

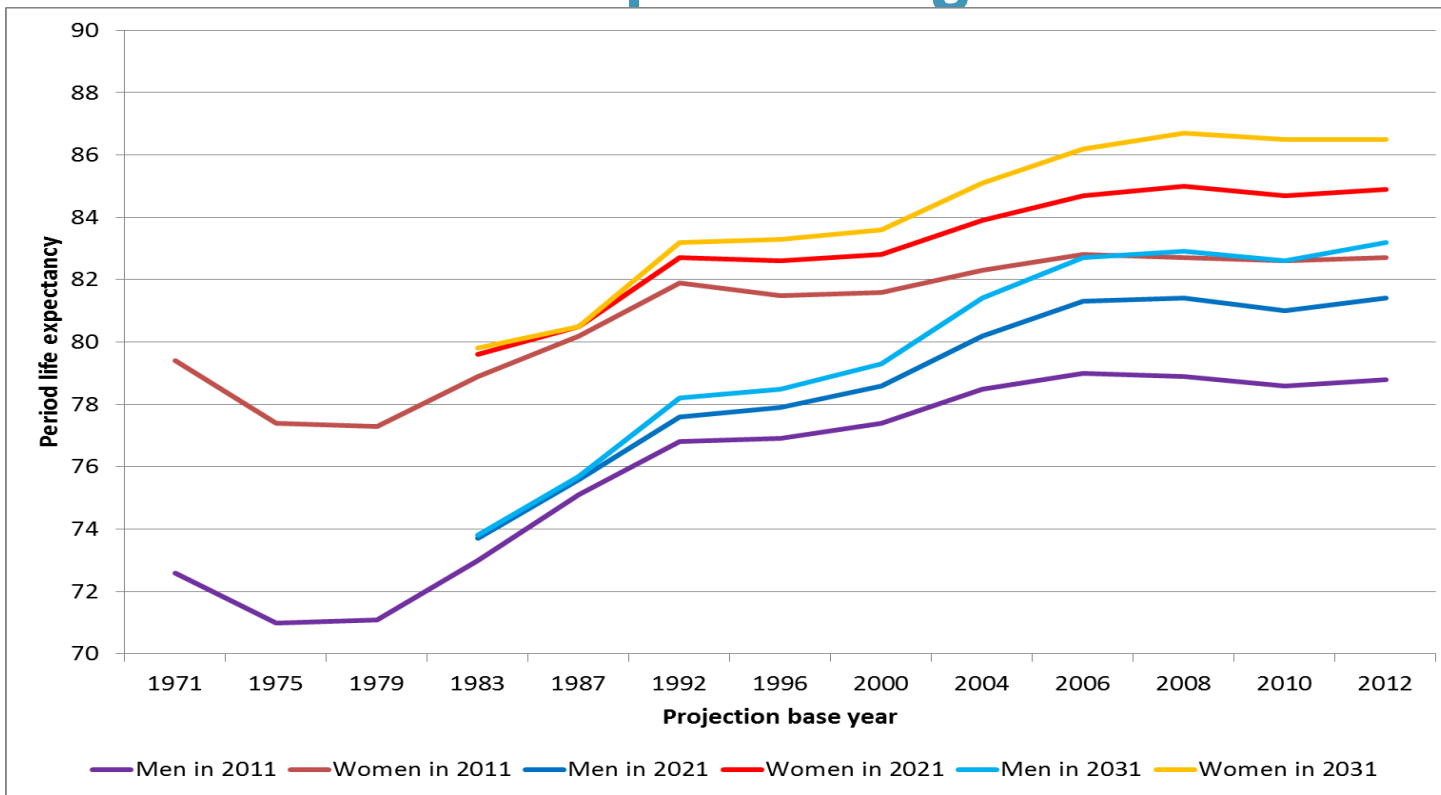


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# If we knew then what we know now: how Medical Advances have Influenced Longevity in the Past, Along with Expectations for the Future

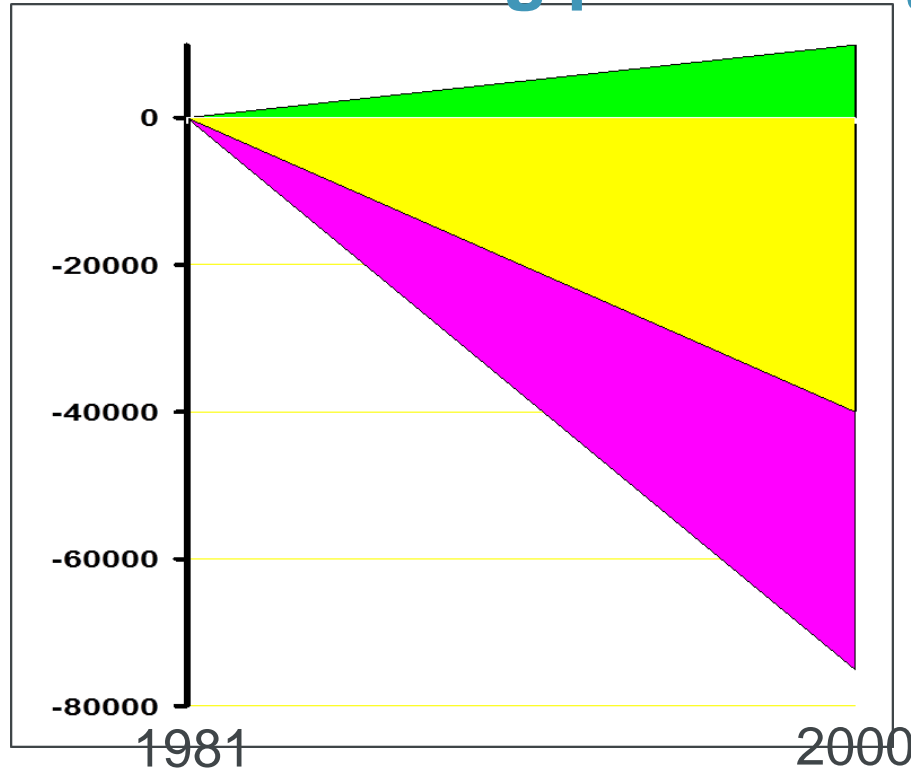
Daniel Ryan  
Head of Life & Health R&D  
Swiss Re

# How well are we predicting future UK longevity



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# Understanding past changes in CHD deaths



## *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(9) 1101



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# Debating the evidence for further reductions

By checking this box you are agreeing to the NICE Terms and Conditions

**NICE** National Institute for Health and Care Excellence

Find guidance ▼ NICE Pathways Quality standards

The new NICE website will be launch

	CVD events avoided	
*18	<b>Total number of CVD events avoided</b>	
*18	<b>Distribution of CVD events</b>	
	Angina aged over 69	
	Angina aged under 70	
	MI without complications	
	MI with complications	
	TIA aged over 69	
	TIA aged under 70	
	Stroke aged over 69	
	Stroke aged under 70	
	CVD or CHD death	
*13	<b>Cost of cardiovascular events avoided</b>	
	Angina aged over 69	1,946
	Angina aged under 70	1,451
	MI without complications	6,538
	MI with complications	8,589
	TIA aged over 69	1,831
	TIA aged under 70	1,064
	Stroke aged over 69	4,614
	Stroke aged under 70	3,015
	CVD or CHD death	-
	<b>Resource impact of cardiovascular events avoided</b>	
*20	<b>Net resource impact of lipid modification guideline (excluding risk assessments)</b>	
*21	Less net resource impact already identified in NICE technology appraisal guidance 34	
	<b>Net additional resource impact of lipid modification guideline (excluding risk</b>	



**Proposals to extend the use of statin drugs should be scrapped, a group of leading doctors and academics says.**

The National Institute for Health and Care Excellence published draft guidance in February calling for their use to be extended to save more lives.

It could mean another five million people in England and Wales using them on top of seven million who already do.

