



Society of Actuaries in Ireland

Drivers of Future Longevity
A Medical Perspective

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Disclaimer

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Quiz

In 2015, what was the average life expectancy at birth of the global population?

1. 76.8 years (average life expectancy in the European region)
2. 71.4 years
3. 67.7 years (global life expectancy at birth in 2000)
4. 81.4 years (average life expectancy in Ireland)

Quiz

Which country currently has the total **longest** life expectancy?

1. Japan

2. Switzerland (longest male life expectancy – 81.3 years)

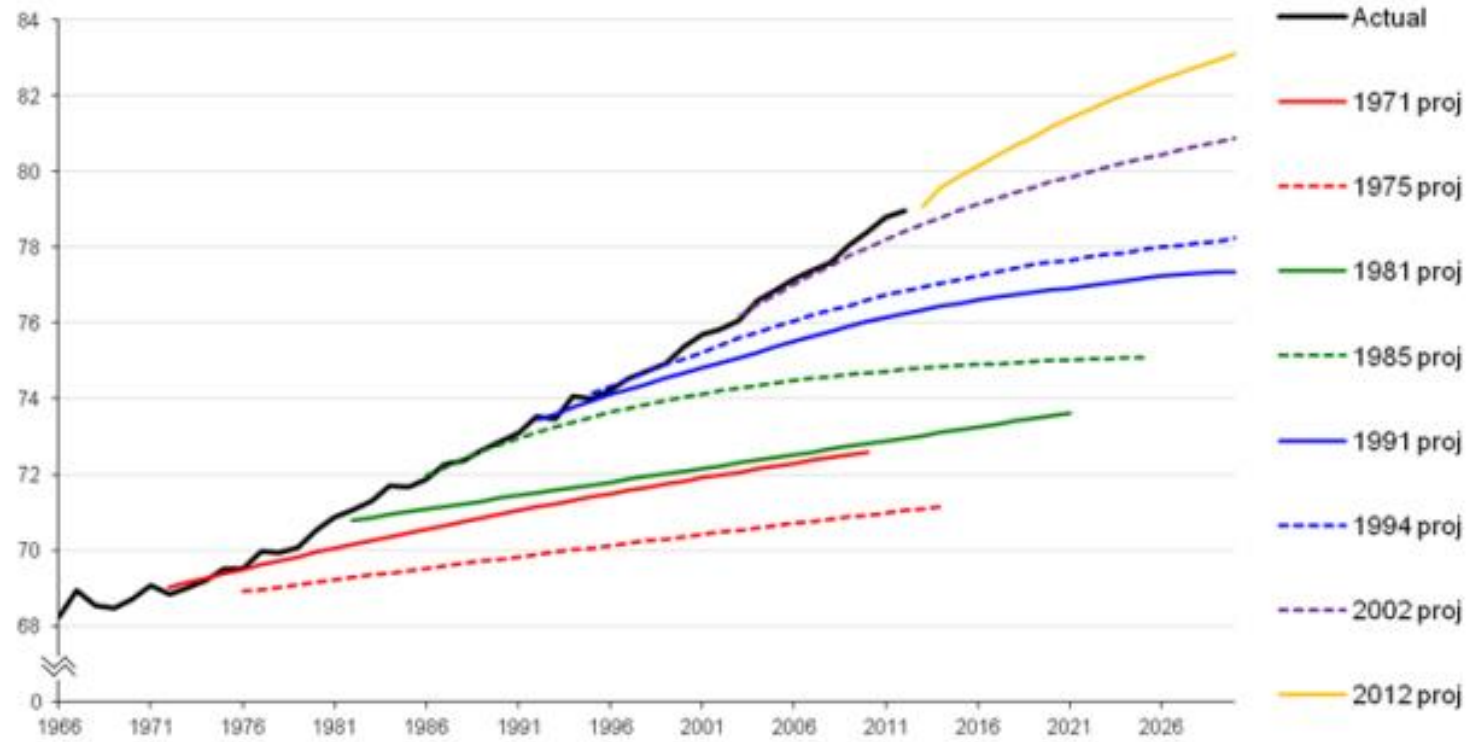
3. Norway (longest life expectancy in 1960 – 73.6 years)

Quiz

What is the socio-economic gap in male life expectancy at birth in Ireland?

1. 3.7 years (gender gap in the UK)
2. 5.0 years (gender gap in Ireland)
3. 6.1 years
4. 7.3 years (US gap between highest and lowest educational groups)

Why this presentation?

