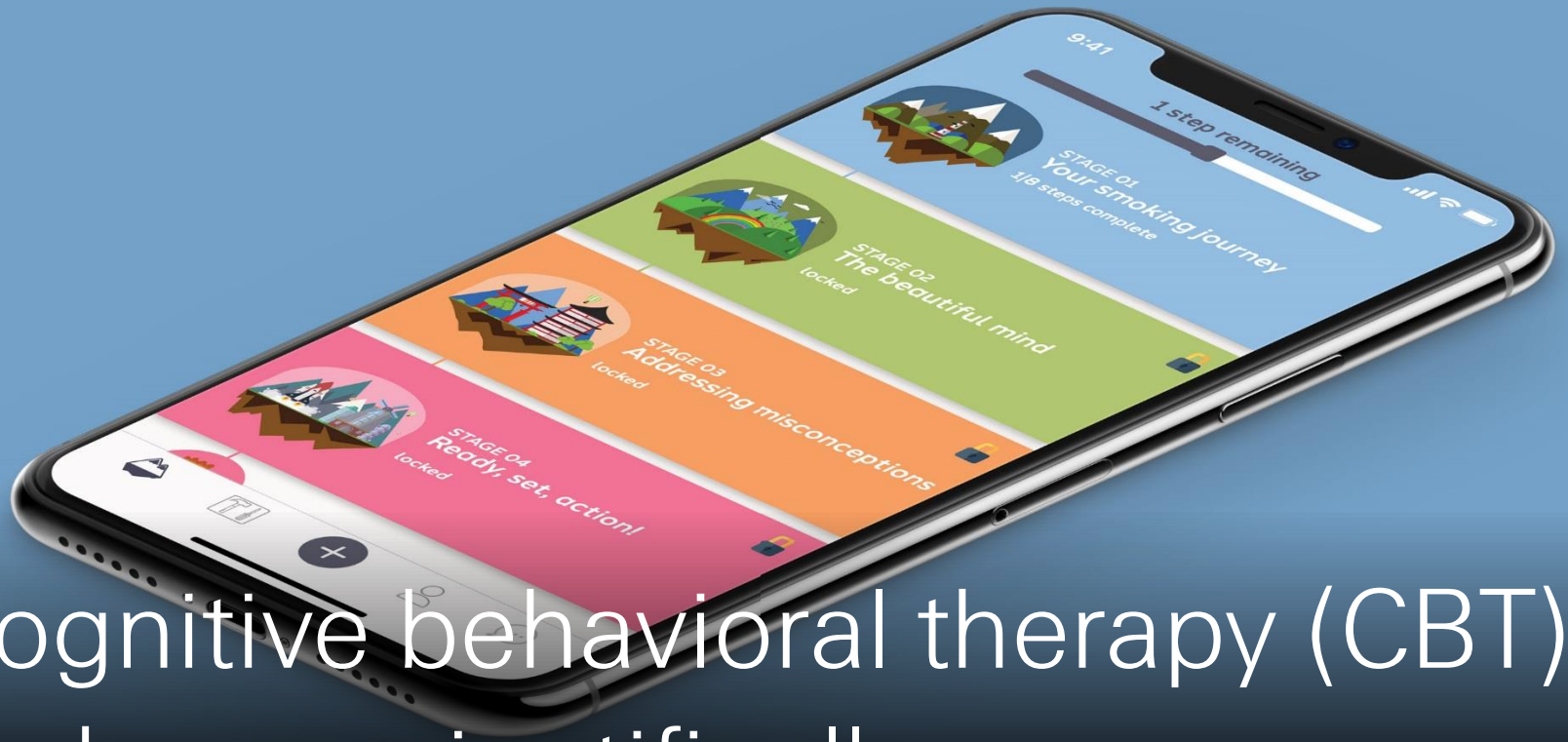


Pillpack – medication made easy

A full-service pharmacy that sorts your doses and delivers straight to your door

Source: https://www.pillpack.com/

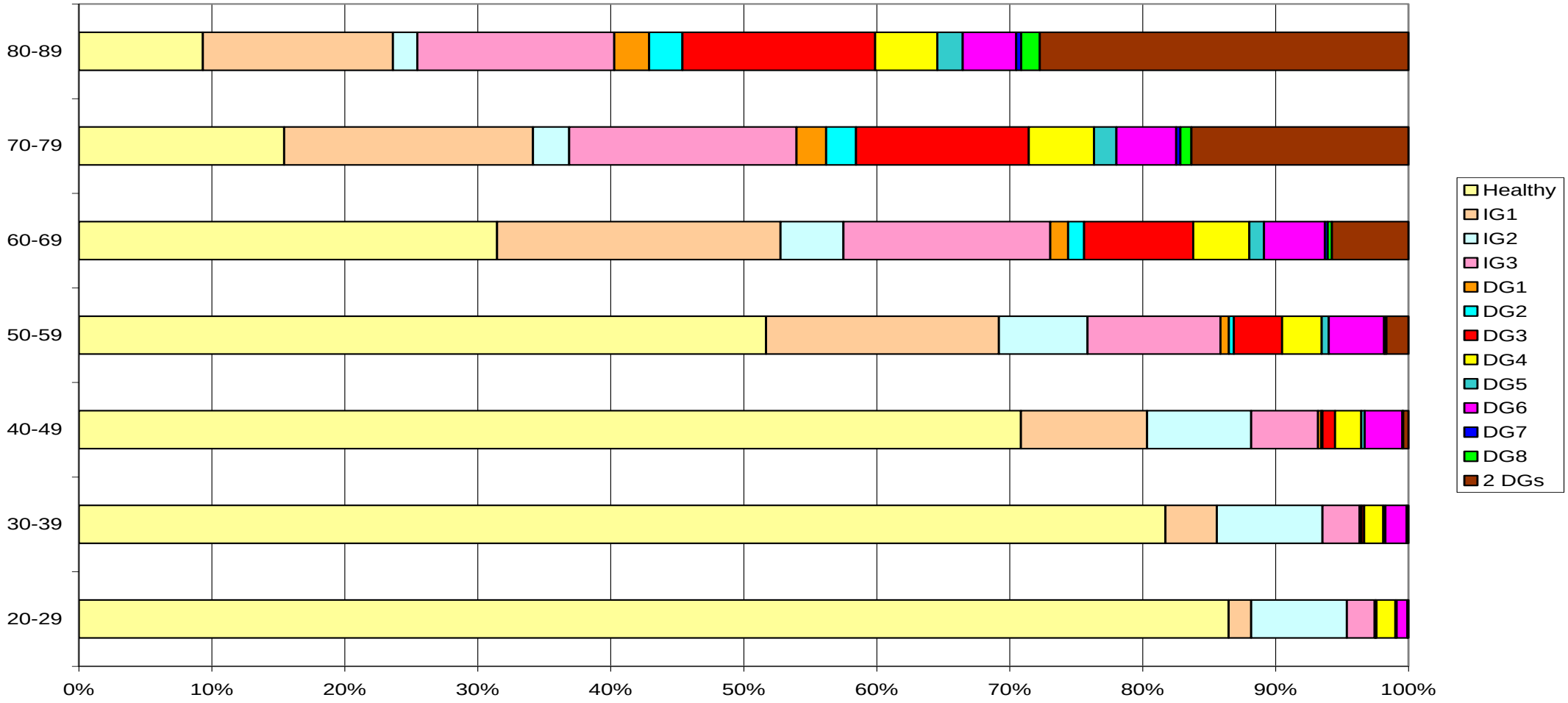
QuitGenius



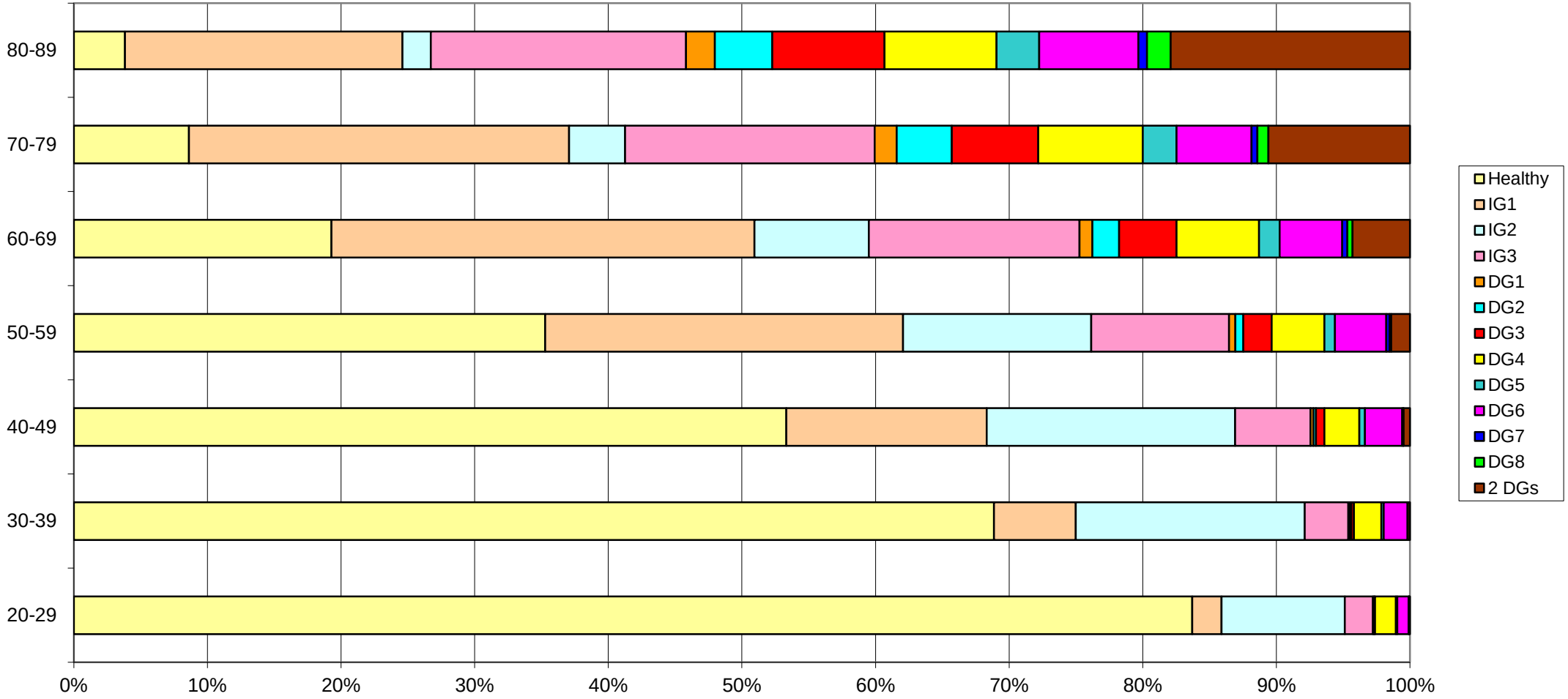
First mobile cognitive behavioral therapy (CBT) program that's been scientifically proven

Source: https://www.quitgenius.com/

Mapping disease in the population
Clinical Practice Research Dataset – Men in 2010



Future possibility from scenario-based projections
Mosaic of disease prevalence – Men in 2030



Concept of target populations

Differences in mortality between healthy subgroups and the general population provide a lens through which to consider potential, but as yet untapped, mortality gains

Identify an ideal (ie, target) population
either in terms of absence of disease or favourable risk factors

Specify interventions
either in behavioural or treatment, that might benefit groups with worse mortality experience than target population

