

# Current Developments in Aging and Mortality

Helsinki 23 May 2017



## Is longevity *still* improving?

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### With thanks to:

Adrian Gallop, Jon Palin, Richard Willets, Magali Barbieri, Assia Billig, Al Klein, Sam Gutterman, Michael Sherris, Kriszti Halay, David Raymont, Jari Niittuinperä and many others



# Is longevity *still* improving?



## Is longevity *still* improving?

“In some countries, recent years of heavier mortality cast doubt on assumptions about future mortality improvements. It’s a subject of particular interest to life and pensions actuaries. What do we know so far?”

### Terminology

ONS = Office for National Statistics (UK)

SMR = Age-Standardised Mortality Rate

E & W = England and Wales

EOL = “Life expectancy” = Period life expectancy  
(unless specifically mentioned)



# Improving longevity



We are accustomed to seeing longevity improving in developed countries

*but not always*

## Quality warning:

*It is hard to get up-to-date figures. Human Mortality Database is an excellent resource, but recent past is difficult to access anywhere*

*Need to revert from Life Expectancies to SMRs and even crude death rates to estimate rate of mortality improvement*

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# Is longevity *still* improving?



## 30 years of improving longevity

## What countries?

Recent developments

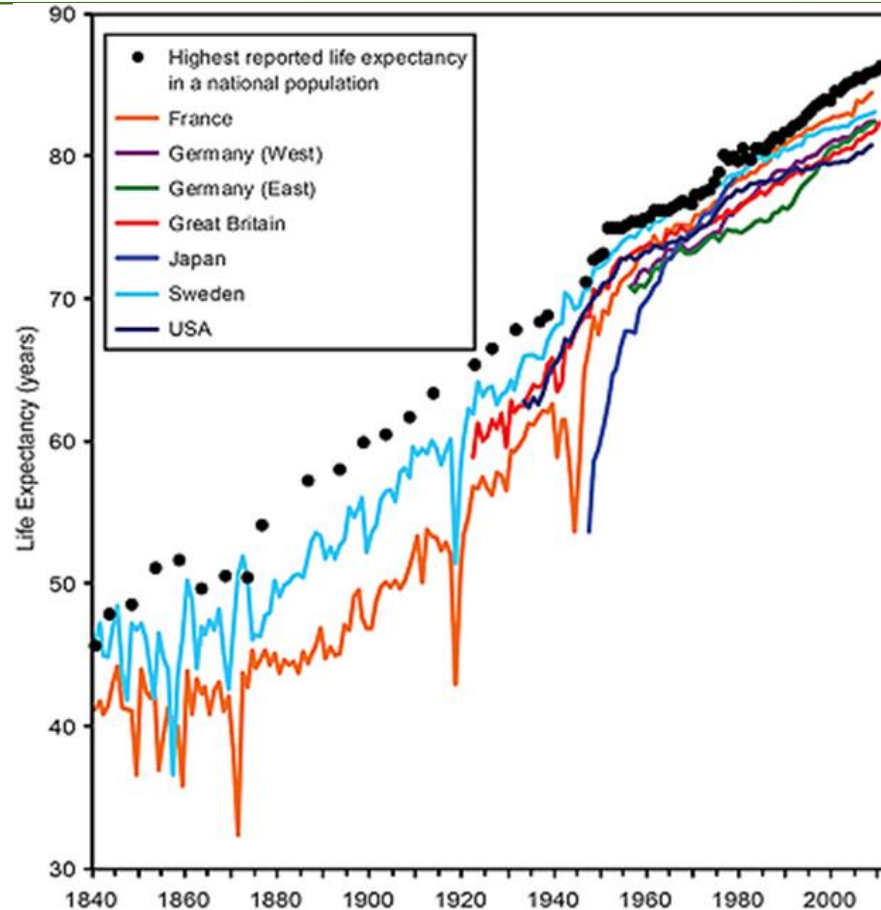
## “Blip” or long-term change?

Causes

## What are actuaries doing?



# Female Life Expectancy in Developed Countries: 1840-2009



Source: Highest reported life expectancy for the years 1840 to 2000 from online supplementary material to Oeppen J, Vaupel JW. Broken limits to life expectancy. Science 2002; 296:103-106. All other data points from the Human Mortality Database (<http://www.mortality.org>) provided by Roland Rau (University of Rostock). Courtesy National Institute of Aging



# Is longevity *still* improving?



30 years of improving longevity

**What countries?**

Recent developments

**“Blip” or long-term change?**

Causes

**What are actuaries doing?**



# What countries?



## UK constituent countries

Rest of Europe, eg: France, Germany,  
Finland, Italy, Netherlands, Spain, Sweden

Australia

Canada

US



# England and Wales

## The future?



### The future of life expectancy and life expectancy inequalities in England and Wales: Bayesian spatiotemporal forecasting

Bennett et al the Lancet July 2015

*“Between 1981 and 2012, life expectancy increased by 8·2 years for men and 6·0 years for women”*

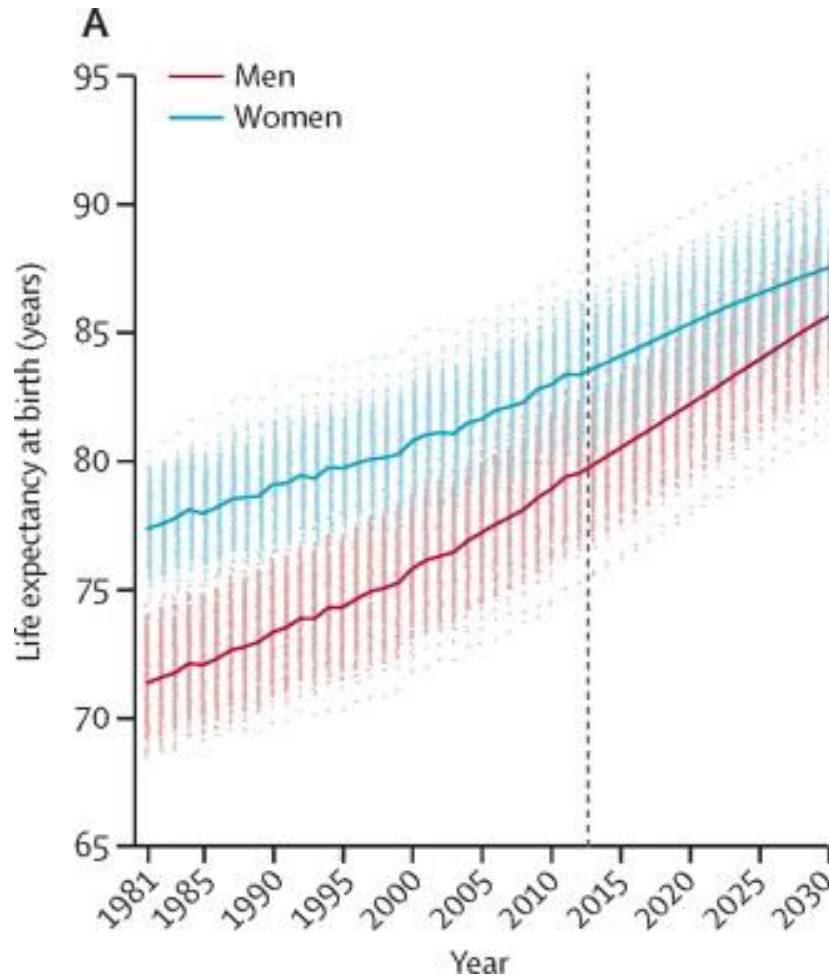
- *“Life expectancy at birth in England and Wales was 79·5 years ... for men and 83·3 years ... for women in 2012.”*
- *“National life expectancy in 2030 is expected to reach 85·7 (up 6·2 years) for men and 87·6 years (up 4·3 years) for women”*
- They compare their forecasts with those of the ONS, and conclude that the ONS principal projections are significantly too low.



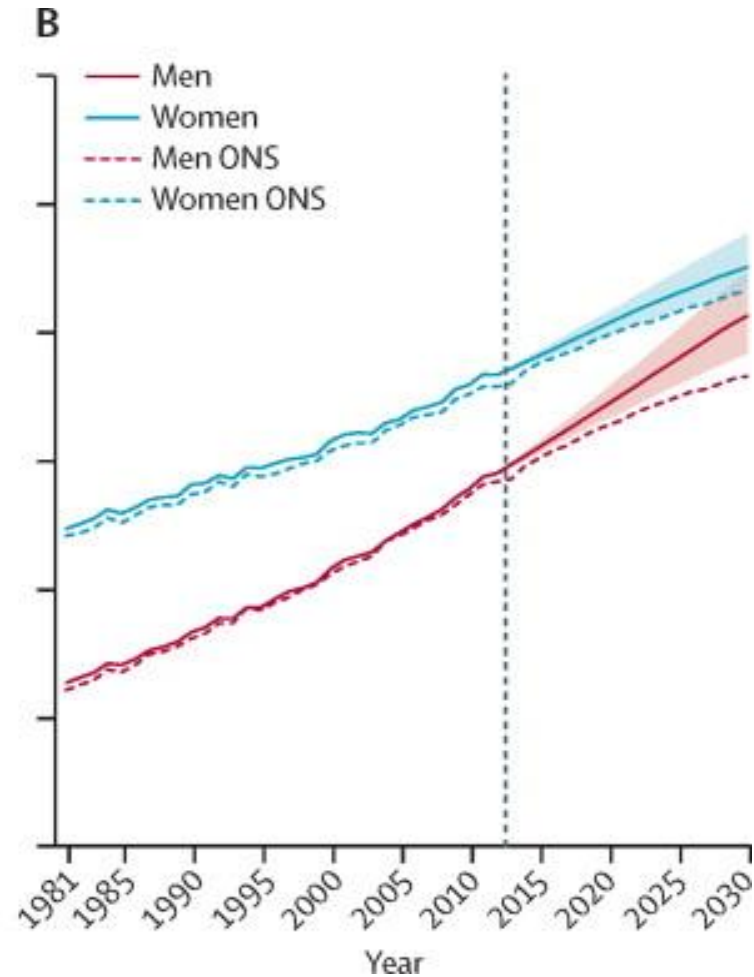
# The future of life expectancy? England and Wales