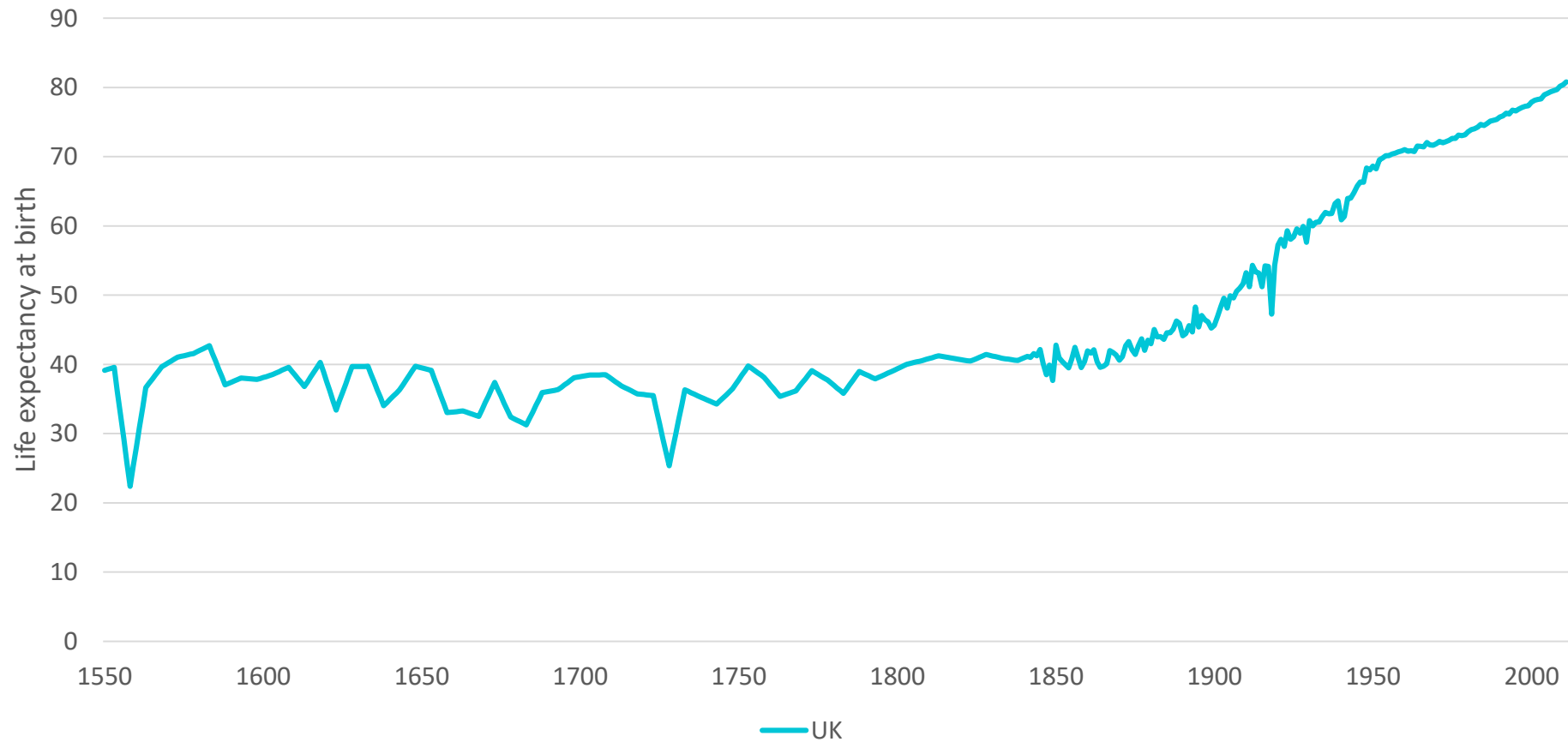


Source: ONS, National Population Projections Accuracy Report, July 2015

Drivers of Future Longevity

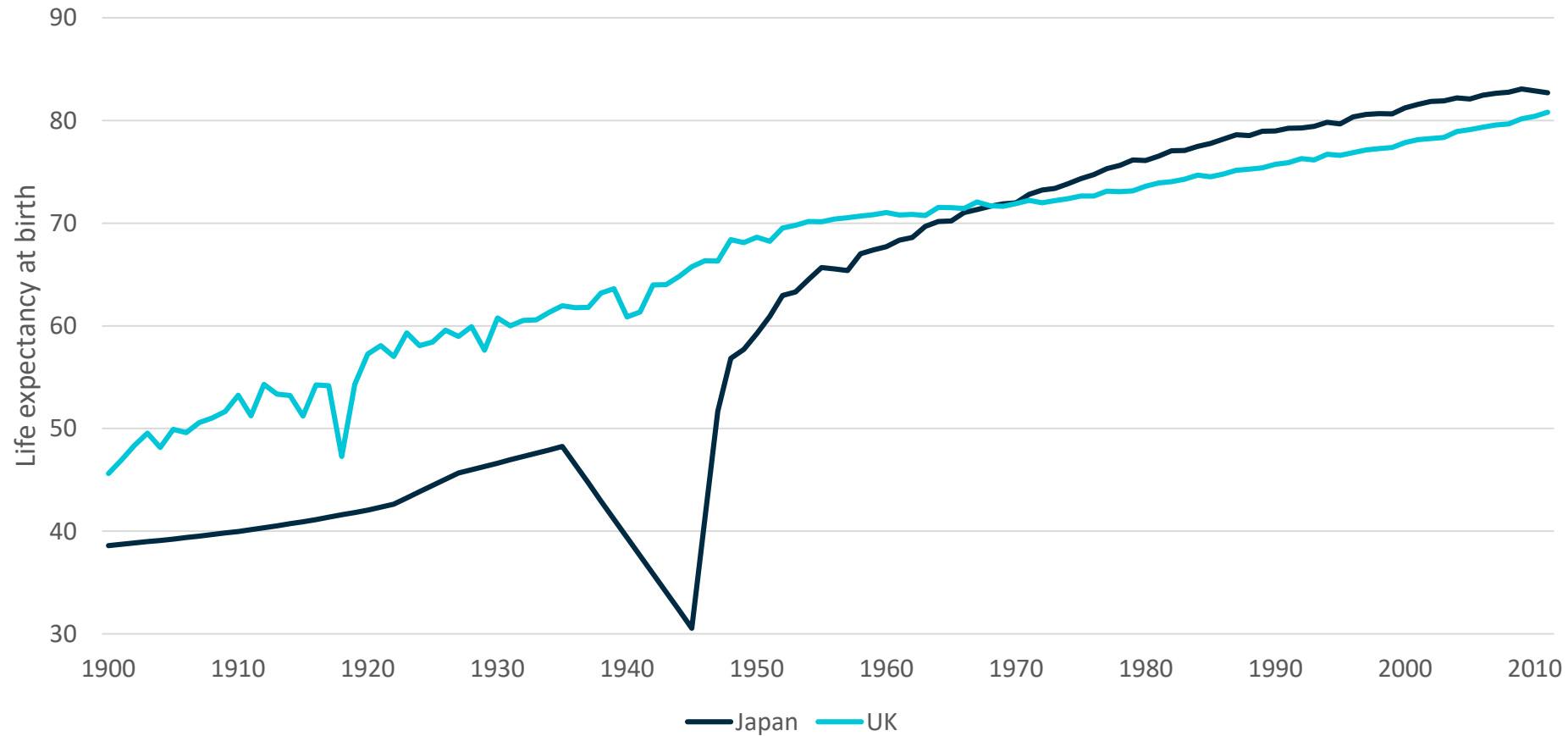
- Introduction: A Look Back
- Medical Progress
- Socio-economic Influences
- Medical Progress – the Next Generation
- Conclusion