## Related Stories

**Statins side effects claims probed**

**Statins: Are they safe?**

**'Millions more should take statins'**

Source: BBC News



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Source: National Institute of Health & Clinical Excellence

# CMI Mortality Projections Library

[Home](#) » [Research and resources](#) » [Continuous Mortality Investigation](#) » [CMI mortality projections](#) » [CMI library of mortality projections](#)

News

Research

Sessional Research Programme

The Actuarial Research Centre

Continuous Mortality Investigation

About the CMI

News

Latest publications

CMI committees

CMI data

CMI investigations

CMI mortality projections

CMI library of mortality projections

CMI presentations

CMI reports

CMI working papers

## CMI library of mortality projections

Version 1.4 of the CMI library of mortality projections was released in April 2013

The updated version of the [user guide](#), version 1.4, documents the contents of the library.

The library itself is available in a series of zipped spreadsheets. Please note that Volumes 1 to 6 (inclusive) are unchanged from version 1.1 of the library; the additional projections in version 1.2 of the library are all contained in Volume 7:

- [Volume 1](#) contains previously-published tables of projections (see section 3 and 5 of the user guide)
- [Volume 2](#) contains specimen adjusted interim cohort projections (see section 4 of the user guide)
- [Volume 3](#) contains specimen P-Spline age-period projections (see section 6 of the user guide)
- [Volume 4](#) contains specimen P-Spline age-cohort projections (see section 6 of the user guide)
- [Volume 5](#) contains specimen Lee-Carter projections (see section 7 of the user guide)
- [Volume 6](#) contains the additional projections from version 1.1 of the library
- [Volume 7](#) contains the additional projections from version 1.2 of the library
- [Volume 8](#) contains the additional projections from version 1.3 of the library
- [Volume 9](#) contains the additional projections from version 1.4 of the library

Please note that

- Volume 9 and version 1.4 of the user guide are available to [Authorised Users](#) only.
- These are large documents and may take some time to download.

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Associated documents

- [User guide to version 1.2 of the CMI library of mortality projections](#)
- [CMI library of mortality projections. Previously-published tables of projections](#)
- [CMI library of mortality projections. Interim cohort projections](#)

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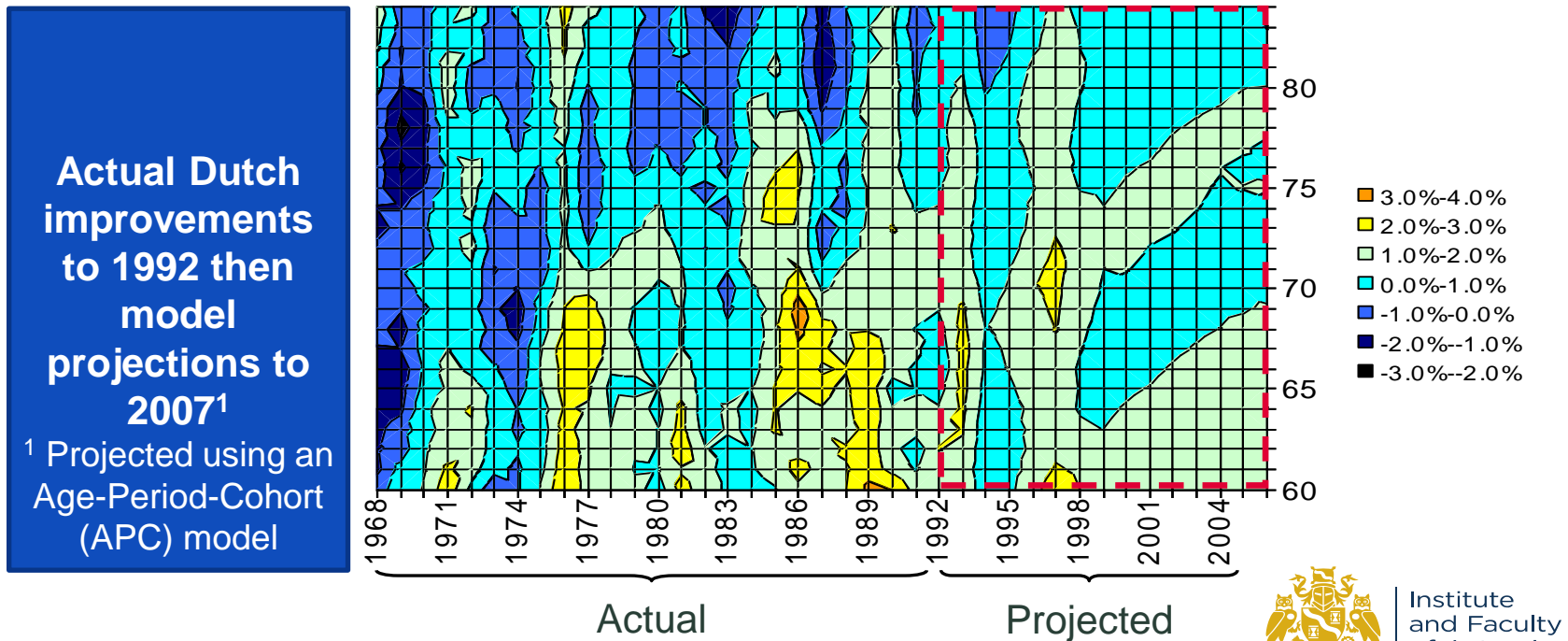
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# How fit for purpose are our models?

- experience for Dutch men



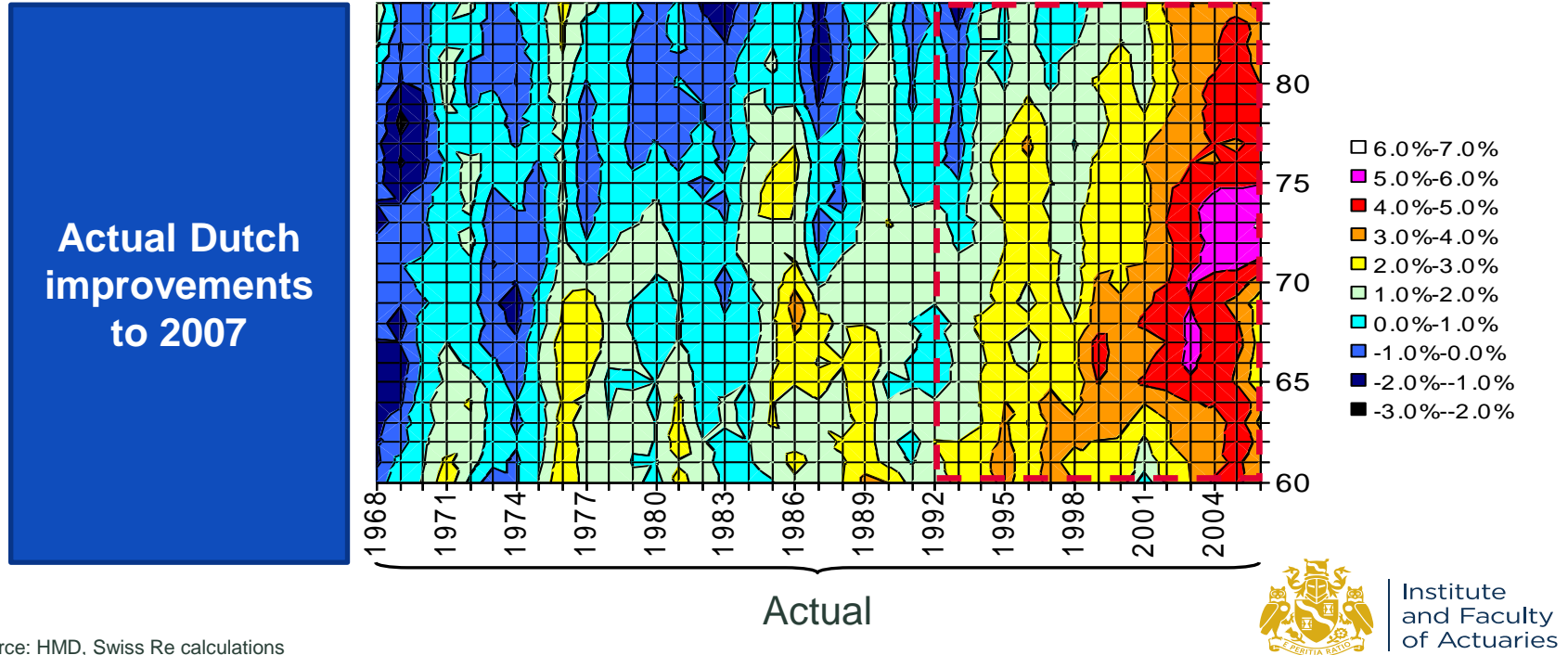
Source: HMD, Swiss Re calculations



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# How fit for purpose are our models?