**Authors' projections**



**ONS Principal Projections**



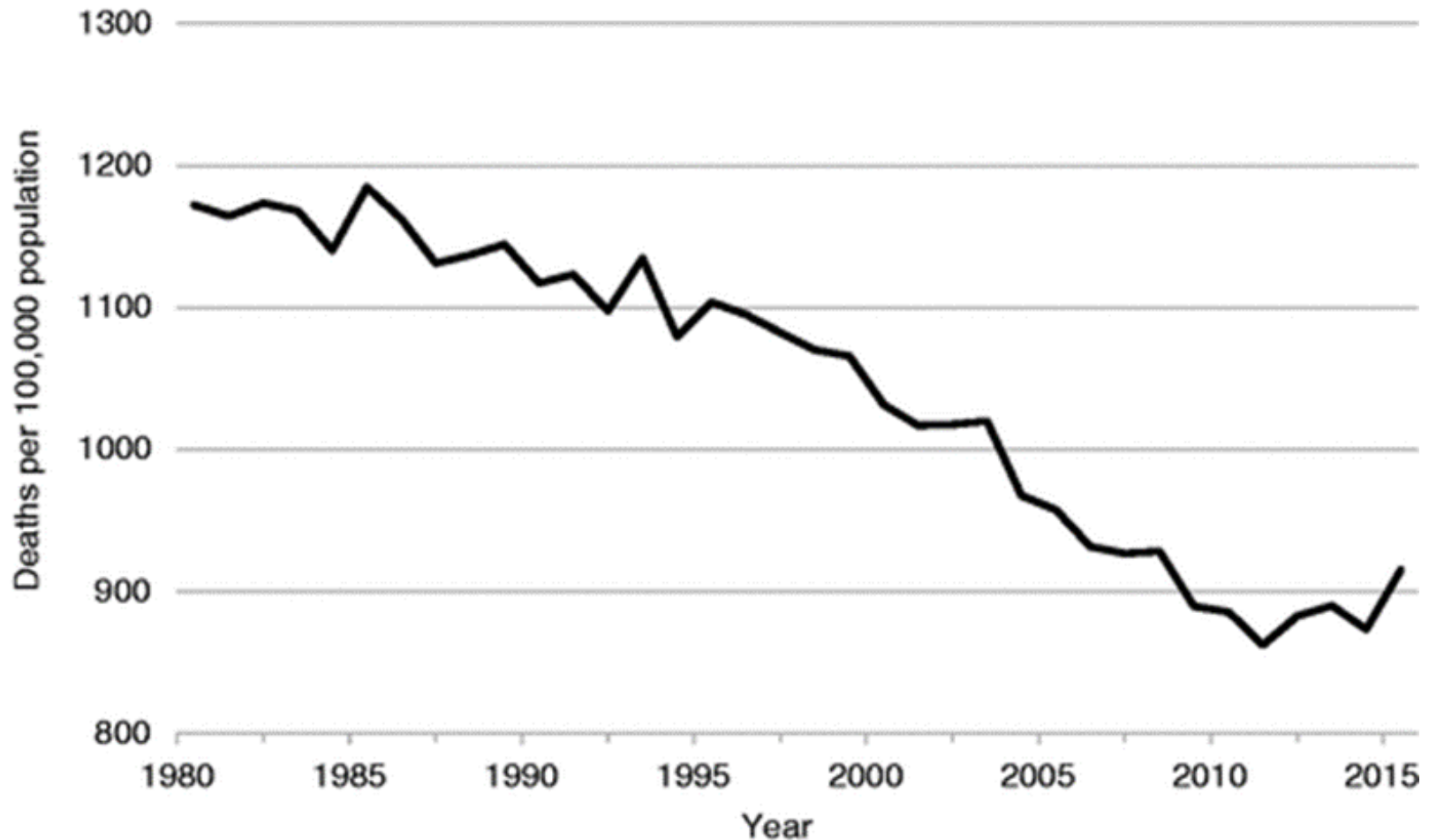
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# England and Wales

## Age-standardised mortality



**Age-standardised mortality in England and Wales 1980 - 2015**



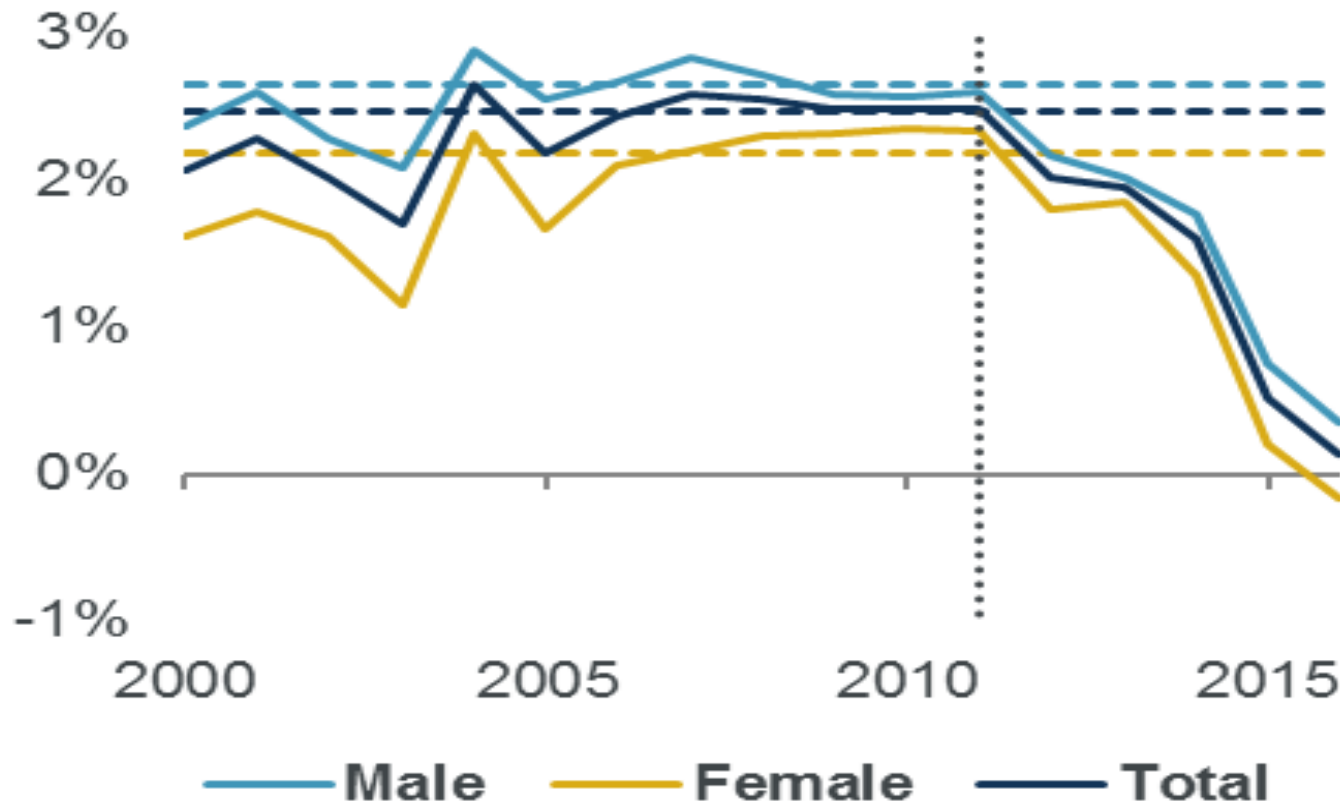
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# England and Wales

Five-year average annual mortality improvements



Five-year average annual mortality improvements (solid) compared to trends from 2000-2011 (dashed)



Source: CMI Working Paper 97, 27 Mar 2017 Chart 2E

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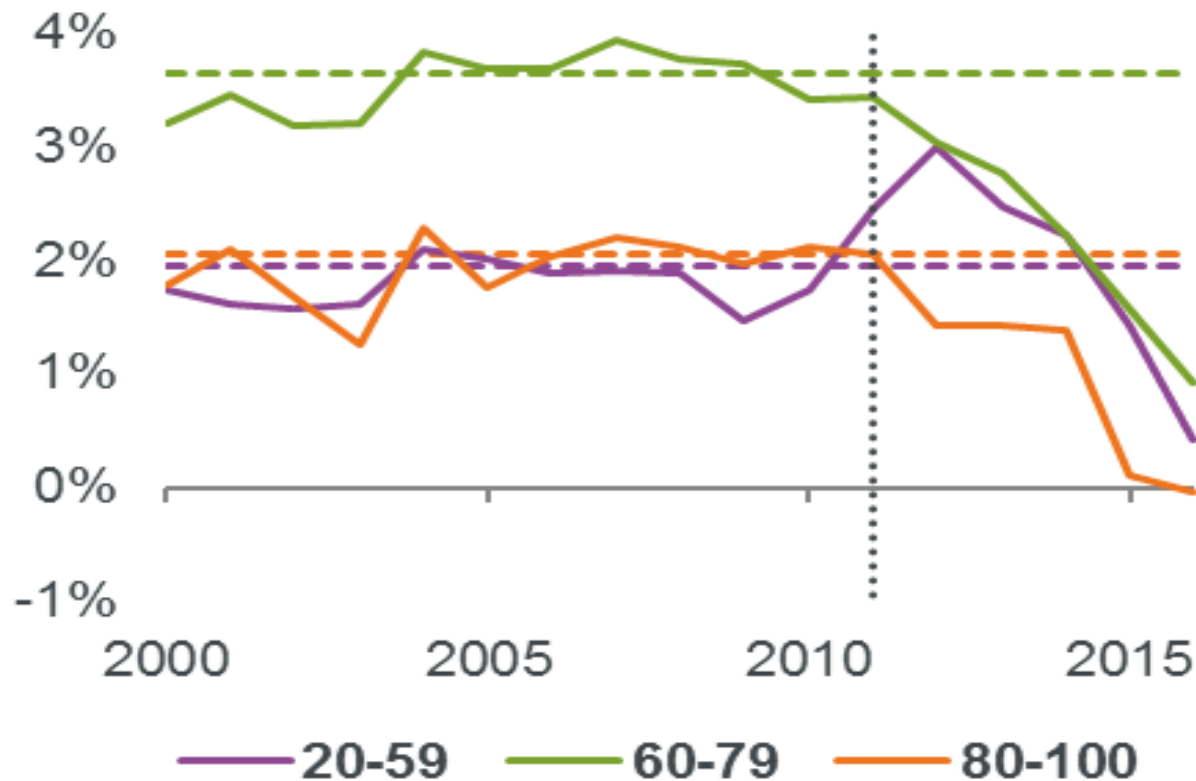
# England and Wales

affects all age bands



The average mortality improvements affect all age bands

Five-year average mortality improvements for different age bands (male shown)



Source: CMI Working Paper 97, 27 Mar 2017 Chart 2G/H

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# England and Wales

## Annual mortality improvements



### Conclusion:

Mortality improvements have declined from 2-3% per annum in 2000-2010 to near zero by 2016

Source: CMI Working Paper 97, 27 Mar 2017

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# What countries?



UK constituent countries

**Rest of Europe, eg: France, Germany,  
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# Europe



France, Germany, Italy, Netherlands, Spain, Sweden, UK,  
Finland

Took latest published *provisional* EOLs and compared past 5  
years' improvements against previous 5 years

# Europe: comparing past 5 years gains in EOL from birth with prev. five

(in decimals of a year: 0.200 = 20% of a year)



Country	Male		Female		Reduction in annual increase		
	Last year	Prev 5	Past 5	Prev 5	Past 5	M	F
France	2016	0.240	0.200	0.160	0.080	0.040	0.080
Germany	2013/14	0.260	0.134	0.162	0.094	0.126	0.068
Italy	2015	0.239	0.172	0.153	0.061	0.067	0.092
Netherlands	2015	0.320	0.180	0.220	0.080	0.140	0.140
Spain	2015	0.406	0.175	0.299	0.076	0.231	0.223
Sweden	2016	0.218	0.154	0.152	0.084	0.064	0.068
UK	2015	0.304	0.000	0.230	0.072	0.304	0.158
Finland	2016	0.276	0.242	0.142	0.114	0.034	0.028

Source: Provisional figures Courtesy Adrian Gallop, Statistics Finland and HMD - own calculations E&OE !