Development of Life Expectancy



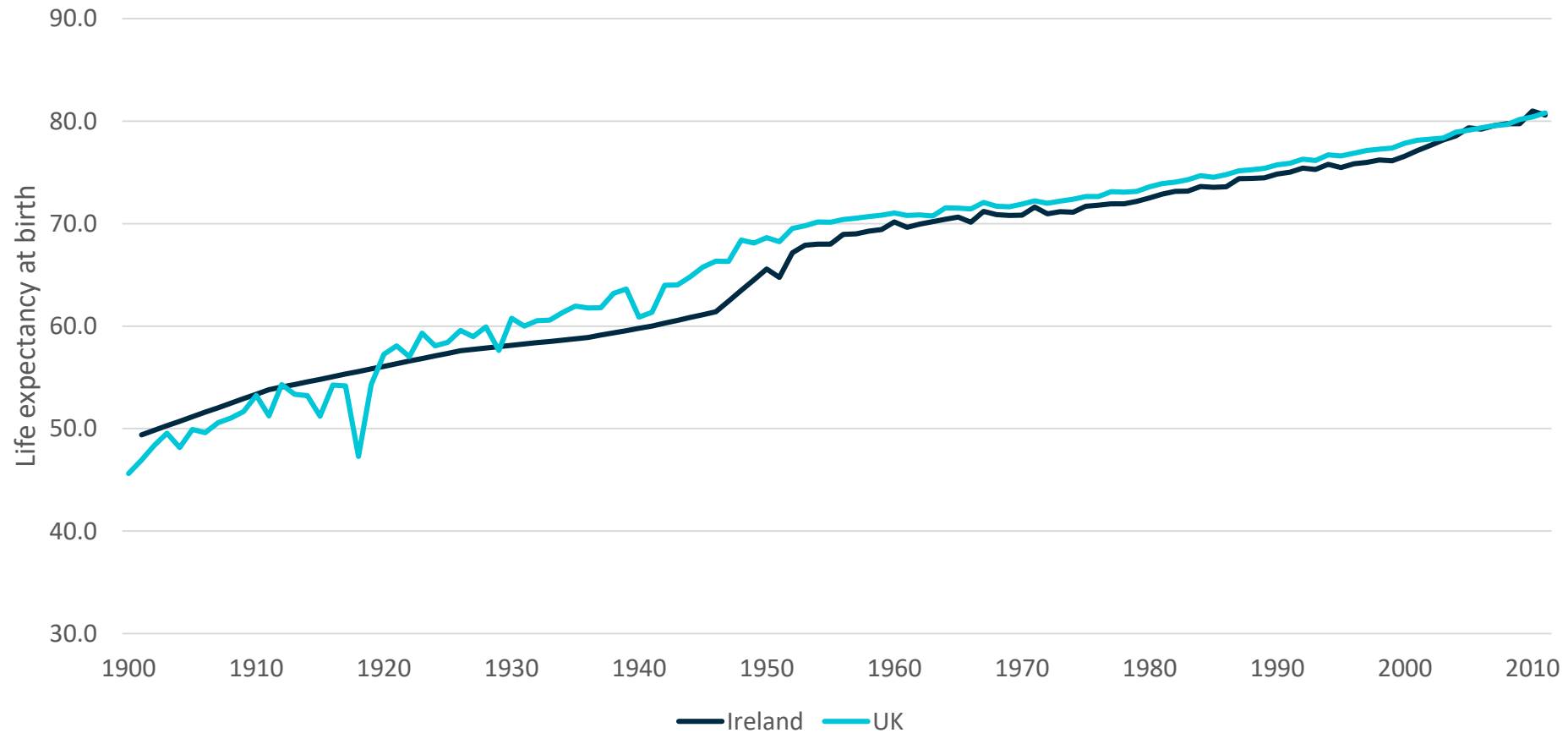
Source: OurWorldInData.org

Development of Life Expectancy



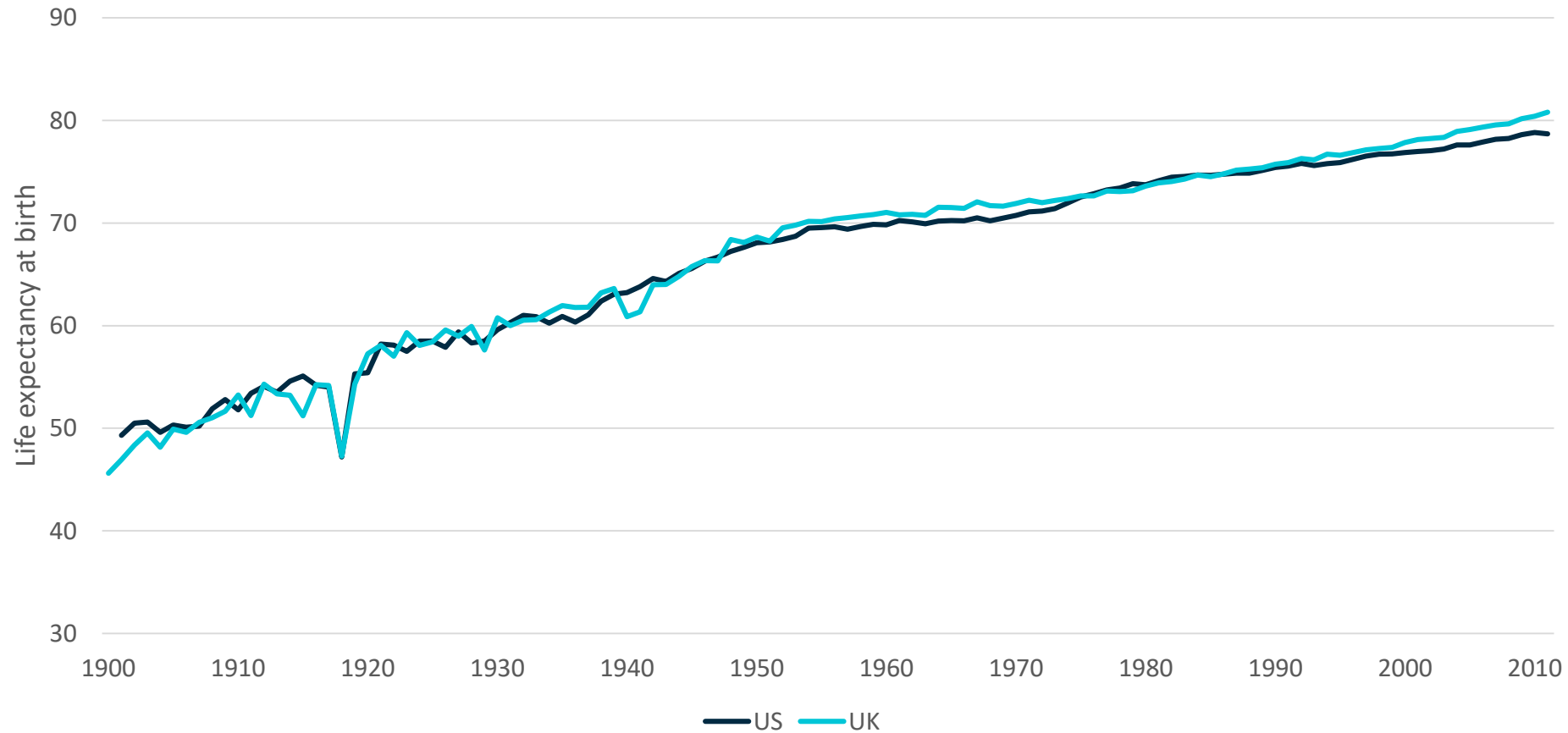
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Development of Life Expectancy