- experience for Dutch men



Source: HMD, Swiss Re calculations



# Longevity catalysts working group

[Home](#) [About](#) [Catalysts](#) [Indicators](#) [Uses](#) [FAQs](#) [Contact Us](#)

## LONGEVITY CATALYSTS

The Longevity Catalysts Working Group of the Actuarial Profession to answer the question: "What future events are we aware of likely to be coupled with a significant increase in human lifespan?"

### Philosophy

It is clearly impossible to foresee all future catalyst events that will significantly impact human lifespan. The situation is thus imperfect. Yet this serves to illustrate the even greater imperfection of [ignoring future catalyst events that are now known](#).

## Catalysts


This section of catalysts working group events are expected to occur over time.

- Definitions
  - Introduction of New Medicine
  - Past Longevity Catalysts
    - Breast Cancer
    - Classification
      - Longevity Catalysts summary
      - Use of novel diagnostic biomarkers
      - KRAS targeted cancer treatment
      - Bowel cancer screening
      - Stem cell therapy & Parkinson's disease
      - Polypill
      - Universal Influenza Vaccine
      - Catalyst evolution

[Longevity Catalysts Summary](#)[Indicators Summary](#)

## Classification

Each catalyst is classified into one of eight broad groups.





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# Aiming for a more holistic view of longevity

General drivers to diagnosis and survival

## Individual risk factors

- Age, gender, diet, smoking
- Taxes and restrictions
- Current treatments (bupropion)
- Future treatments (vaccines)

## Healthcare funding

- Public vs private funding
- Patient advocacy groups
- Allocation of resources towards cure vs prevention

## Patient interaction

- Health awareness
- Trust and confidence
- Use of clinical guidelines

## Research & development

- Public/commercial sponsors
- Regulators' attitude
- **Disease-focused** approach vs global impact of ageing

Disease types and disease progression

Healthy

## Circulatory

Stroke, angina, heart attack

## Respiratory

Chronic obstructive pulmonary disease

## Multiple diseases

Death

## Cancer

Lung, colorectal prostate, breast

## Neurological

Dementia, Alzheimer's, Parkinson's

## Risk factors

- Family history
- Obesity
- Having children later in life
- Not breast feeding

## Early detection

- Digital mammography
- MRI for high-risk
- Gail algorithm (own factors)
- Klaus algorithm (family history)

## Medical innovations

- Tumour profiling
- Clinical trials – Kadcycla from Phase III EMILIA

## Breast cancer

## Current approaches

- Targeting DCIS
- Surgery with node follow-up
- Adjuvant radiotherapy
- Herceptin, Tamoxifen

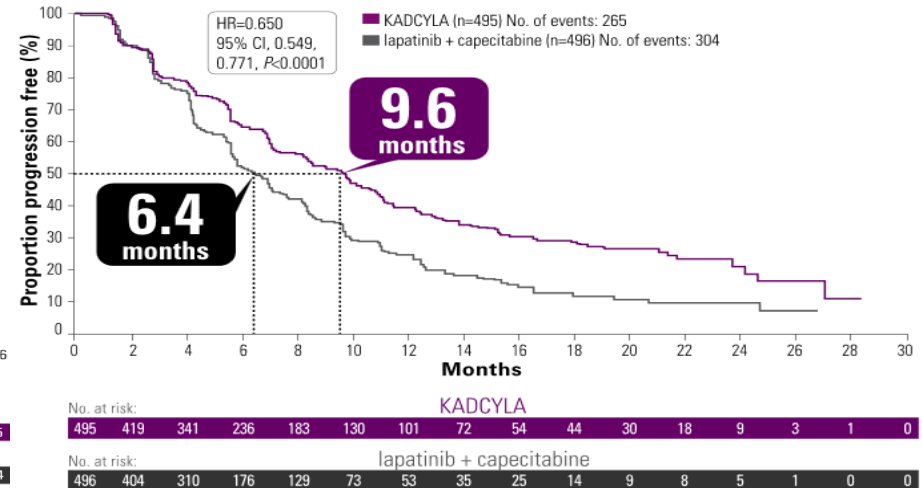
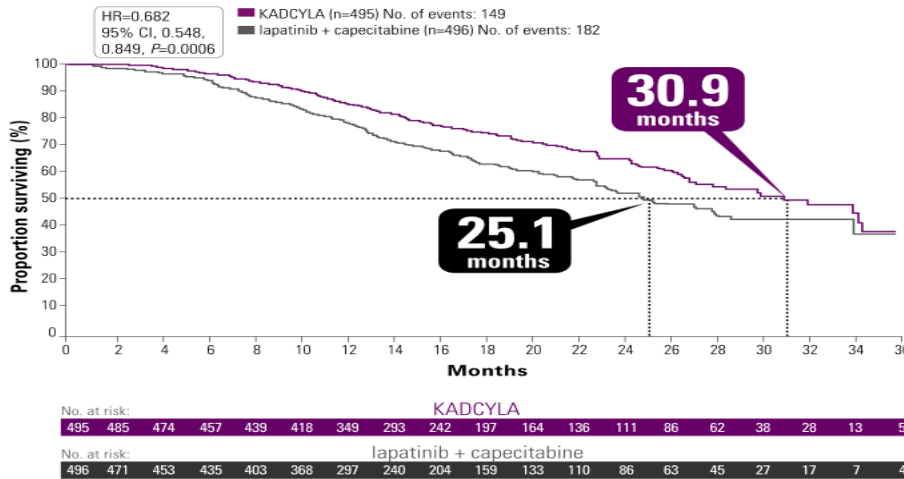
Factors involved in assessing specific example disease



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# Understanding potential of cancer treatments

- Kadcykla for HER2-positive, late-stage metastatic breast cancer
- EMILIA phase III trial results



- FDA approval Feb. 2013; EMA approval Nov. 2013



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# The true cost of pharmaceutical research

Company	Ticker	Number of drugs approved	R&D Spending Per Drug (\$Mil)	Total R&D Spending 1997-2011 (\$Mil)
<a href="#">AstraZeneca</a>	AZN	5	11,790.93	58,955
<a href="#">GlaxoSmithKline</a>	GSK	10	8,170.81	81,708
<a href="#">Sanofi</a>	SNY	8	7,909.26	63,274
<a href="#">Roche Holding</a> AG	RHHBY	11	7,803.77	85,841
<a href="#">Pfizer</a> Inc.	PFE	14	7,727.03	108,178
Johnson & Johnson	JNJ	15	5,885.65	88,285
Eli Lilly & Co.	LLY	11	4,577.04	50,347
Abbott Laboratories	ABT	8	4,496.21	35,970
Merck & Co Inc	MRK	16	4,209.99	67,360
Bristol-Myers Squibb Co.	BMJ	11	4,152.26	45,675
Novartis AG	NVS	21	3,983.13	83,646
Amgen Inc.	AMGN	9	3,692.14	33,229

Sources: InnoThink Center For Research In Biomedical Innovation; Thomson Reuters Fundamentals via FactSet Research Systems



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# Understanding the drivers of future longevity

## - common risk factors across diseases

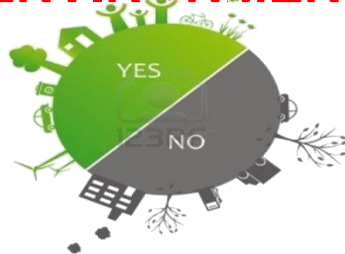
**GENES**



**BEHAVIOUR**



**ENVIRONMENT**



**HEALTHCARE**



**SOCIETAL PRESSURES**



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# Risk factors linking across disease

## Global Burden of Disease

Ranking legend																						
<div><div></div>1-5</div>	<div><div></div>6-10</div>	<div><div></div>11-15</div>																				
<div><div></div>16-20</div>	<div><div></div>21-25</div>	<div><div></div>26-30</div>																				
<div><div></div>31-35</div>	<div><div></div>36-40</div>	<div><div></div>&gt; 40</div>																				
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

# Understanding the drivers of future longevity

## - transition from remedial to curative medicine

**GENES**



**BEHAVIOUR**



**ENVIRONMENT**



**HEALTHCARE**



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# If we knew then what we know now: how Medical Advances have Influenced Longevity in the Past, Along with Expectations for the Future