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# Scandinavia: comparing past 5 years gains in EOL from birth with prev. five

(in decimals of a year: 0.200 = 20% of a year)



*Not the same at all! .....*

Country	Male			Female		Reduction in annual increase	
	Last year	Prev 5	Past 5	Prev 5	Past 5	M	F
Denmark	2014	0.338	0.342	0.246	0.388	-0.004	-0.142
Finland	2016	0.276	0.242	0.142	0.114	0.034	0.028
Norway	2014	0.218	0.286	0.146	0.208	-0.068	-0.062
Sweden	2014	0.196	0.204	0.134	0.146	-0.008	-0.012

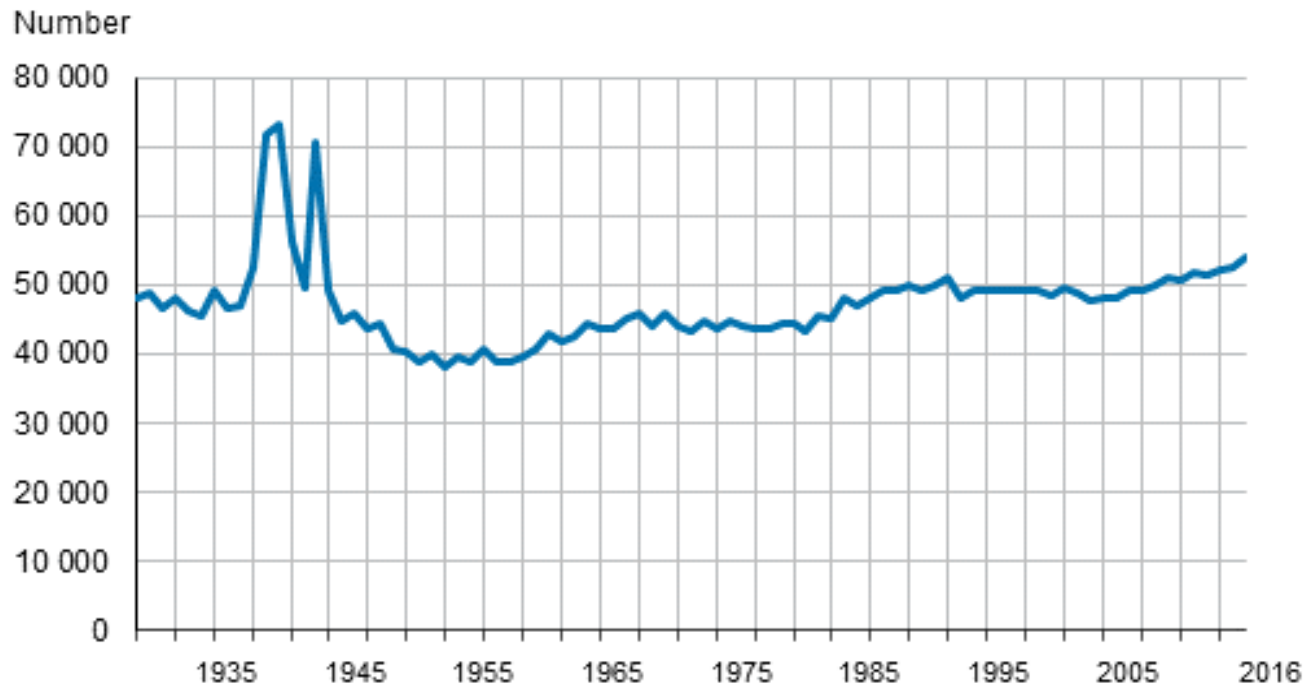
Source: Provisional figures Statistics Finland and HMD - own calculations E&OE !

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# Finland total deaths

showing 2015 peak experienced in many European countries



*“In 2016, the average life expectancy at birth was 78.4 years for boys and 84.1 years for girls. Men’s average life expectancy decreased by 0.1 years and women’s remained unchanged from 2015”*

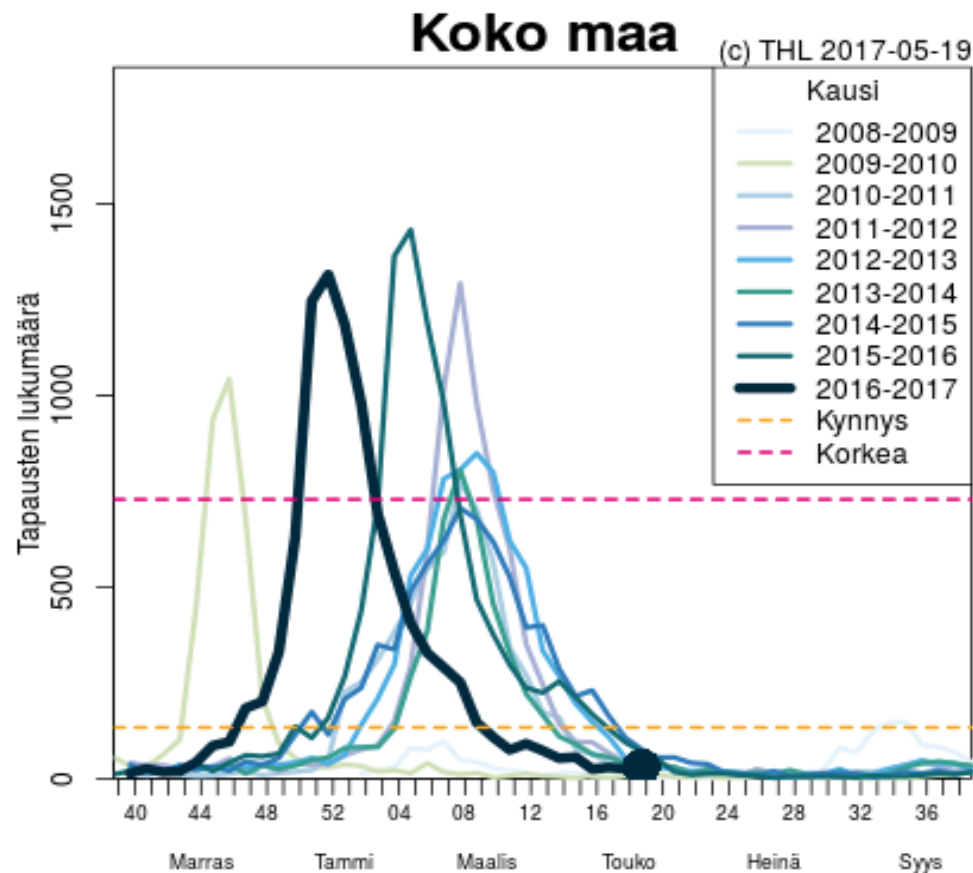
Worsened, but perhaps for a different reason.....

# Finland total deaths – Oct to Sept

Perhaps it's an Excess Winter Mortality effect?



## Weekly influenza visits to health centres - the whole country



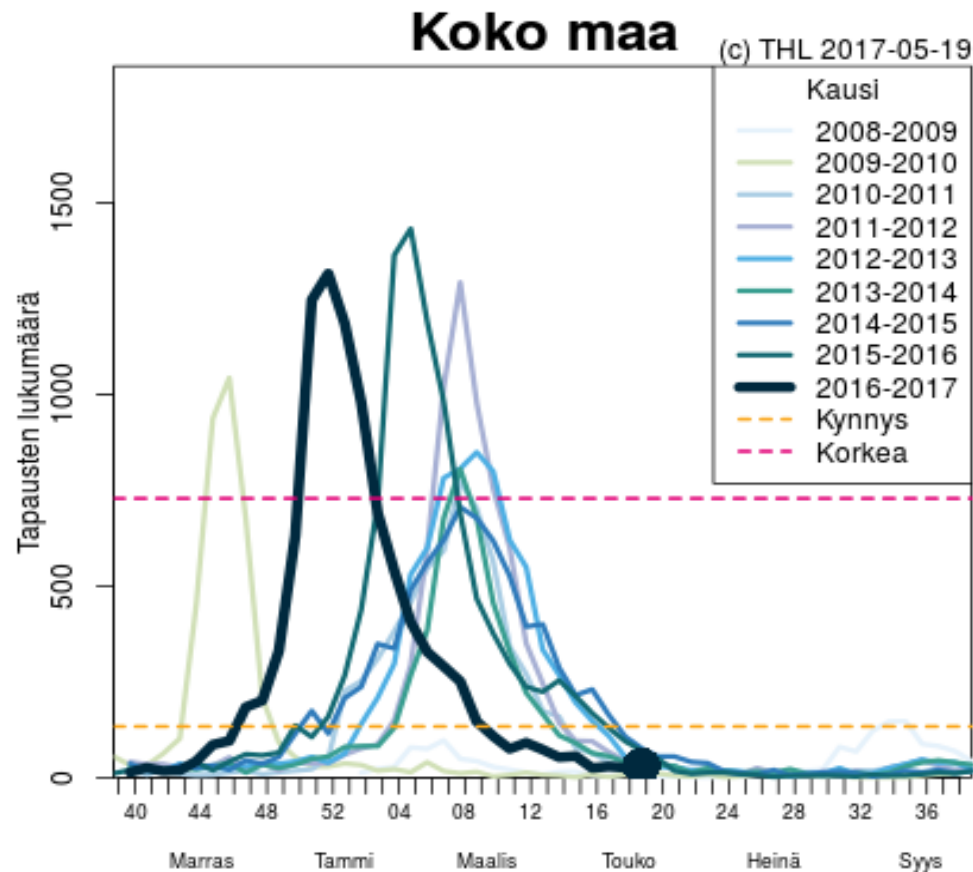
Shows weekly visits from October to September

# Finland total deaths - Oct to Sept

Probably it's an Excess Winter Mortality effect



## Weekly influenza visits to health centres - the whole country



Shows weekly visits from October to September

***Influenza peaked in December 2016***

***Downturn perhaps was a blip***



# What countries?



## Rest of Europe, eg: France, Germany, Finland, Italy, Netherlands, Spain, Sweden

Comparing past 5 years improvements  
against previous 5 years improvements,  
the rate of improvement is lower

for all countries examined except Scandiavia  
from birth and from age 65, and  
for both sexes

*(the situation is likely to improve for 2016, but may fall back again for 2017)*



# What countries?



UK constituent countries

Rest of Europe, eg: France, Germany,  
Finland, Italy, Netherlands, Spain, Sweden

**Australia**

Canada

US



# Australia



HMD (*last year 2014*): Australia's aggregate life expectancy from birth grew on average by

- 1990 to 1999      0.309 years per annum
- 2000 to 2009      0.249 years per annum
- 2010 to 2014      0.17 years per annum

ABS 2014 to 2015: Australia's SMR stayed same(5.5)

*"So there appears to be slowing of the rate of improvement in recent years. This has to be interpreted in terms of the volatility of mortality rates .... "*

Sources: [HMD](#), [ABS](#) Michael Sherris

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# What countries?