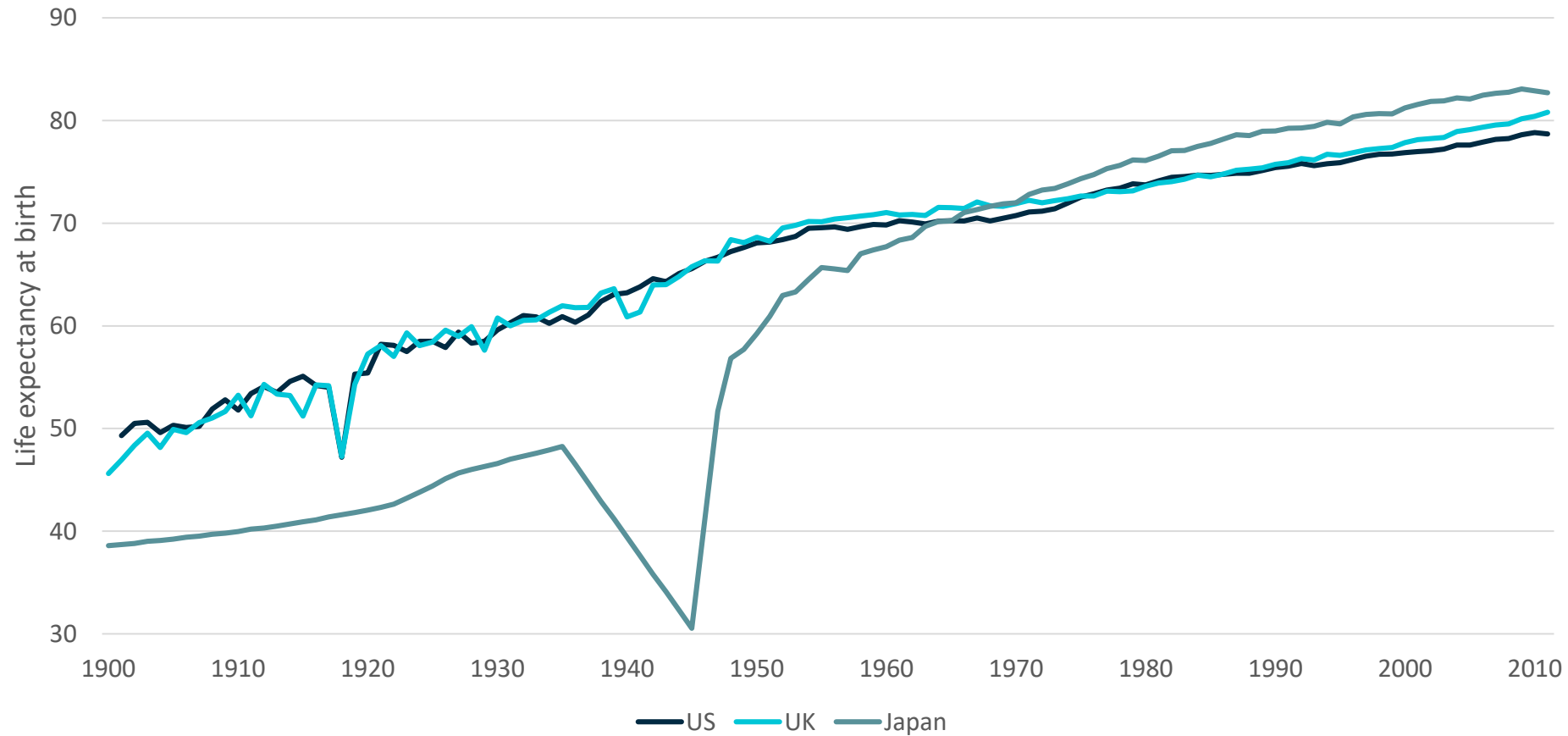
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Development of Life Expectancy