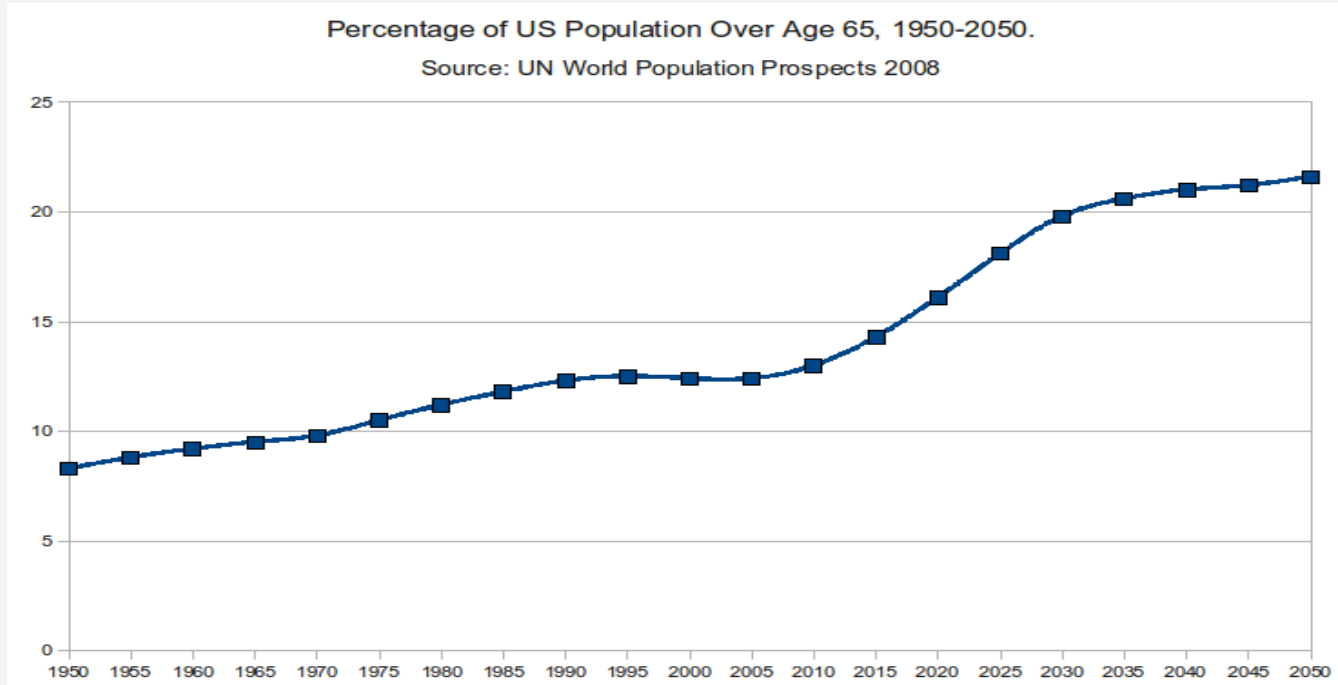
Aubrey de Grey  
Chief Science Officer  
SENS Research Foundation

[aubrey@sens.org](mailto:aubrey@sens.org)

<http://www.sens.org/>

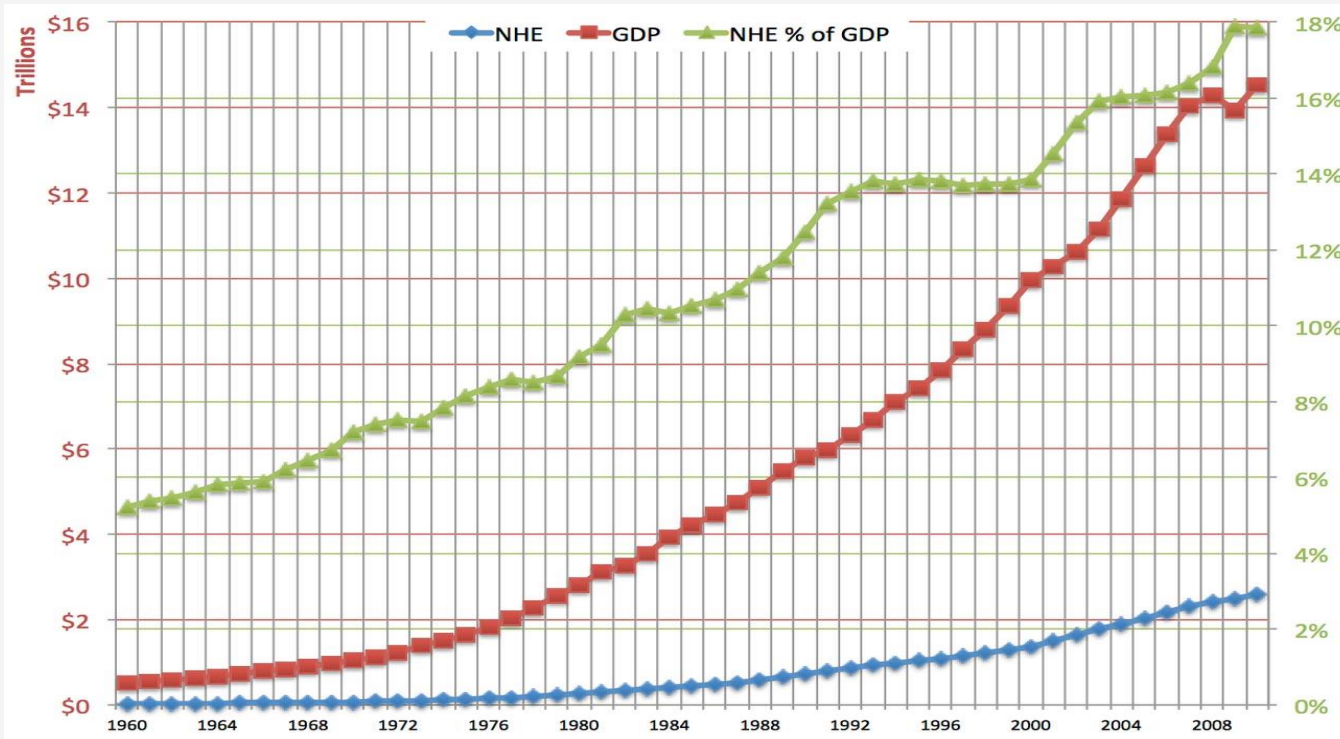


# The aging population



\* Source: [http://esa.un.org/wpp/unpp/panel\\_population.htm](http://esa.un.org/wpp/unpp/panel_population.htm)

# The economics of aging



Source: <http://sambaker.com/econ/classes/nhe10/>

If historical rates continue, US healthcare spending will be 34% of GDP by 2040. Source: <http://www.whitehouse.gov/administration/eop/cea/Th eEconomicCaseforHealth CareReform>  
In 2010, the US spent \$1.186 trillion on healthcare for people 65+ Source: [http://www.deloitte.com/as sets/Dcom- UnitedStates/Local%20As sets/Documents/us\\_dchs 2012\\_hidden\\_costs11271 2.pdf](http://www.deloitte.com/as sets/Dcom- UnitedStates/Local%20As sets/Documents/us_dchs 2012_hidden_costs11271 2.pdf)

# Age-related vs. infectious diseases

- Most infectious diseases have been easily prevented
  - Sanitation
  - Vaccines
  - Antibiotics
  - Carrier control
- Age-related diseases have not. **Why not?**

# Well... what is 'aging', exactly?

Aging is:

The life-long accumulation of “damage” to the body that occurs as an intrinsic side-effect of the body’s normal operation.

The body can tolerate some damage, but too much of it causes disease and disability.

# A bizarrely underappreciated truth

**Age-related diseases are caused by aging!**

Thus, they are:

- widespread now that infections are “rare”
- staggeringly costly
- universal if you live long enough
- not medically curable, in the strict sense

But they, and aging itself, are nonetheless:

- medical problems
- medically preventable in principle

# ARDs and aging: conventional view

Diseases			Aging
Communicable	Congenital	Age-related	
Tuberculosis Malaria HIV ...	Tay-Sachs MELAS Li-Fraumeni ...	Alzheimer's Cancer Atherosclerosis ...	Frailty Sarcopenia Immunosenescence ...