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# Canada : recent figures?



## Official figures for Canada only go to 2012

How can we get a clue at more recent developments?

2 sources of recent figures:

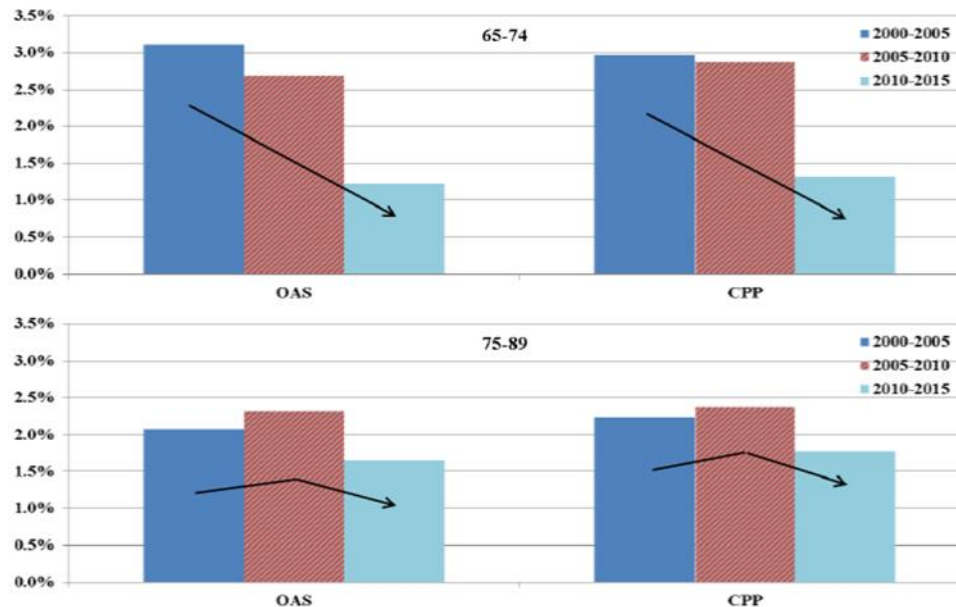
- **Canada Pension Plan** covers all workers except Quebec, and the Old Age Security Program covers 97% of Canadian Population 65+ (*Courtesy Assia Billig*)
- **Quebec** has its own statistics. They show that life expectancy at birth has not fallen (and almost always increased) over each five-year period from 1930 until 2015.

Courtesy Assia Billig, Actuary, OCA and OFI

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## *CPP-OAS Average Annual Mortality Improvement Rates (males)*



OSFI  
BSIF

Source: Office of the Chief Actuary calculations.

Office of the Chief Actuary Bureau de l'actuaire en chef

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***So a slowdown in improvements for over 65s in Canada***

Courtesy Assia Billig, Actuary, OCA and OFI

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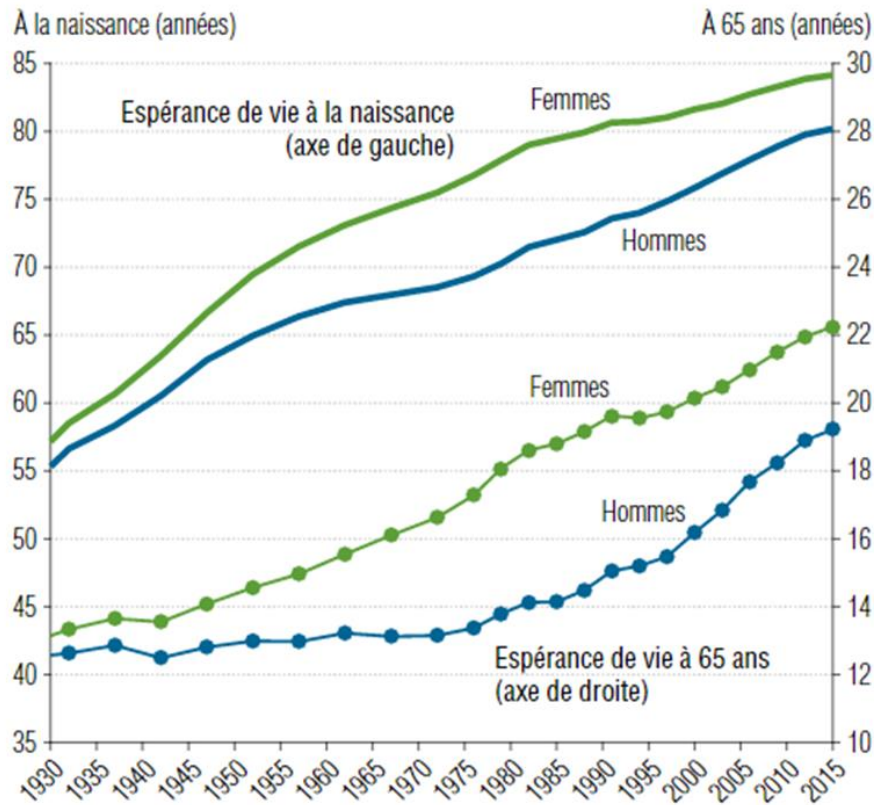


# Canada: Quebec



Figure 2

**Espérance de vie à la naissance et à 65 ans, Québec, 1930-2015<sup>p</sup>**



Sources : Base de données sur la longévité canadienne, adapté par Institut de la statistique du Québec (1930-1974) et Institut de la statistique du Québec (1975-2015).

Courtesy Assia Billig, Actuary, OCA and OFI

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# Canada: Quebec



## Quebec: Recent trends

Life expectancy at birth and at 65, Quebec (combined)

Improvement (months)

	at birth	at 65	at birth	at 65
2000-2002	79.1	18.5		
2005-2007	80.4	19.5	3.12	2.40
2010-2012	81.7	20.4	3.12	2.16
2013-2015	82.2	20.8	2.00	1.60
2015 est	82.2	20.8		

*So there appears to be a slowdown in improvements in Quebec*

1st 3 cols: [Décès et mortalité](#), chapitre 3 dans *Le bilan démographique du Québec*

Improvement: own calculation (different)

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# What countries?



UK constituent countries

Rest of Europe: France, Germany,  
Finland, Italy, Netherlands, Spain, Sweden

Australia

Canada

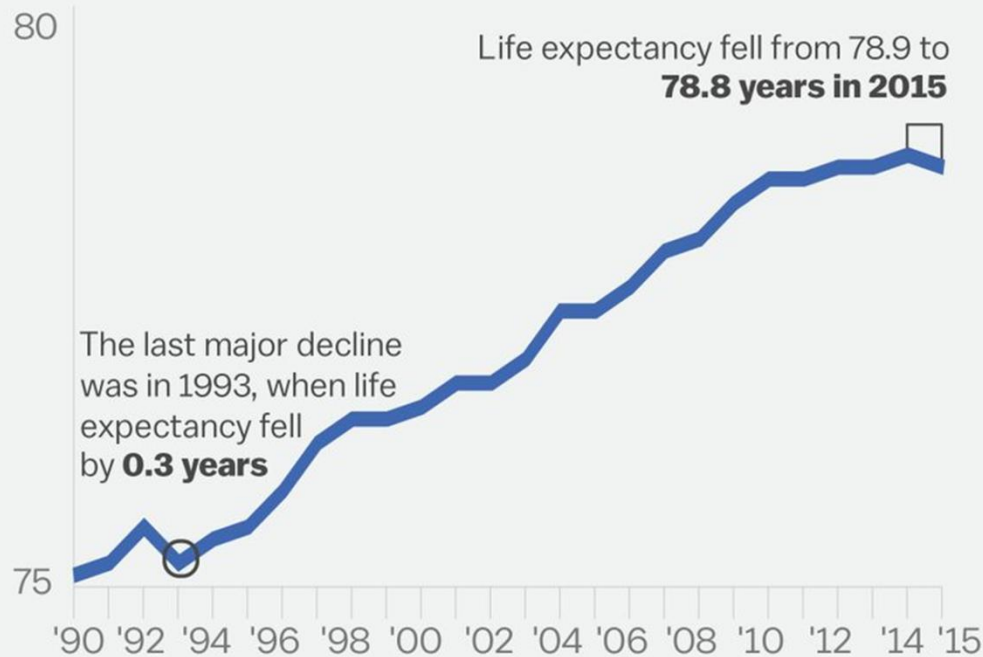
US



# US to 2015



## Life expectancy has improved in the US, but a 2015 dip shows that might be changing



Source: National Vital Statistics System  
Credit: Sarah Frostenson

Vox

Decline

Flattening of slope

# US to Q3 2016



What about 2016?

Age-adjusted mortality rates

2015 worsened by 1.2%

2016 improved by 1.3%

*Preliminary figures, subject to adjustment*

Source: Sam Gutterman: from US rapid release data

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# So, have longevity improvements reduced?



**In the past five years:**

UK England and Wales **yes**

Rest of Europe: France, Germany, etc  
but not Scandiavia ....., **likely**

Australia **maybe**

Canada **likely**

USA **yes**





# So, *why* have longevity improvements reduced?



## Is this just a “blip”?

Just excess winter mortality?