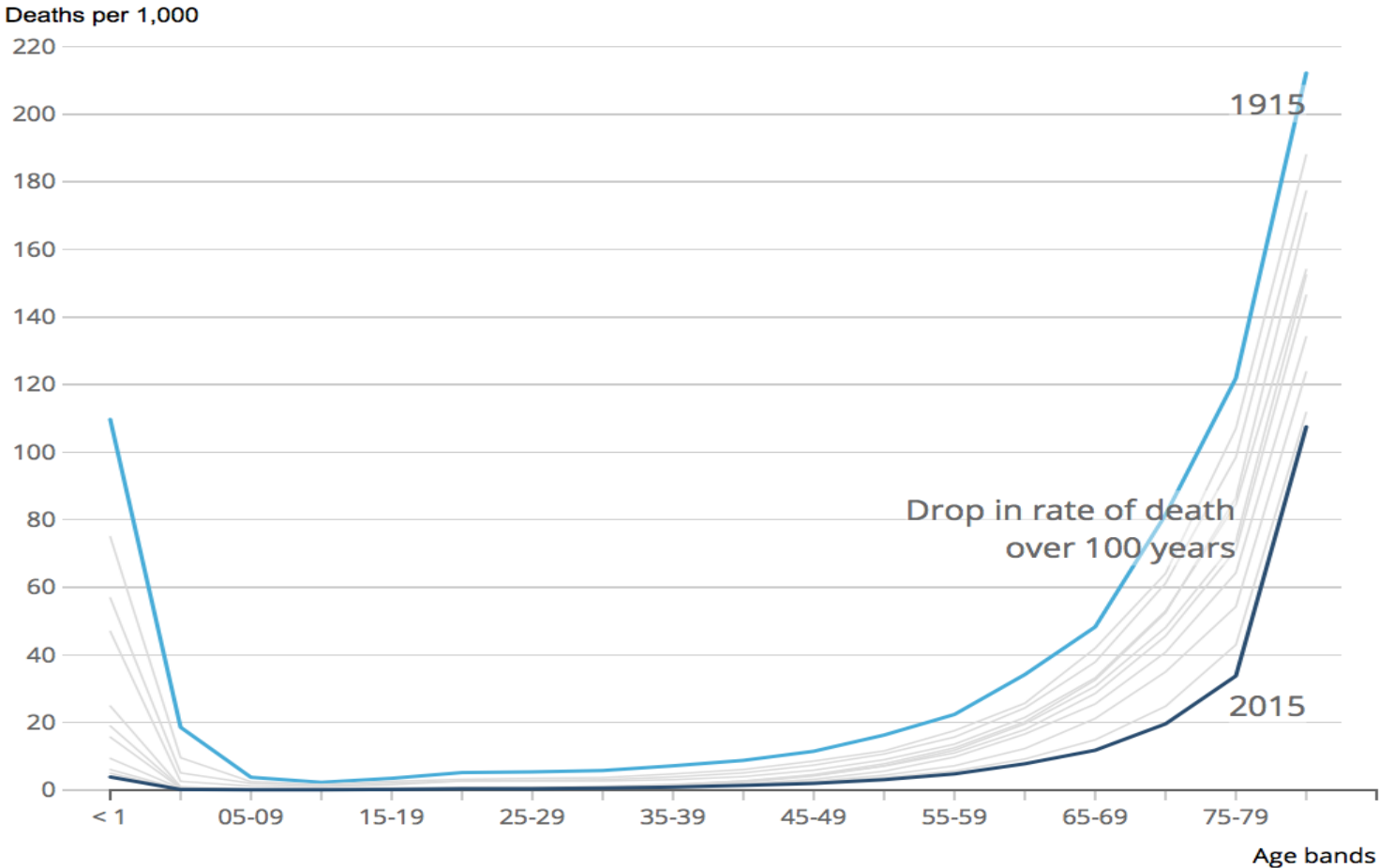
Source: OurWorldInData.org

Development of Life Expectancy



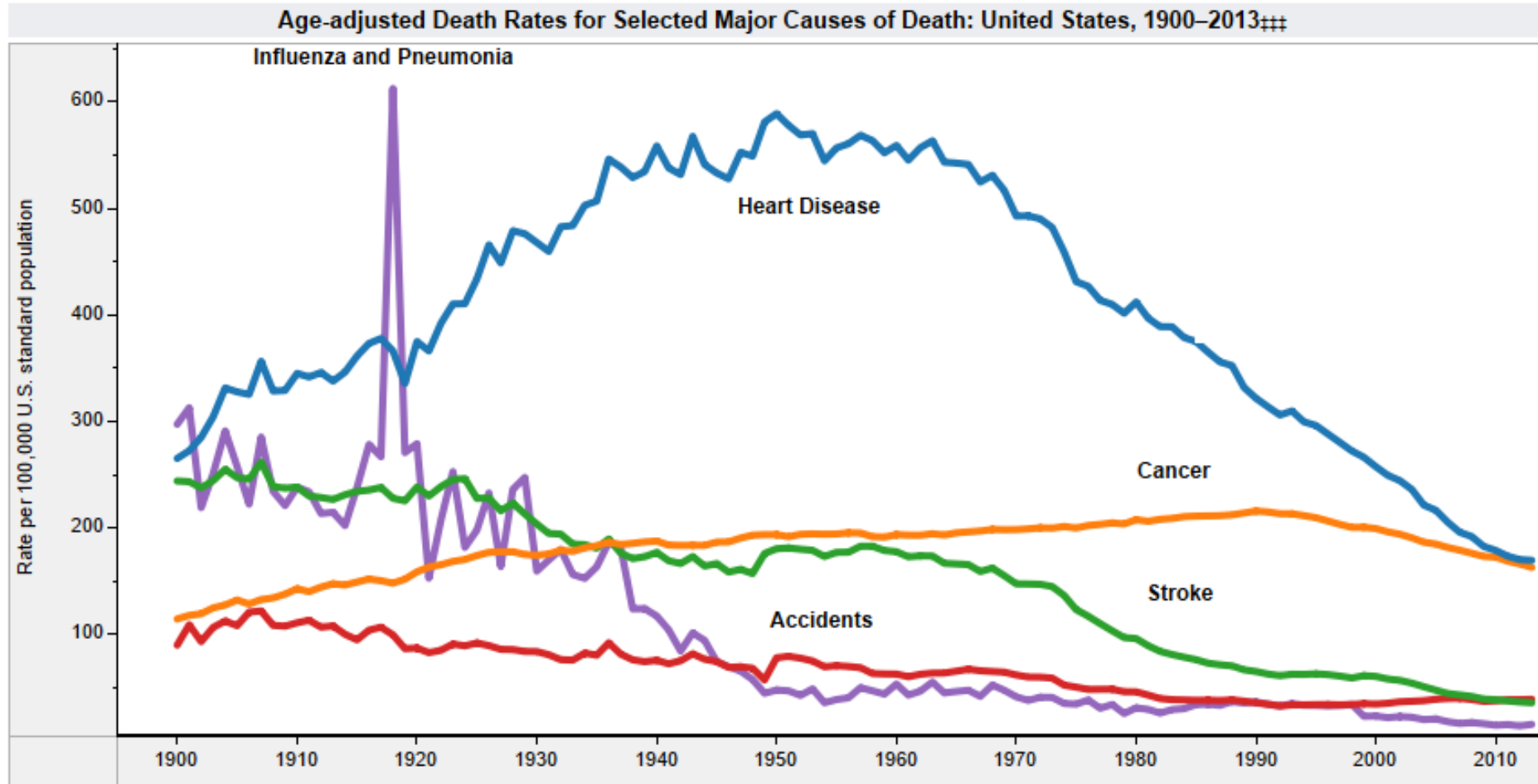
Source: OurWorldInData.org

Death rate by age, England and Wales, 1915 to 2015



Source: 21st century mortality files, ONS and 20th century mortality files, ONS

What happened in the 20th century?

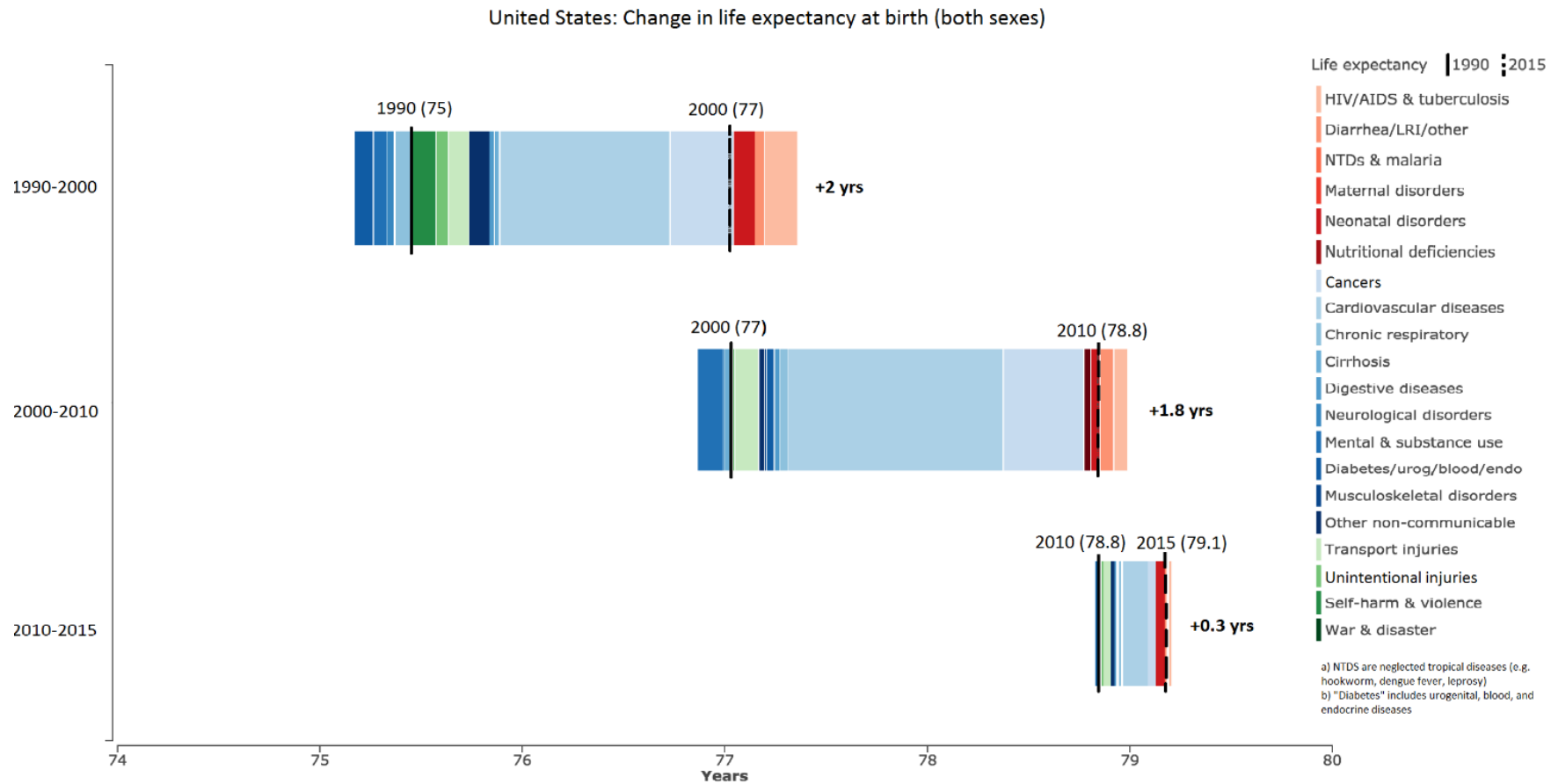


Source: CDC

Drivers of Future Longevity

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Gains in life expectancy are dropping