# ARDs and aging: correct view

Diseases		Aging	
Communicable	Congenital	Specific	General
Tuberculosis Malaria HIV ...	Tay-Sachs MELAS Li-Fraumeni ...	Alzheimer's Cancer Atherosclerosis ...	Frailty Sarcopenia Immunosenescence ...

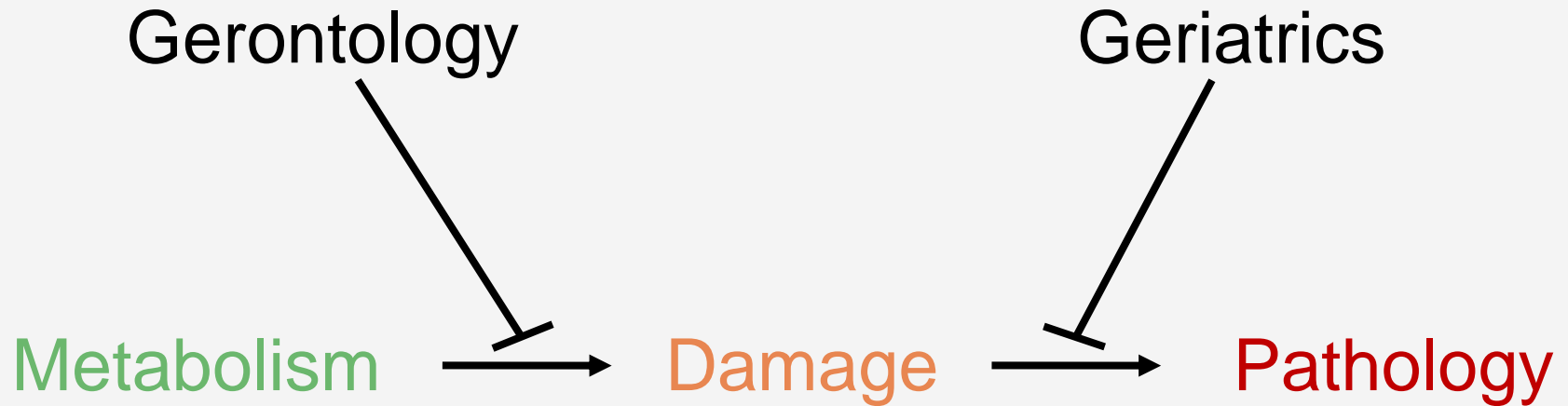


# What this misguidedness means in \$\$

Even though 90% of US deaths and at least 80% of US medical costs are caused by aging:

National Institutes of Health budget (\$M)	~30,000
National Institute of Aging budget	~1,000
Division of Aging Biology budget	~150
Spent on translational research (max)	~10
SENS Research Foundation budget	~5

# How age-related disease is addressed today



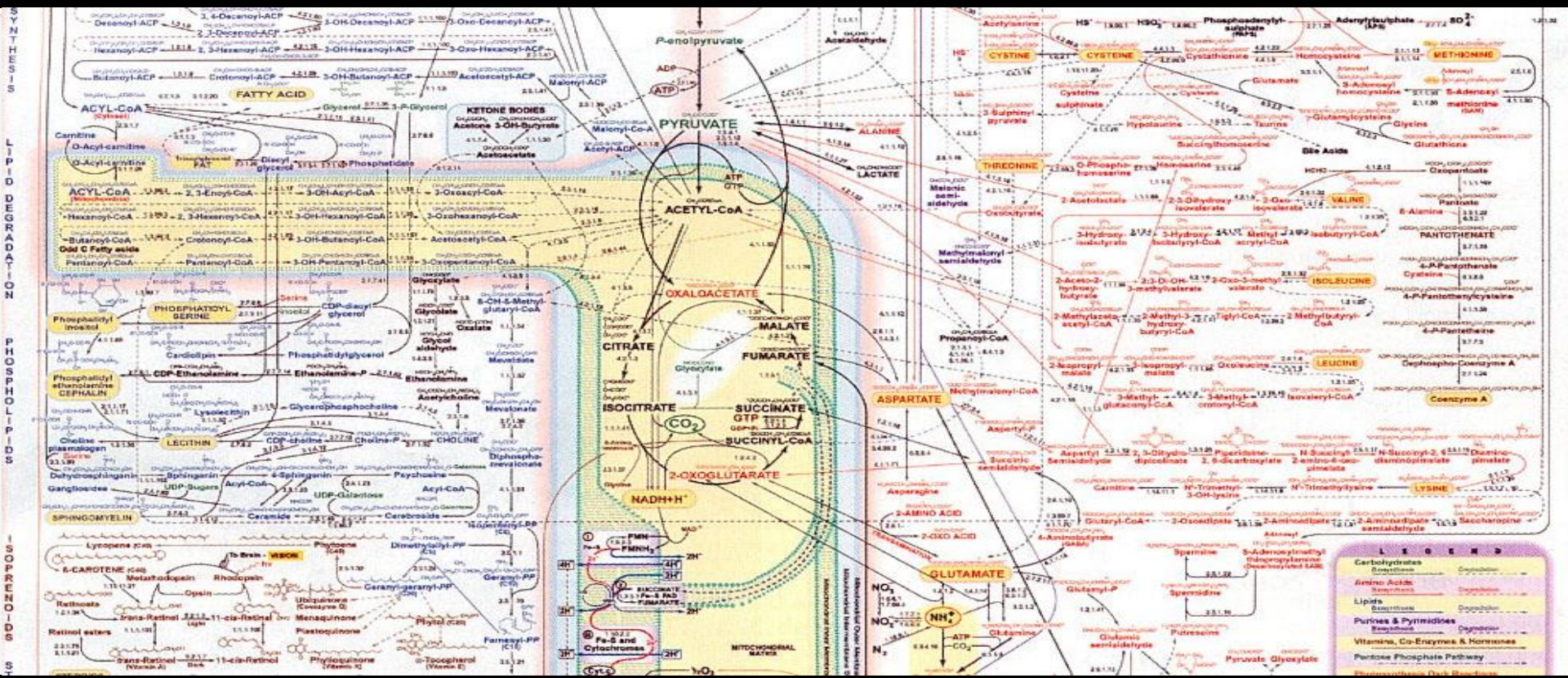
# Targeting pathology: tricky

presbycusis  
osteoporosis  
osteoarthritis  
autoimmunity  
greying hair  
presbyopia  
cataract  
glaucoma  
temporal arteritis  
polymyalgia rheumatica  
wrinkling  
Alzheimer's disease  
Pick's disease  
corticobasal degeneration  
progressive supranuclear palsy  
Parkinson's disease  
multiple system atrophy  
dementia with Lewy bodies  
sarcopenia  
glomerulonephritis  
senile cardiac amyloidosis  
atherosclerosis  
arteriosclerosis  
age-related macular degeneration  
cardiomyopathy  
diastolic heart failure  
cancer  
systemic inflammation  
oxidative stress  
reduced coronary blood flow  
loss of cardiac reserve  
andropause  
thymic involution  
reduced plasma renin activity  
reduced aldosterone  
reduced melatonin diurnal rhythm