## Or is it a trend?



# Winter mortality in Europe 2014/17

Excess winter mortality affects age groups differently



**Winter excess deaths** have a major impact

See EuroMOMO = European monitoring of excess mortality for public health action

**Pooled estimates of weekly total number of all-cause deaths in the winter seasons**

Note particularly Winters of 2014/15 and 2016/17

Source: [EuroMOMO](#)

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Age band

0 – 4

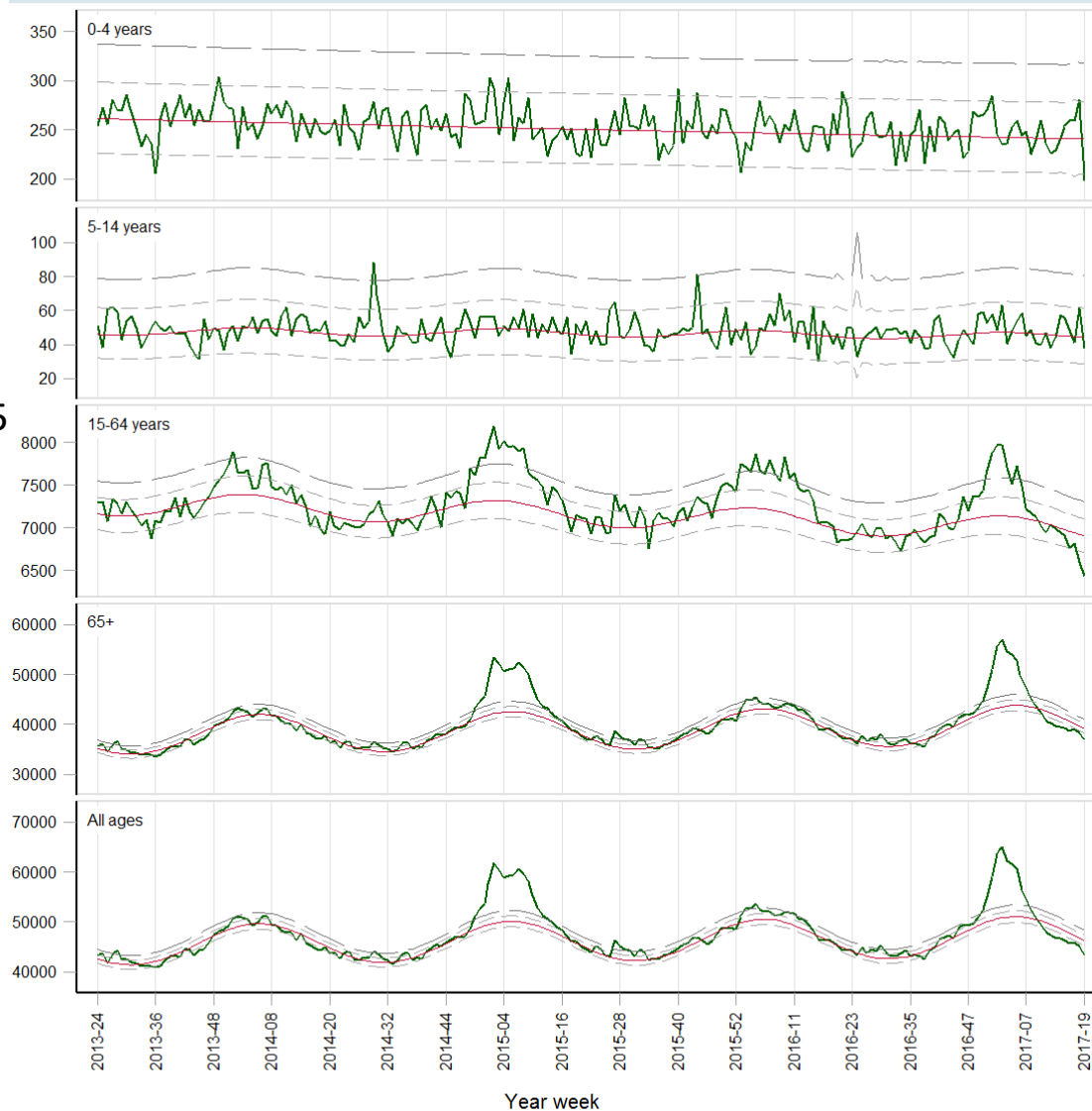
5 – 14

15 – 64

65 +

all ages

Winter 2014/15

Normal excess  
Winter mortalitySource: [EuroMOMO](http://euro-momocentre.org/)

— Stratified baseline

— Delay-adjusted number of deaths

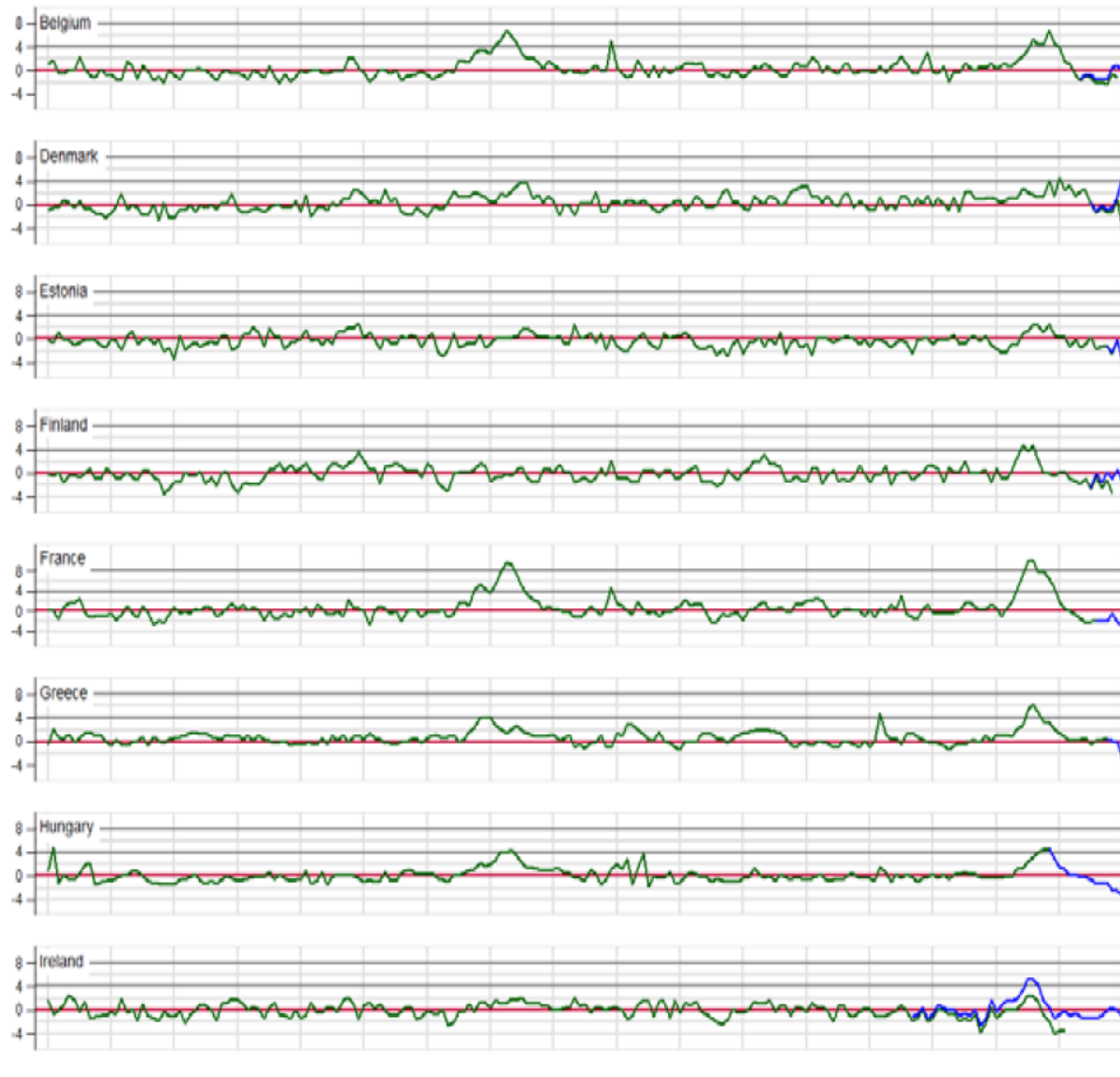
--- Normal range (+/- 2 z-scores)

--- Substantial increase (4 z-scores)

Winter 2016/17

**Participating countries:**

Belgium, Denmark, Estonia, Finland, France, Greece, Hungary, Ireland, Italy, Malta, Netherlands  
 Norway, Portugal, Spain, Sweden, Switzerland, UK (England), UK (Northern Ireland), UK (Scotland), UK (Wales)



Finland  
Excess winter mortality  
2016 week 47 –  
2017 week 7

# So, *why* have longevity improvements reduced?



## Is this just a “blip”?

Just excess winter mortality?

## Or is it a trend?

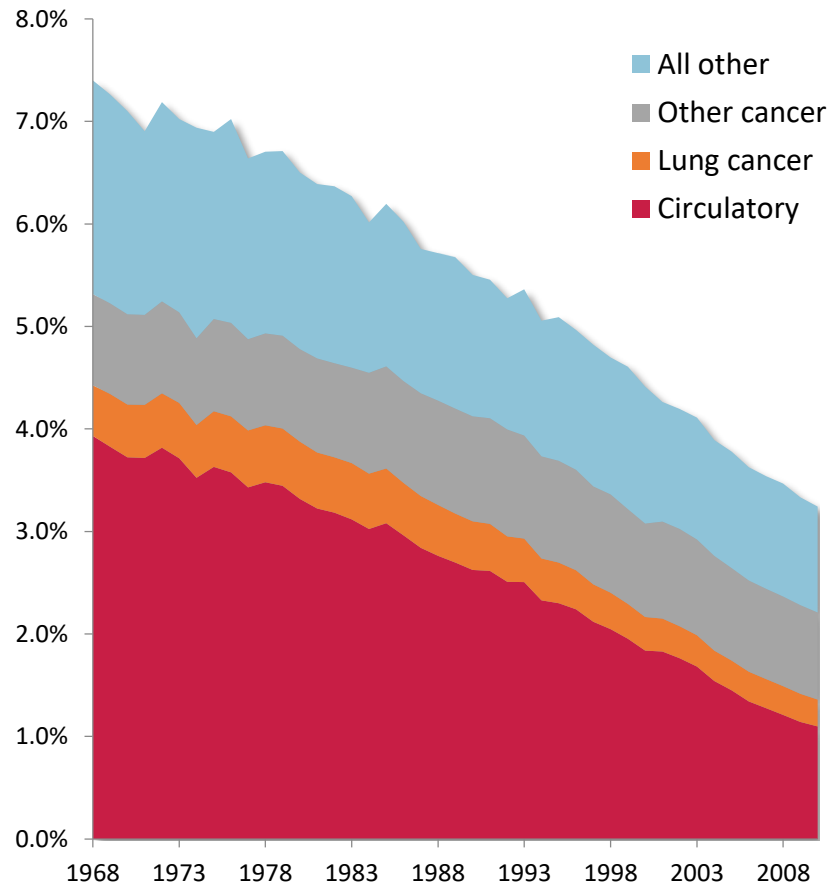
Look at overall *improvements* age 60 – 89 since 1968 ....