Source: Institute for Health Metrics and Evaluation

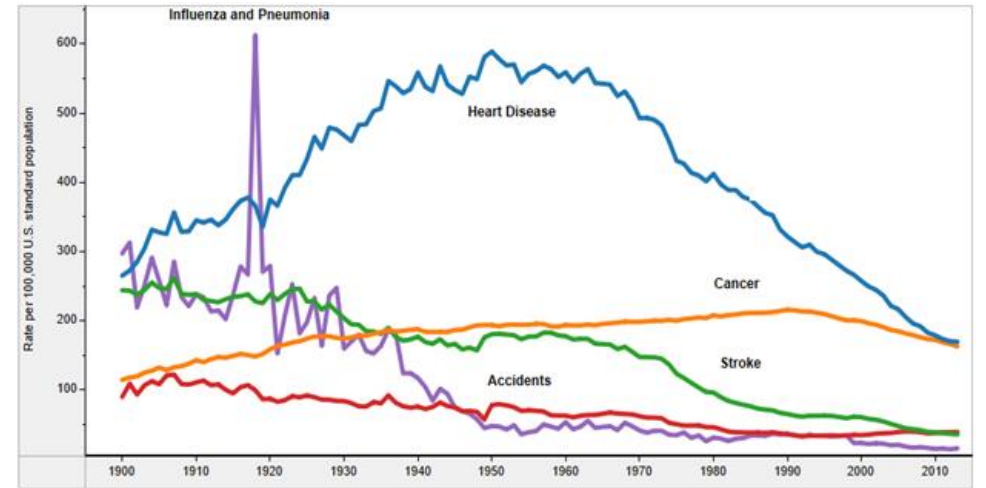
Heart Disease: Past and Present

- Medical innovations:

- Coronary Artery Disease (CAD)
 - investigation & treatment:
 - coronary angiogram, CAC, clot busters, CABG & stents
- Controlling BP & new drugs; ACE inhibitors
- Lipid research & treatment with statins
- Heart rhythm control:
 - atrial fibrillation, anticoagulants, pacemakers, ICD

- Public Health & Lifestyle

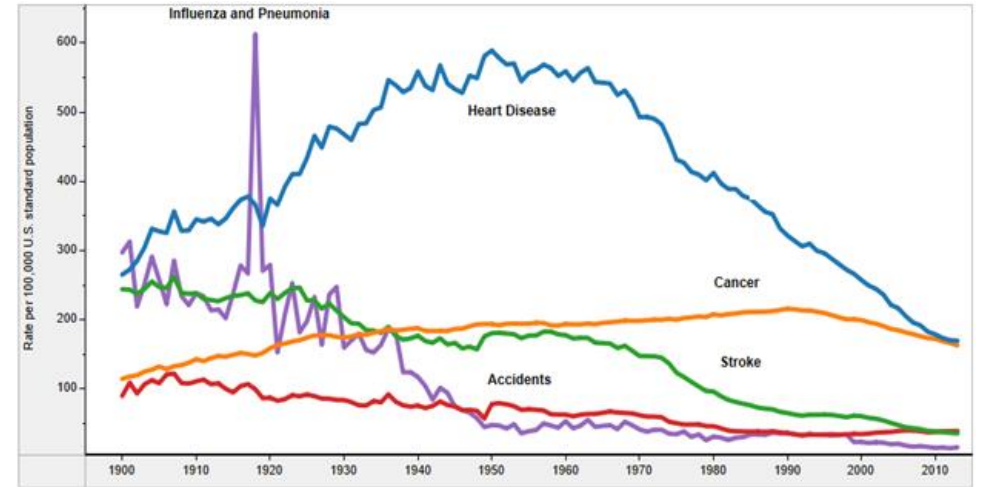
- Education and the importance of smoking cessation, diet & exercise
- Screening for BP, cholesterol, arrhythmias & diabetes



Heart disease: future

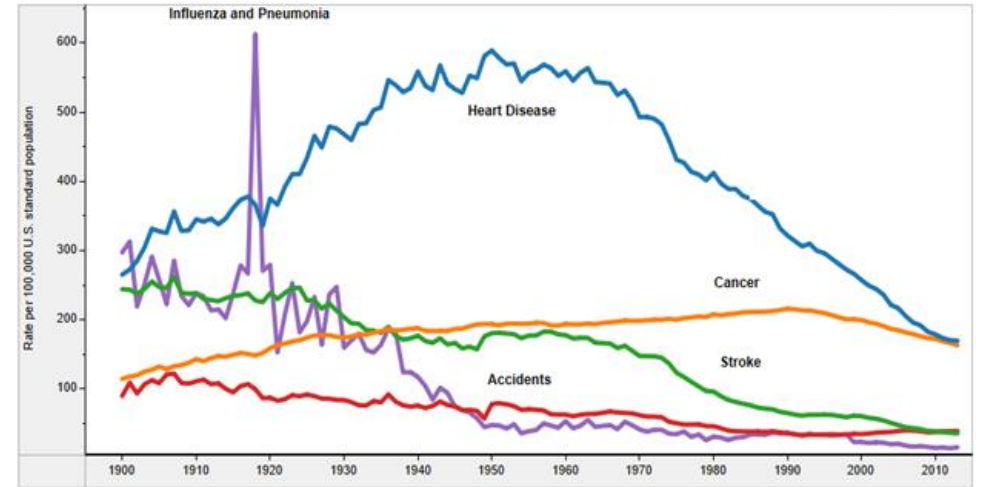
- Future

- Primary goal is prevention of CAD
- Existing disease cannot be reversed
- Innovations in medical treatment will benefit, but...
- Most gains through CV risk factor reduction and treatment
- Challenge of public inertia to healthy diet, weight loss, exercise and smoking cessation
- Political role, e.g. Sugar Tax, banning soft drinks in schools, smoking in public places, and more?
- Continued mortality improvement may prove but it's difficult with the obesity epidemic



Cancer: present and future

- Medical innovations
 - Early detection:
 - screening – mammography, PSA, occult blood, chest X-ray, family history
 - Improved imaging techniques
 - Surgical improvements & more localized treatment
 - Chemotherapy, radiotherapy & others



Trends in 5-year Relative Survival Rates (%), 1975-2012

Site	1975-1977	1987-1989	2006-2012
All sites	49	55	69
Breast (female)	75	84	91
Colorectum	50	60	66
Leukemia	34	43	63
Lung & bronchus	12	13	19
Melanoma of the skin	82	88	93
Non-Hodgkin lymphoma	47	51	73
Ovary	36	38	46
Pancreas	3	4	9
Prostate	68	83	99
Urinary bladder	72	79	79