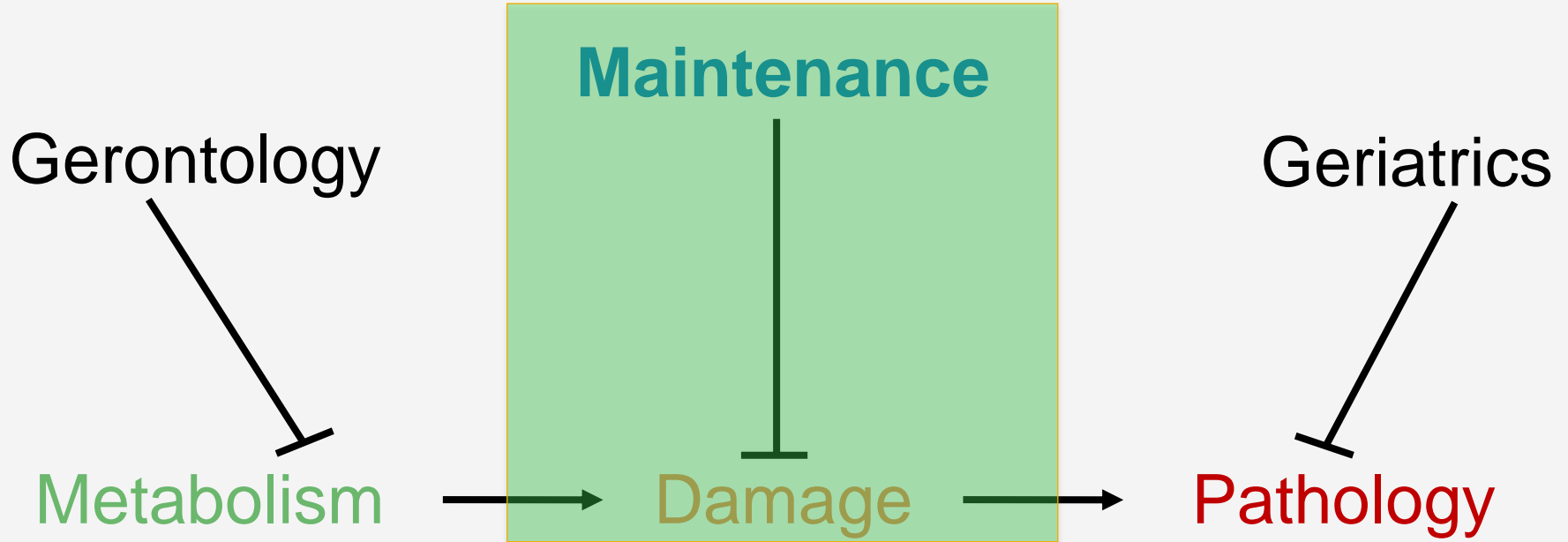
reduced light adaptation  
reduced ethanol metabolism  
altered drug pharmacokinetics  
somatopause  
loss of cardiac adaptability  
incontinence  
impaired wound healing  
idiopathic axonal polyneuropathy  
autonomic neuropathy  
arrhythmia  
chronic obstructive pulmonary disorder  
benign prostatic hypertrophy  
menopause  
leukoaraiosis  
stroke  
vascular dementia  
frontotemporal dementia  
immunosenescence  
anosmia  
cachexia  
anorexia of aging  
systolic hypertension  
ageusia  
erectile dysfunction  
orthostatic hypotension  
impaired adaptive beta-cell proliferation  
fibroblast collapse  
anergic T-cell clones  
cellular senescence  
vascular calcification  
impaired transdermal absorption  
impaired thermoregulation  
reduced tactile acuity  
impaired vasoconstriction  
loss of neuromuscular junctions  
delayed withdrawal reflex

impaired pH maintenance  
reduced chemical clearance  
altered dermal immune cell residence and function  
aberrant allergic and irritant reactions  
loss of skin elasticity  
impaired vitamin D synthesis  
reduced renal reserve  
renal cortex atrophy  
gut dysbiosis  
loss of jejunal villus height  
impaired response to vaccination  
impaired thirst  
lentigo senilis  
thinning hair  
impaired proprioception  
impaired balance  
reduced vital capacity  
reduced cardiorespiratory endurance  
impaired sweat response  
impaired blood distribution  
nutrient malabsorption  
diverticular disease  
presbyphagia  
increased reflux  
alveolar loss  
neuronal loss  
senile emphysema  
degenerative disc disease  
joint calcification  
pineal calcification  
aberrant differentiation  
gait instability  
frontal demyelination  
axonal atrophy  
impaired functional connectivity  
impaired working memory

# Targeting metabolism: also tricky



# Maintenance: targeting damage



**Claim:** unlike the others, the maintenance approach can deliver a big extension of human healthy lifespan quite soon



# Comparison: car maintenance



# Categorizing damage

## Damage type

Cell loss, cell atrophy

Division-obsessed cells

Death-resistant cells

Mitochondrial mutations

Intracellular junk

Extracellular junk

Extracellular matrix stiffening

No new type of  
damage  
confirmed since  
1982

And, I've said  
so without  
challenge since  
2002



# Diseases by damage type

## Damage type

Cell loss, cell atrophy

Division-obsessed cells

Death-resistant cells

Mitochondrial mutations

Intracellular junk

Extracellular junk

Extracellular matrix stiffening

***Cancer***



# Diseases by damage type

## Damage type

Cell loss, cell atrophy

Division-obsessed cells

Death-resistant cells

Mitochondrial mutations

Intracellular junk

Extracellular junk

Extracellular matrix stiffening

**Heart  
Disease**

A diagram consisting of six blue lines originating from the right side of the 'Heart Disease' text and pointing towards the six damage type categories listed on the left. The lines connect 'Heart Disease' to 'Cell loss, cell atrophy', 'Division-obsessed cells', 'Death-resistant cells', 'Mitochondrial mutations', 'Intracellular junk', and 'Extracellular matrix stiffening'.

# Diseases by damage type

## Damage type

Cell loss, cell atrophy

Division-obsessed cells

Death-resistant cells

Mitochondrial mutations

Intracellular junk

Extracellular junk

Extracellular matrix stiffening

***Alzheimer's***

# Frailty shares the same causes

## Damage type

Cell loss, cell atrophy

Division-obsessed cells

Death-resistant cells

Mitochondrial mutations

Intracellular junk

Extracellular junk

Extracellular matrix stiffening



***Non-specific  
Decrepitude***

# The “how” of preventative maintenance

- Replace
- Remove
- Repair
- Reinforce

# Addressing each category

Damage type	The maintenance approach
Cell loss, cell atrophy	Cell therapy, mainly
Division-obsessed cells	Telomerase/ALT gene deletion plus periodic stem cell reseed
Death-resistant cells	Suicide genes, immune stimulation
Mitochondrial mutations	Allotopic expression of 13 proteins
Intracellular junk	Transgenic microbial hydrolases
Extracellular junk	Phagocytosis by immune stimulation
Extracellular matrix stiffening	AGE-breaking molecules/enzymes

# How BIG is the longevity side-benefit?

- Western mortality rate at age 20-30 is under  $10^{-3}/y$
- If it didn't rise with age (and in fact it will very probably fall), most people would live to over 1000
- Rejuvenation therapies may never be perfect; first-generation version may give “only” ~30y extra life
- However, that would buy us time to develop better ones with which to re-rejuvenate the same people, and so on (“longevity escape velocity”)
- Period life expectancy will very suddenly become incalculable (literally!)

# How NEAR is the longevity side-benefit?

- This is pioneering technology, so we don't know
- Guess: 50% chance in 20-25y if funding rises soon
- At least 10% chance it'll take >100y
- That's for the therapies I've mentioned today
- They will probably give around 30yr extra life
- LEV thenceforth seems inevitable to me...
- **Everyone will understand the above this decade**



# Learn more

Read the (semi-technical) book.

Available at Amazon and all good book stores.

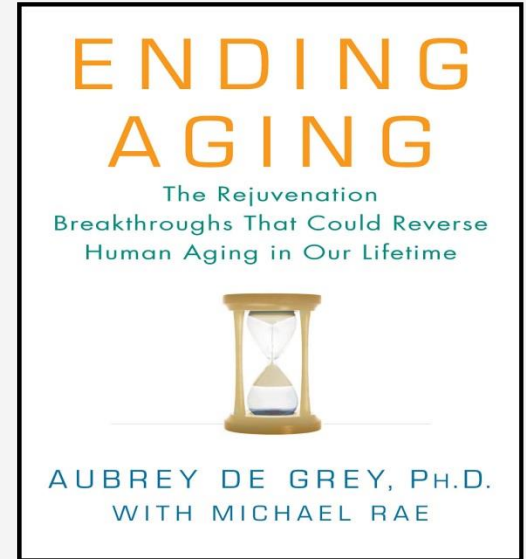
Paperback is cheaper, and has an extra chapter!