*Courtesy CMI, Richard Willets, Jon Palin*



# Improvements by cause of death

Age-standardized mortality rate for ages 60-89, males in England & Wales, by cause of death group, 1968 to 2010

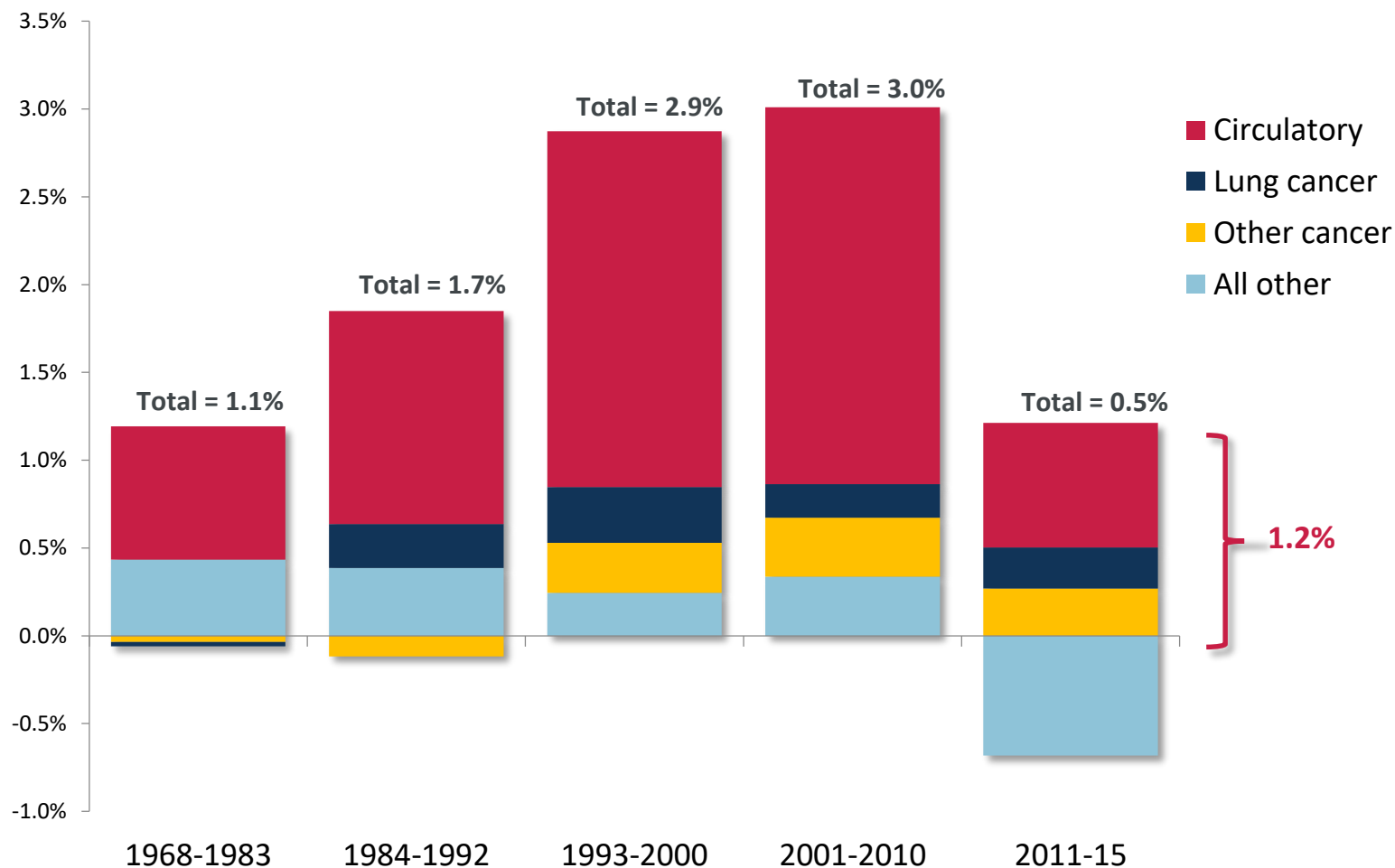


- In the period up to 2010 death rates from circulatory causes fell by up to 75%
- Around 70% of the total improvement was due to this
- The improvement was driven by a range of different factors, the most significant of which was reduced smoking
- The potential for future improvement in circulatory causes is more limited

Potential for future improvement

# Improvements by cause of death

Average annual rate of improvement for ages 60-89, males in England & Wales, decomposed by cause of death group, 1968 to 2015





# “just a blip”? UK 2015



**The possibility that the cuts to health and social care are implicated in almost 30,000 excess deaths is one that needs further exploration**

## What caused the spike in mortality in England and Wales in January 2015?

Lucinda Hiam<sup>1</sup>, Danny Dorling<sup>2</sup>, Dominic Harrison<sup>3</sup> and Martin McKee<sup>1</sup>

<sup>1</sup>London School of Hygiene and Tropical Medicine, London WC1E 7HT UK

<sup>2</sup>School of Geography and the Environment, University of Oxford, Oxford OX1 3QY, UK

<sup>3</sup>Blackburn with Darwen Borough Council, Blackburn BB1 1DH, UK

Corresponding author: Lucinda Hiam, Email: lucinda.hiam@lshtm.ac.uk

### Introduction

In the accompanying paper, we described the exceptionally large increase in mortality in England and Wales in 2015, showing how it was driven by deaths

Yugoslavia.<sup>1</sup> The apparent stagnation in life expectancy in Malta in the 1970s was due to a failure to update population estimates (J Mamo, personal communication). Problems with numerators most often affect cause specific death rates, due to changes in

*while the reduced efficacy of the influenza vaccine being used may have played some role in the January 2015 mortality spike, this is likely to have been limited.*

*the evidence points to a major failure of the health system, possibly exacerbated by failings in social care*

What caused the spike in mortality in England and Wales in January 2015? Hiam et al. Journal of Royal Society of Medicine, 2017

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# Is it a trend? UK



## Underfunded public health and care services - UK

- *“the evidence points to a major failure of the health system, possibly exacerbated by failings in social care”*
- *“The possibility that the cuts to health and social care are implicated in almost 30,000 excess deaths is one that needs further exploration”*

**Not a blip, a social care issue that may not be resolvable**

What caused the spike in mortality in England and Wales in January 2015? Hiam et al. Journal of Royal Society of Medicine, 2017

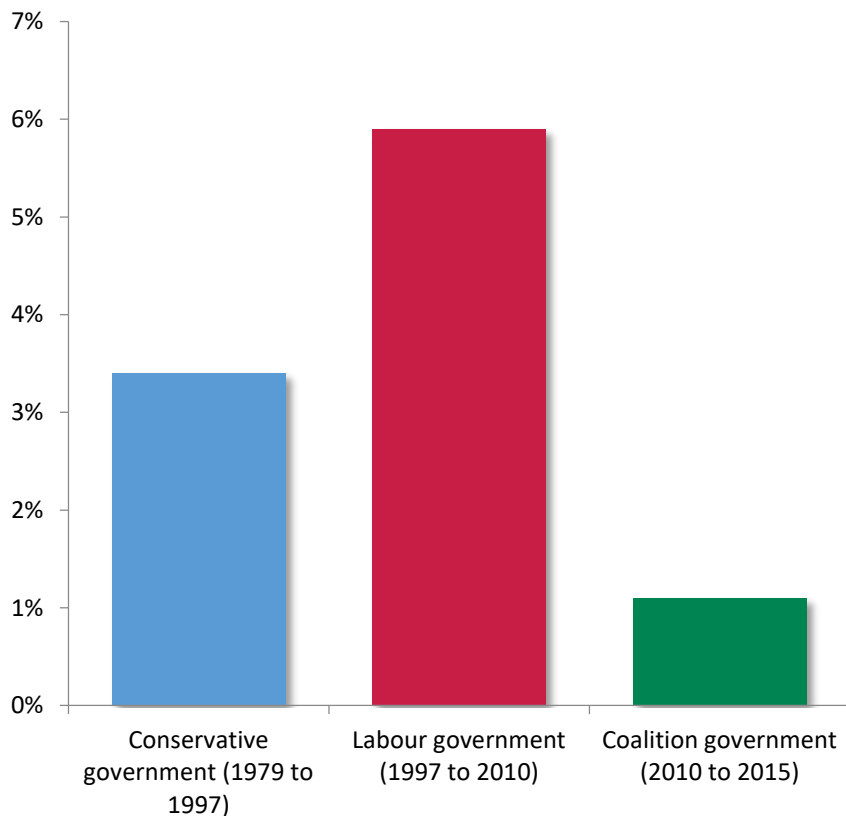
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# Correlation is not causation

Source: Richard Willets

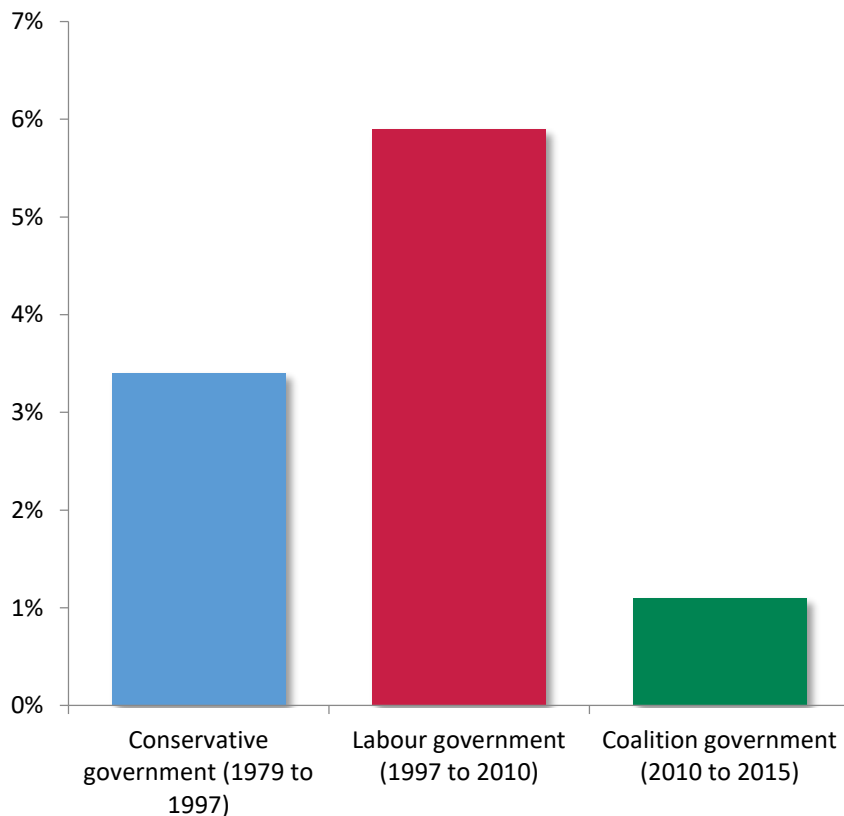
**Average annual increase in National Health Service (NHS) expenditure (source: IFS)**