Source: American Cancer Society & SEER

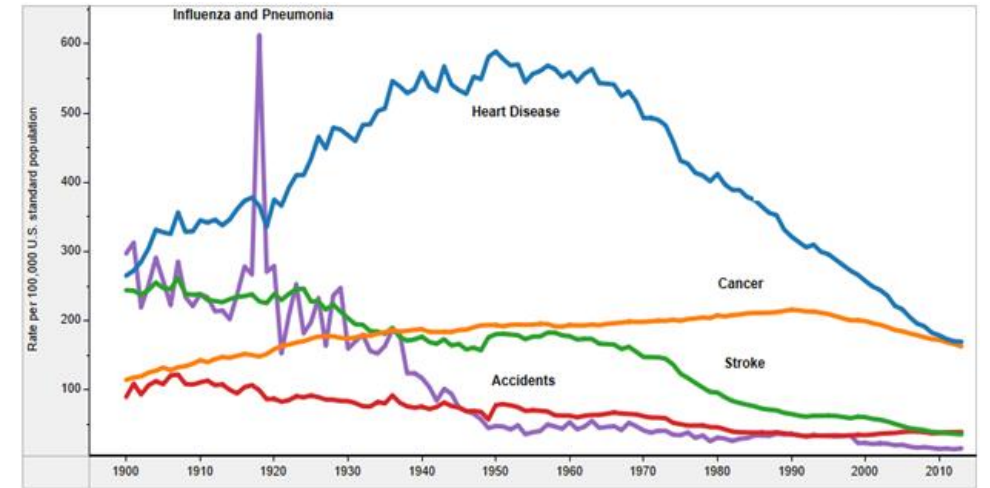
Cancer: present and future

- Future

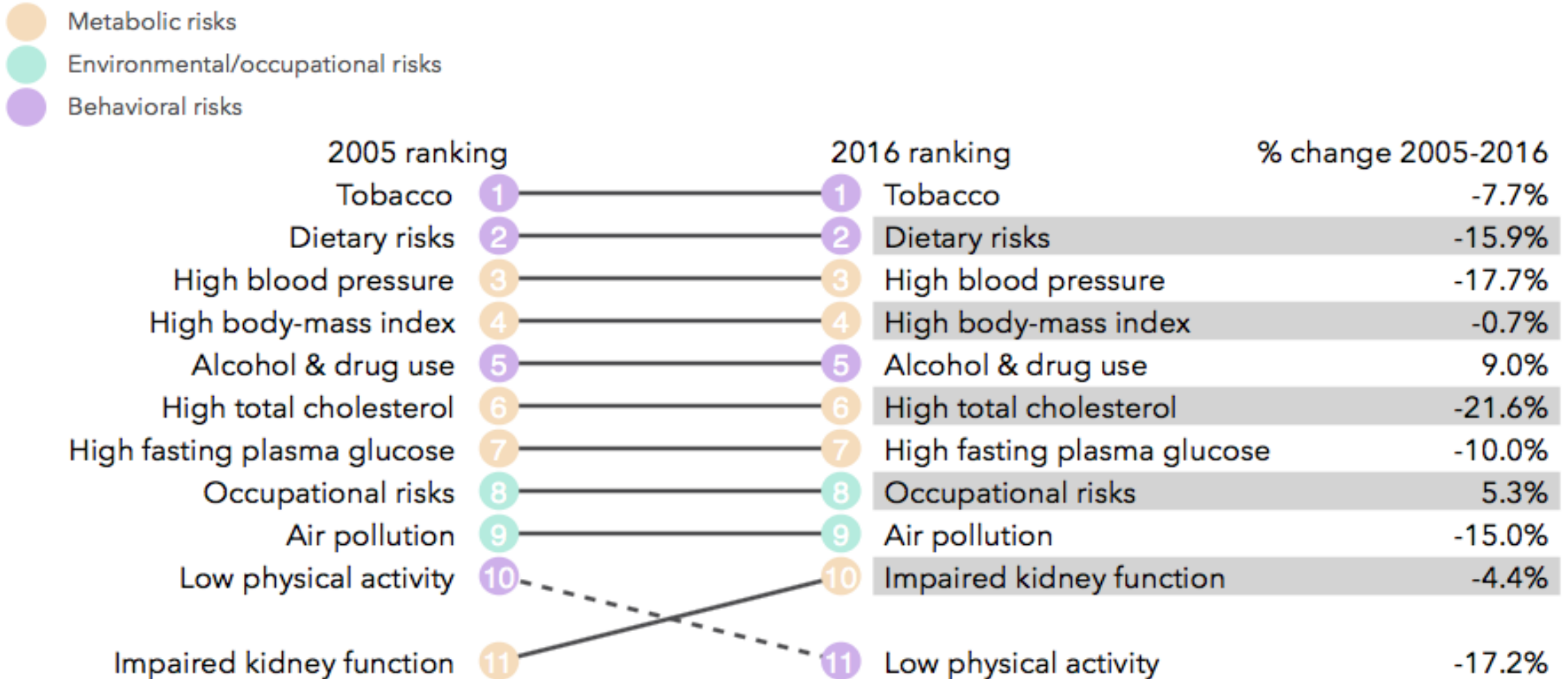
- Liquid biopsy
- Immunotherapy
- Check-point inhibitors
- Personalized medicine
- Early detection through screening “at risk” populations

- Challenges and limitations

- Widespread, unselected screening – too many false positives
- Personalized treatments will be very expensive, and regulatory barriers
- Current treatment effective (e.g. breast cancer) but lung cancer still lags at 19%
- Improvements in life expectancy slowing

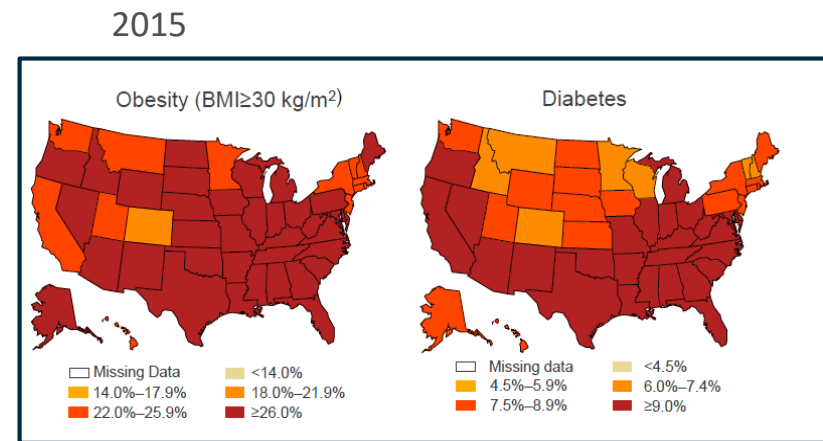
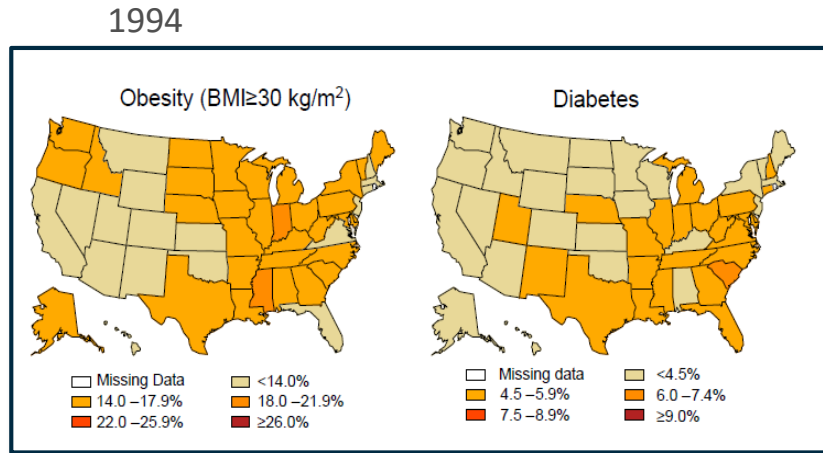