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<http://www.sens.org/outreach/conferences/rejuvenation-biotechnology-conference-2014>

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**Rejuvenation  
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a SENS Research Foundation Conference

August 21-23, 2014

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reimagine aging

[www.sens.org](http://www.sens.org)

[aubrey@sens.org](mailto:aubrey@sens.org)



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# If we knew then what we know now: how Medical Advances have Influenced Longevity in the Past, Along with Expectations for the Future

Daniel Ryan  
Head of Life & Health R&D  
Swiss Re

# Understanding the drivers of future longevity

## - the individual & social networks

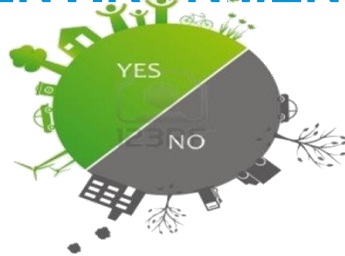
**GENES**



**BEHAVIOUR**



**ENVIRONMENT**



**HEALTHCARE**

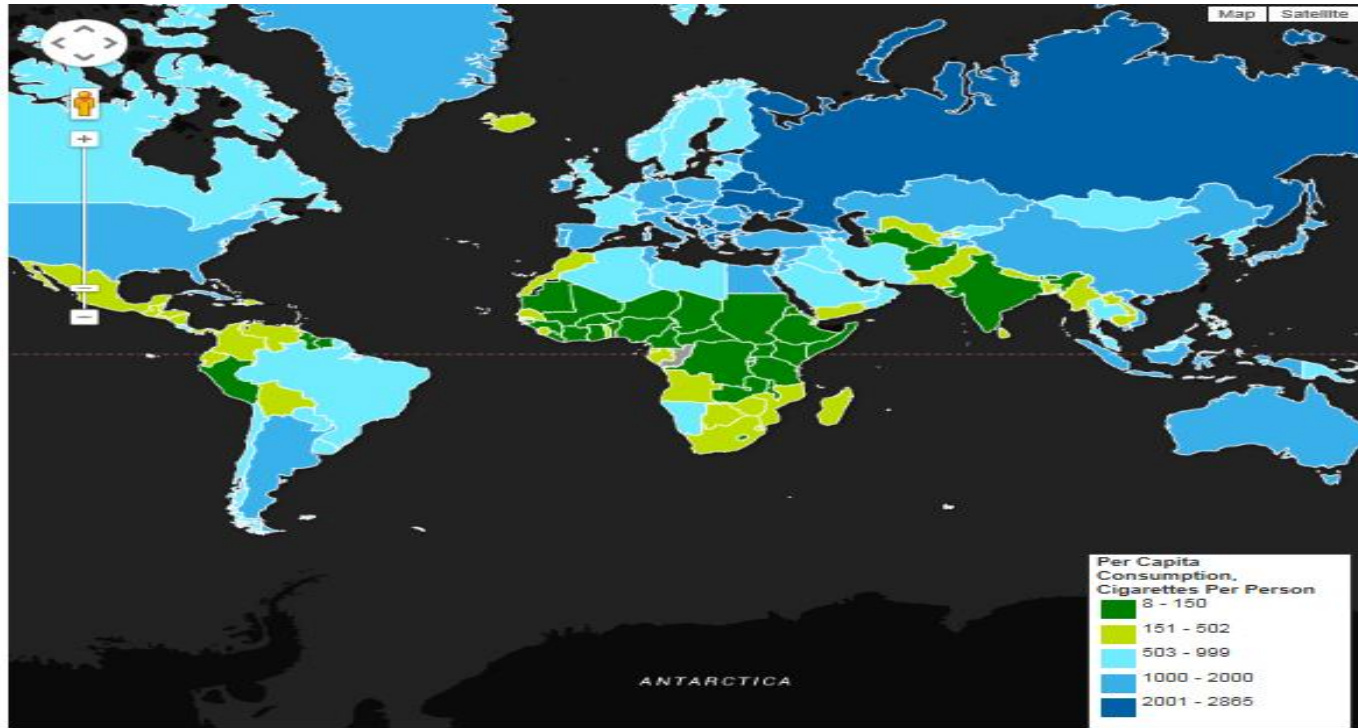


**SOCIETAL PRESSURES**



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# 1 billion will die from smoking in 21<sup>st</sup> century



Source: Tobacco Cancer Atlas



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# Why do we engage in unhealthy behaviours?

10. Peer pressure
9. Social rewards
8. Risk-taking behaviour
7. Parental influence
6. Misinformation
5. Genetic predisposition
4. Advertising
3. Self-medication
2. Media influences
1. Stress relief



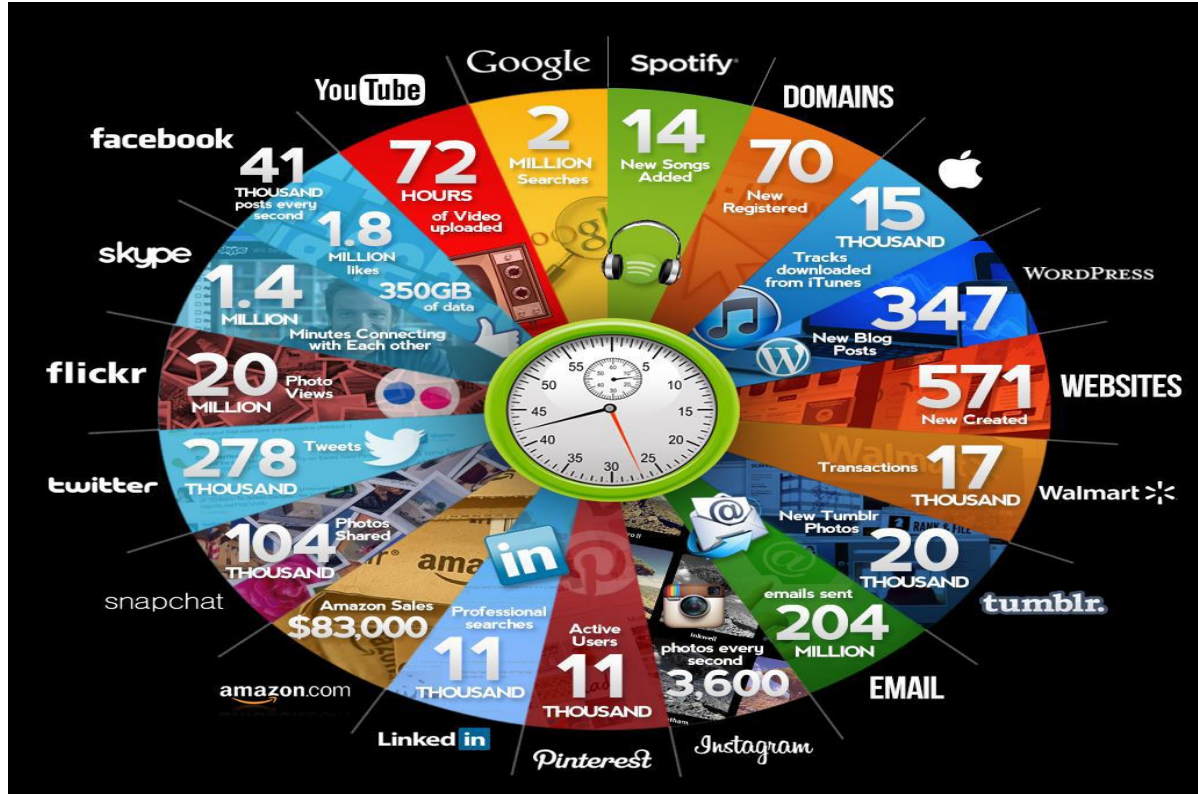
Source: Vape Lab in Shoreditch High Street, London



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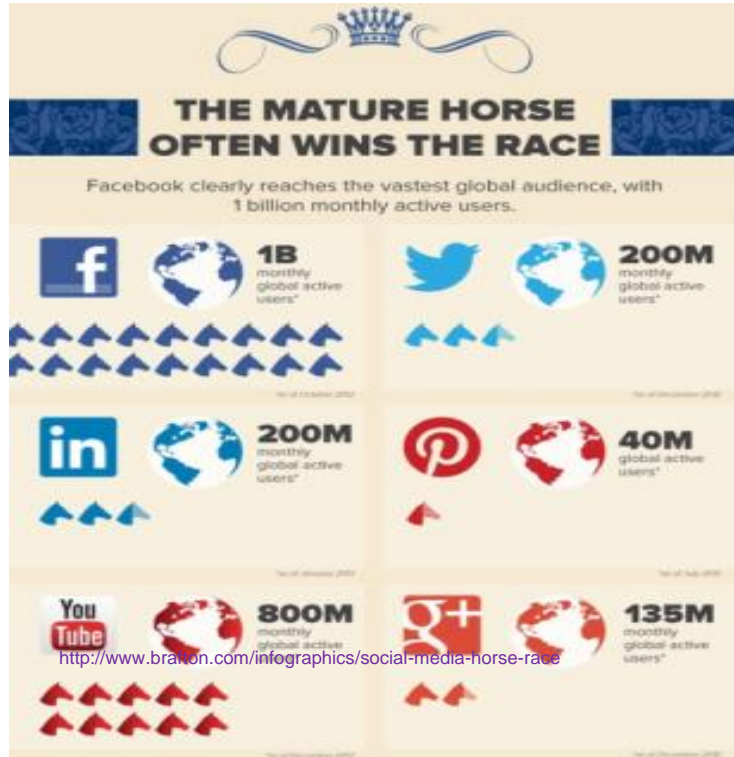
# We live in an increasingly connected world