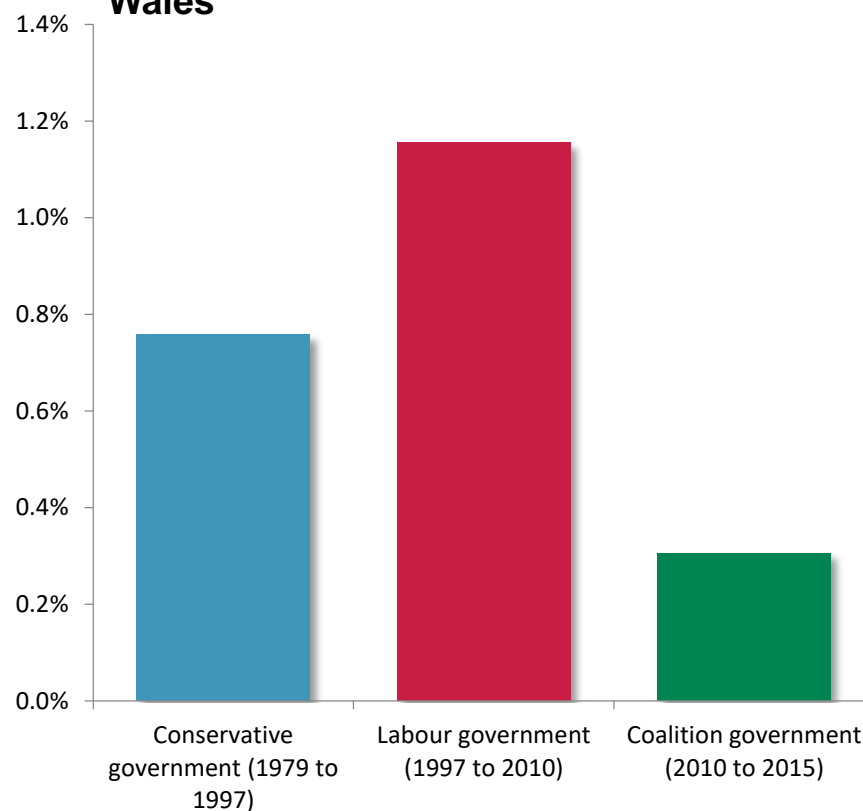
# Correlation is not causation

Source: Richard Willets

**Average annual increase in NHS expenditure (source: IFS)**



**Average annual increase in life expectancy at age 65, England & Wales**



# Concluding thoughts from Richard Willets, Expert Longevity Consultant, Just

- The deceleration can be partly explained by the reduced contribution to aggregate improvements from circulatory causes
- This has been exacerbated by mortality increases in a range of miscellaneous causes
- Therefore the fall in improvements can be seen as:-
  - a reversion to a more typical aggregate rate of change (following a period of unusually rapid improvement); plus
  - the impact of economic austerity (NHS & social care funding)
- Therefore lower improvements are not likely to be temporary (i.e. they are not a 'blip')
- There is a case to reduce the value of the 'smoothing parameter' when using CMI\_2016

# So, why have longevity improvements reduced?



Is this just a “blip”?

Just excess winter mortality

**Or is it a trend?**

Underfunded public health and care services - **UK**

Social change



# Is it a trend? U.S.

## Mortality in the United States, 2015



- Life expectancy for the U.S. population in 2015 was 78.8 years, a decrease of 0.1 year from 2014.
- The age-adjusted death rate increased 1.2% from 724.6 deaths per 100,000 standard population in 2014 to 733.1 in 2015.
- The 10 leading causes of death in 2015 remained the same as in 2014. Age-adjusted death rates increased for eight leading causes and decreased for one.



NCHS Data Brief No. 267 2016 Data from the National Vital Statistics System

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# Is it a trend? U.S.

## Rising mortality for US White non-Hispanics



US has seen rising mortality.

Could it be flu or other transitory causes, or something deeper?

“Rising morbidity and mortality in midlife among white non-Hispanic Americans in the 21st century” Case and Deaton

Case, A.; Deaton, A. (2015). [Rising morbidity and mortality in midlife among white non-Hispanic Americans in the 21st century](#). Proceedings of the National Academy of Sciences (2015) 112

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# Is it a trend? U.S.

## Rising mortality for US White non-Hispanics



**“Rising morbidity and mortality in midlife among white non-Hispanic Americans in the 21st century” Case and Deaton**

- 1. Compares the mortality for 45 to 54 year-old US White non-Hispanics, US Hispanics against population of six other countries**  
All-cause mortality, ages 45–54 for US White non-Hispanics (USW), US Hispanics (USH), and six comparison countries: France (FRA), Germany (GER), the United Kingdom (UK), Canada (CAN), Australia (AUS), and Sweden (SWE).

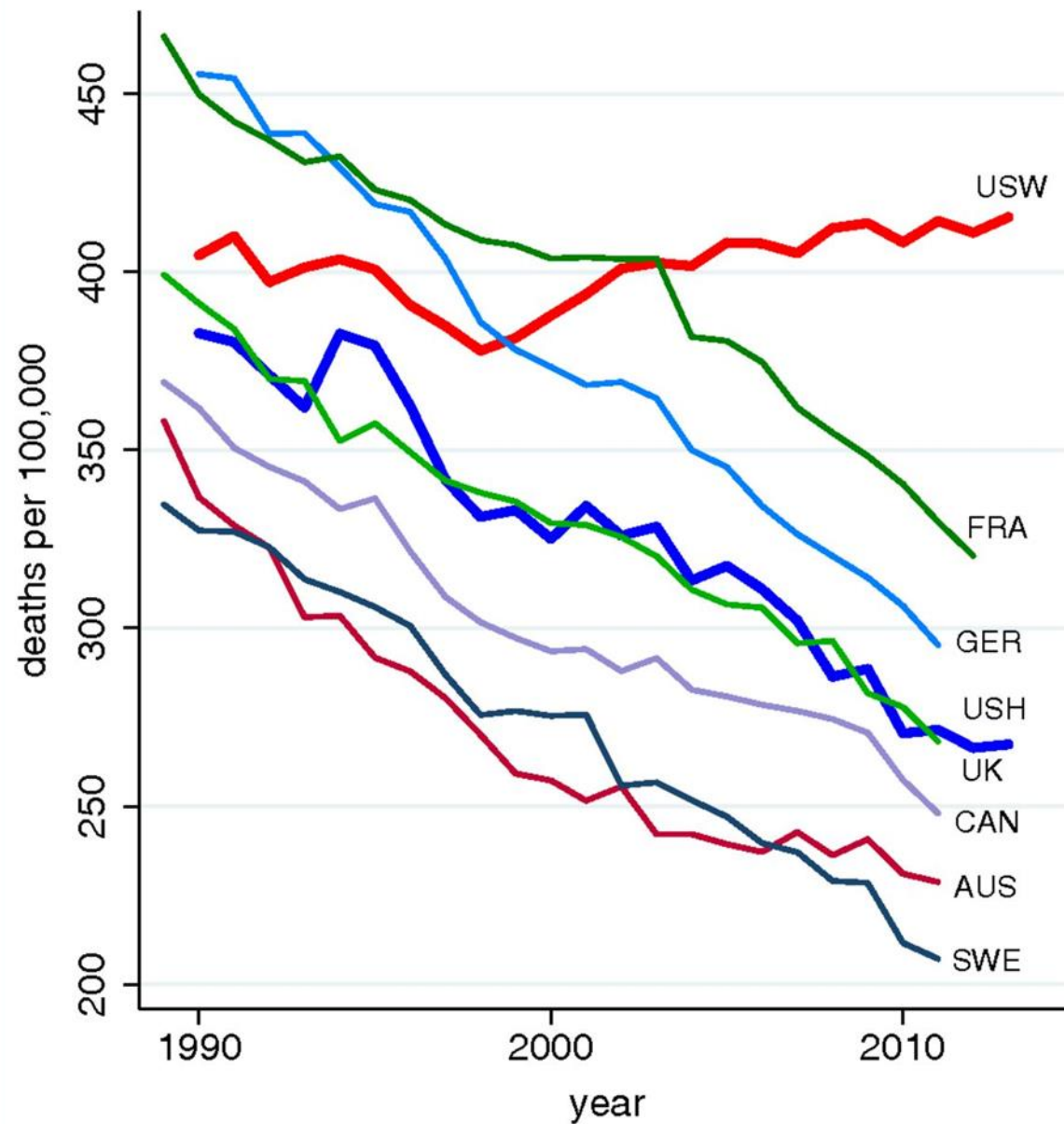
## **2. Causes of death?**

**Mortality by cause, white non-Hispanics ages 45–54.**

Case, A.; Deaton, A. (2015). [Rising morbidity and mortality in midlife among white non-Hispanic Americans in the 21st century](#). Proceedings of the National Academy of Sciences (2015) 112

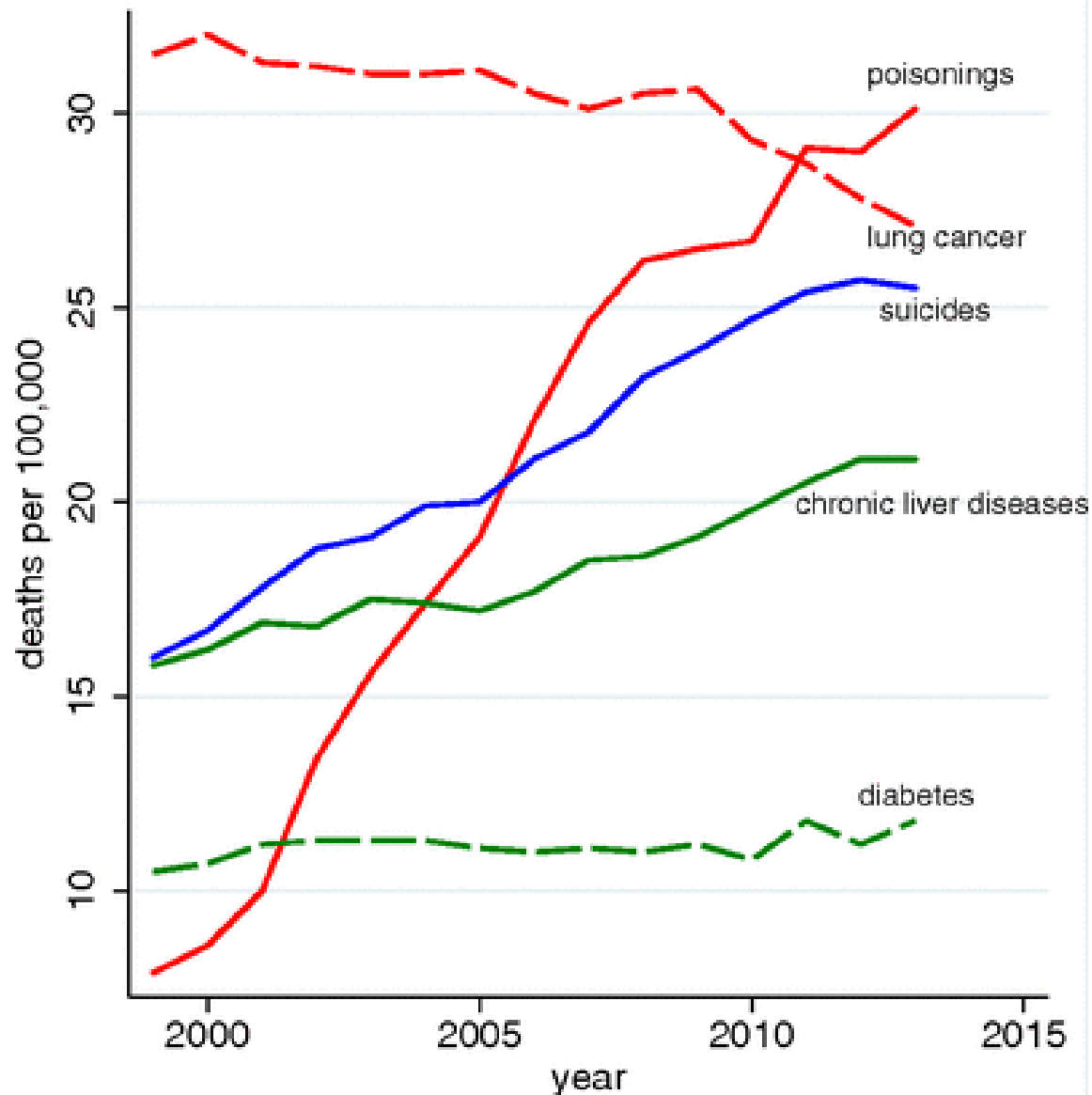
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Case, A.; Deaton, A. (2015). [Rising morbidity and mortality in midlife among white non-Hispanic Americans in the 21st century](#). Proceedings of the National Academy of Sciences (2015) 112

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# Is it a trend? U.S.