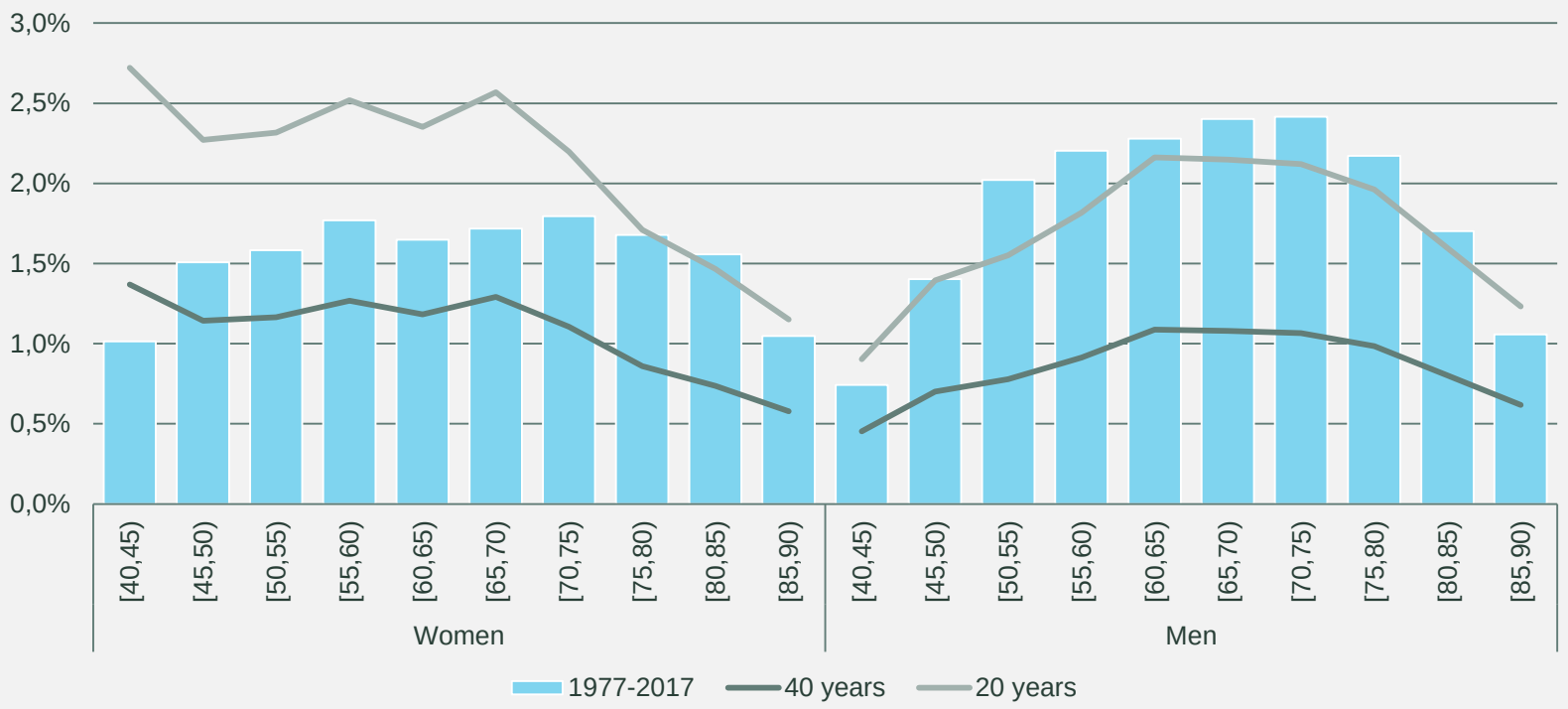
Evaluate effective and efficient interventions
through control studies how and how widely it should be adopted

Targeting the health of healthy populations

If mortality of target group (ie, without 30 major diseases) is replicated in the general population, improvement would return to earlier levels – but pace of achievement matters

Avg. annual improvement rate if mortality gap between target healthy and general population is closed

At different paces by age groups (ie, within 50, 40, 30 or 20 years)



Notes: THIN is a registered trademark of Cegedim SA in the United Kingdom. The presented study was reviewed and approached by the Scientific Review Committee U.K.
Sources: Swiss Re Institute, THIN Database

Thank you

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