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# We are redefining our social networks



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# Social physics – how good ideas spread

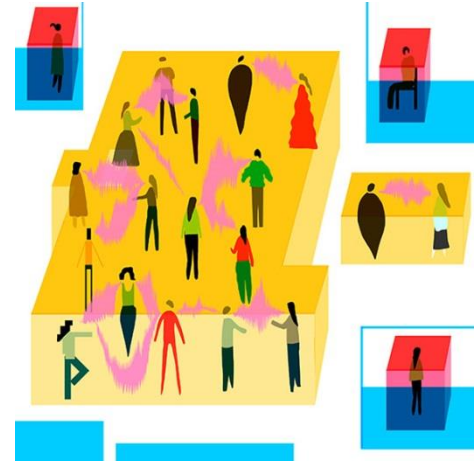
- Professor Alex Pentland – MIT Human Dynamics Lab
- How flow of ideas and information translates into changes in behaviour
- Promoting the development and sharing of social interactions from Living Labs



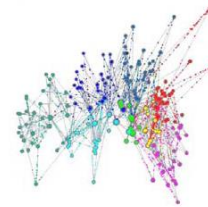
Source: 2013 Sense Networks - mClick-to-Visit™ Analytics



Source: 2008 Sense Networks – San Francisco Tribes



Source: Big Data comes to the Office, The New Yorker



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# How we can influence behaviour on future benefits

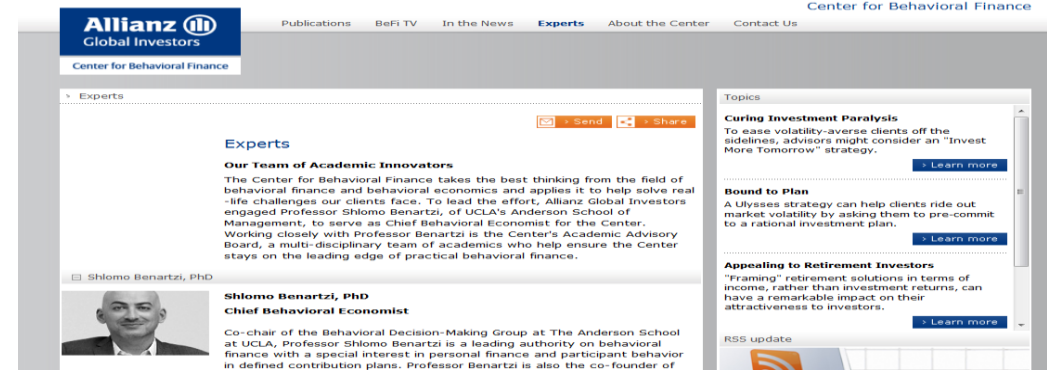
- We all know we should save for retirement - but we don't
- How about saving a proportion of your next pay increase?
- Professor Benartzi developed Save More Tomorrow™ (SMarT), which led to savings rates increased from 3.5% to 13.6% over three and a half years
- Save More Tomorrow™ is now offered by approximately half of the large retirement plans in the U.S. and many in UK

Shlomo Benartzi: Saving for tomorrow, tomorrow

**TED@AllianzGI**  
Behavioral Finance



In November 2011, Professor Shlomo Benartzi, of the UCLA Anderson School of Management and Chief Behavioral Economist of the Allianz Global Investors



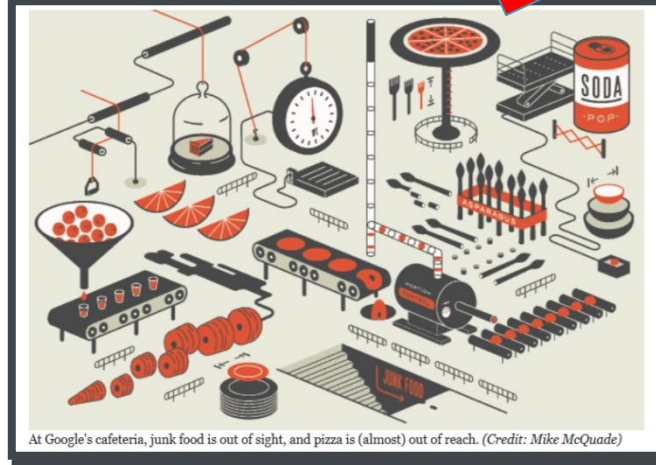
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# Promoting healthy behaviour

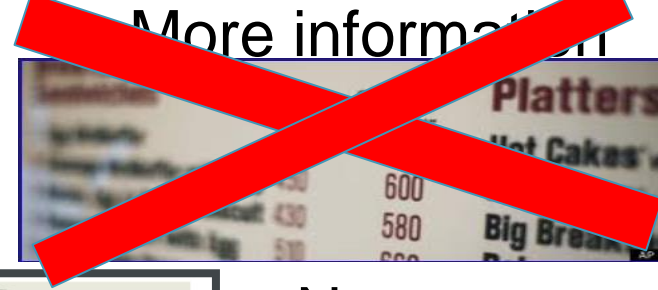
## Salience



Yellow tape was placed across a shopping cart indicating where fruit and vegetables should be placed.  
Result: 102% increase in sales of fruit and vegetables.



Google cafeteria hid unhealthy food out of sight and out of reach and placed healthy food more centrally.  
Result: fat consumption from chocolate decreased by 11%.



## Norms



## Incentives



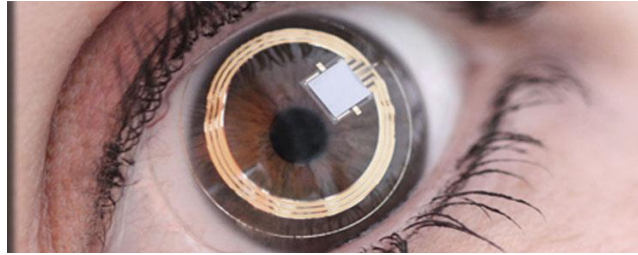
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# Immediate feedback on impact of choices



Wearable sensors



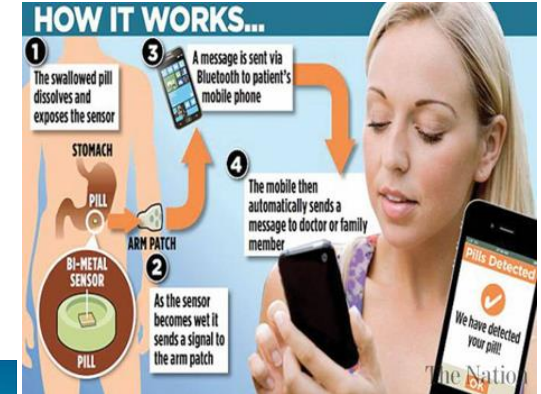
Smart lenses



Smart garments



Handheld medical scanner



Smart Pill



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# Putting it all together

- Models of longevity must consider the underlying drivers
- Learnings from behavioural economics & social physics will lead to more effective health interventions and communication
- Continuous collection of biomedical data will link choices to health impact
- Necessary transition from remedial healthcare to curative healthcare over coming decades - benefits focused on pre-retirement population
- Future of longevity is more uncertain than ever before – key factors are individual engagement, societal attitudes & pace of technological change



# Questions

# Comments

Expressions of individual views by members of the Institute and Faculty of Actuaries and its staff are encouraged.

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



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