## Rising mortality for US White non-Hispanics



So: The change in all-cause mortality for white non-Hispanics 45–54 is largely accounted for by an increasing death rate from external causes, mostly increases in drug and alcohol poisonings and in suicide.

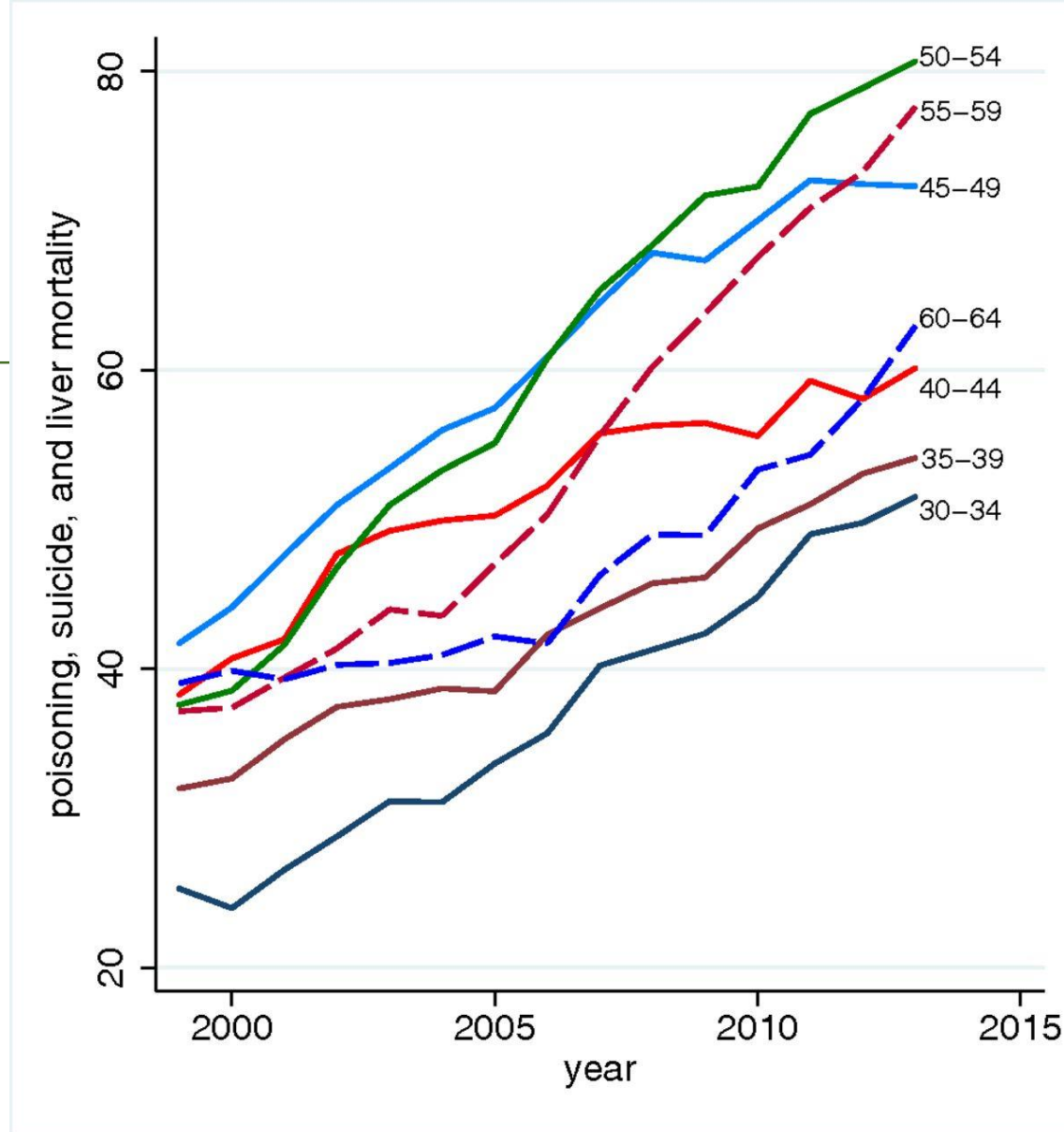
**And:** all 5-y age groups between 30–34 and 60–64 have witnessed marked and similar increases in mortality from the sum of drug and alcohol poisoning, suicide, and chronic liver disease and cirrhosis over the period 1999–2013 **That's not a blip**



Case, A.; Deaton, A. (2015). [Rising morbidity and mortality in midlife among white non-Hispanic Americans in the 21st century](#). Proceedings of the National Academy of Sciences (2015) 112

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Case, A.; Deaton, A. (2015). [Rising morbidity and mortality in midlife among white non-Hispanic Americans in the 21st century](#). Proceedings of the National Academy of Sciences (2015) 112

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# Is it a trend? U.S.

## Rising mortality for US White non-Hispanics



**all 5-y age groups between 30–34 and 60–64** have witnessed marked and similar increases in mortality from the sum of drug and alcohol poisoning, suicide, and chronic liver disease and cirrhosis over the period 1999–2013

*That's not a blip!*



Case, A.; Deaton, A. (2015). [Rising morbidity and mortality in midlife among white non-Hispanic Americans in the 21st century](#). Proceedings of the National Academy of Sciences (2015) 112

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# So, why have longevity improvements reduced?



## Is it a trend?

Underfunded public health and care services - **UK**

Social change – **US**

And what are actuaries doing about it?





## **Flawed longevity assumptions could be adding extra £25bn to DB pension deficits**

“ ... assuming people will live four months longer than they actually will,...”  
Club Vita

## **Slowdown in improving life expectancy could cut pension deficit by £28bn**

Mercer.

## **High mortality rates challenge the way life insurers project longevity**

.. survey results on what insurers are currently projecting for long-term improvements in the UK – Willis Towers Watson – Nov 2016



## **Schemes should be cautious of longevity mispricing - Aon Hewitt Pensions Age Feb 2017**

“Pension schemes should review lower rates of UK mortality improvement to ensure fair pricing of longevity insurance transactions, Aon Hewitt has reiterated.”

## **Medical science boosts longevity predictions, improving pricing accuracy WillisTowersWatson April 2016**

Willis Towers Watson has developed the first widely-available mortality model to use medical science and the views of medical experts to improve predictiveness. The model, called PulseModel, incorporates the impact of medical conditions, such as diabetes, to inform future mortality patterns and is designed to help insurance companies and pension funds accurately price insurance cover, calculate liabilities and manage risk.



## Mortality Projections

New CMI Model 2016

- CMI\_2016 (published March 2017)
  - Essentially similar to previous version of the model, although ...
    - ... faster, simpler, more transparent, more useable, pure Excel/VBA
  - The Core model is slightly less responsive than before, but ...
    - ... responsiveness can now be adjusted explicitly by users

# Impact of CMI\_2016

## Impact on life expectancy *projections* of moving to CMI\_2016

	Projection	Age					
		35	45	55	65	75	85
Male	CMI_2014	-2.25%	-2.52%	-2.72%	-2.54%	-2.33%	-4.38%
	CMI_2015	-1.73%	-1.86%	-1.88%	-1.31%	-0.49%	-2.46%
Female	CMI_2014	-2.98%	-3.12%	-3.19%	-3.35%	-3.39%	-5.76%
	CMI_2015	-2.40%	-2.41%	-2.27%	-2.00%	-1.47%	-3.78%

*Life expectancies are based on the Core model using an illustrative long-term rate of 1.5% p.a. applied to S2PMA / S2PFA base.*

*Source: CMI Working Paper 97.*

*Courtesy Jon Palin, CMI*



# How long can mortality improvement continue?

Fenton et al, WillisTowersWatson June 2016

## Historical mortality improvement

Mortality improvement from 2000 to 2010, and from 2010 to 2014. The difference shown is calculated as the most recent range less the previous decade, 2000 to 2010.

Historical mortality improvement								
Period	Gender	25 – 34	35 – 44	45 – 54	55 – 64	65 – 74	75 – 84	85+
2000–2010	Male	–0.2%	1.8%	0.7%	1.3%	2.7%	2.0%	1.3%
	Female	–0.1%	1.0%	0.0%	1.8%	2.3%	1.5%	1.1%
2010–2014	Male	–1.3%	–0.5%	0.5%	–0.5%	1.1%	1.5%	1.3%
	Female	–1.2%	–1.0%	–0.3%	–0.6%	1.4%	1.1%	0.9%
Difference	Male	–1.1%	–2.3%	–0.2%	–1.9%	–1.5%	–0.5%	0.0%
	Female	–1.2%	–2.0%	–0.4%	–2.4%	–0.9%	–0.4%	–0.2%

[Fenton et al](#), WillisTowersWatson June 2016

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## Updated views on future mortality improvement

Fenton et al, WillisTowersWatson June 2016

### Projected mortality improvement

“.. projected future mortality improvement rates using our COD model to reflect recent historical experience”

Projected Mortality Improvement on Age-Based Approach								
Period	Gender	25 – 34	35 – 44	45 – 54	55 – 64	65 – 74	75 – 84	85+
2000–2014 (Actual)	Male	–0.5%	1.2%	0.6%	0.8%	2.2%	1.8%	1.3%
	Female	–0.4%	0.5%	–0.1%	1.1%	2.0%	1.4%	1.0%
2014–2024 (Projected)	Male	–0.3%	0.8%	0.6%	0.7%	1.7%	1.3%	0.6%
	Female	–0.5%	0.2%	–0.1%	0.8%	1.3%	0.7%	0.2%

Future mortality rates are projected to continue to show a decline in improvement levels and, in a few cases, deterioration.

[Fenton et al](#), WillisTowersWatson June 2016

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## Conclusions

There are Winter Excess Mortality effects but:

Longevity improvements faltering in some countries

Effects differ by: age group, gender, socio-economic group, location

Underlying causes unlikely to disappear

Impact on insured and pensioner populations differ:

- different subsets of the population

- exposure by “amounts” higher for higher socio-economic groups

And need separate consideration



# Is longevity *still* improving?



## With thanks to:

Adrian Gallop, Jon Palin, Richard Willets, Magali Barbieri, Assia Billig, Al Klein, Sam Gutterman, Michael Sherris, Kriszti Halay, David Raymont, Jari Niittuinperä and many others



# Current Developments in Aging and Mortality

Helsinki 23 May 2017



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