What risk factors most drive death and disability – UK



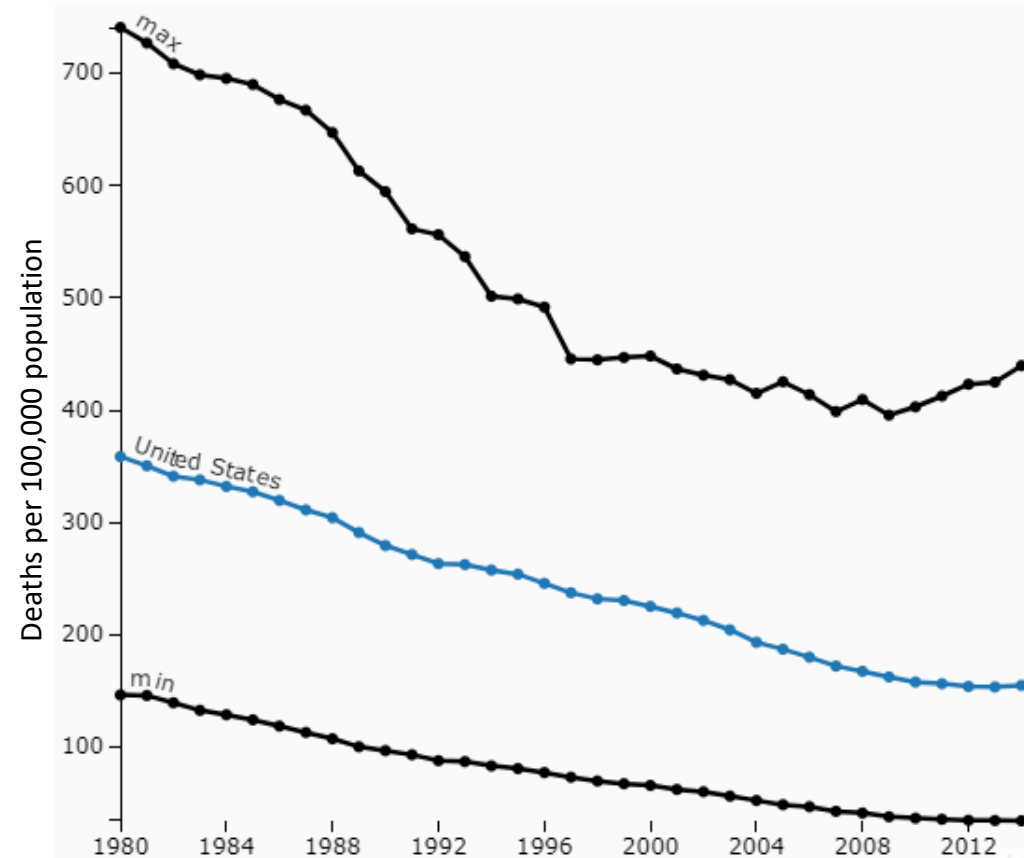
Source: Institute of Health Metrics and Evaluation

Obesity Epidemic US

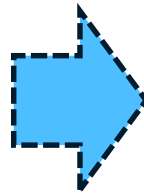


Sources: <http://www.cdc.gov>

Ischemic heart disease



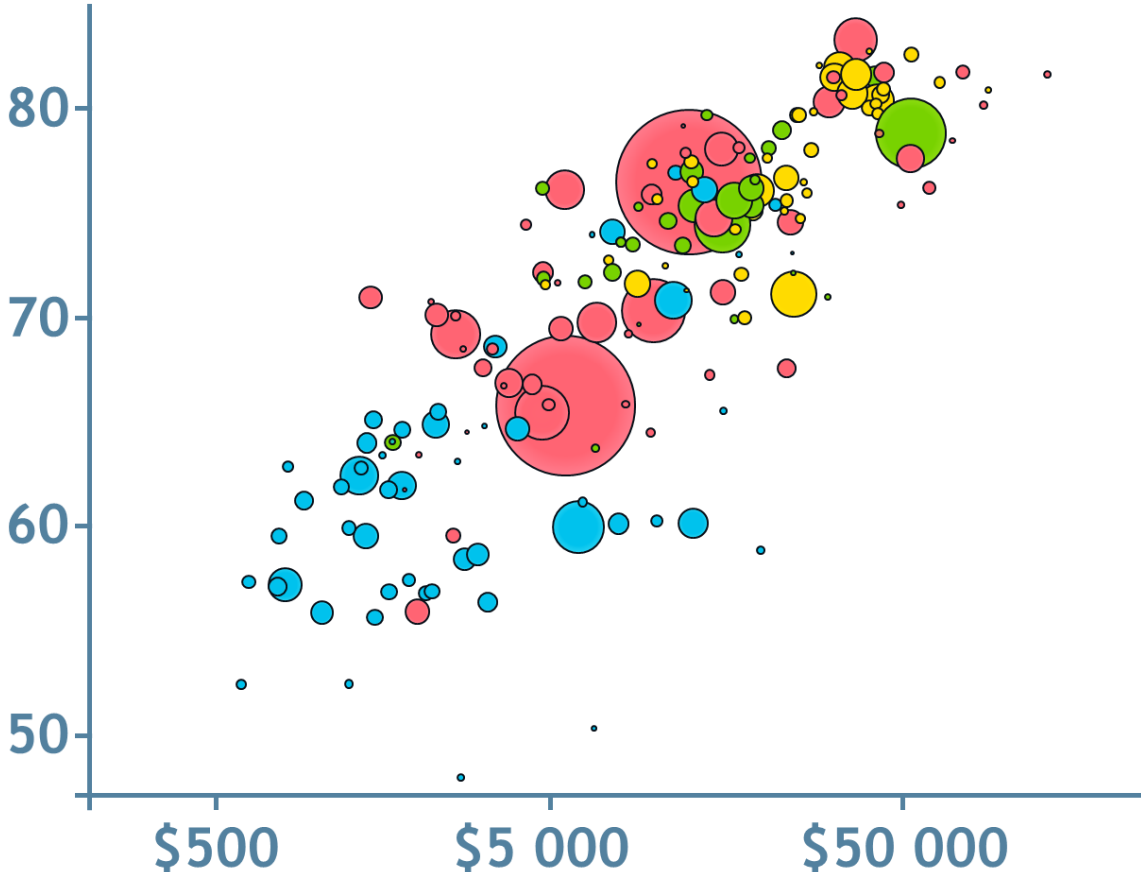
Source: <https://vizhub.healthdata.org/subnational/usa>



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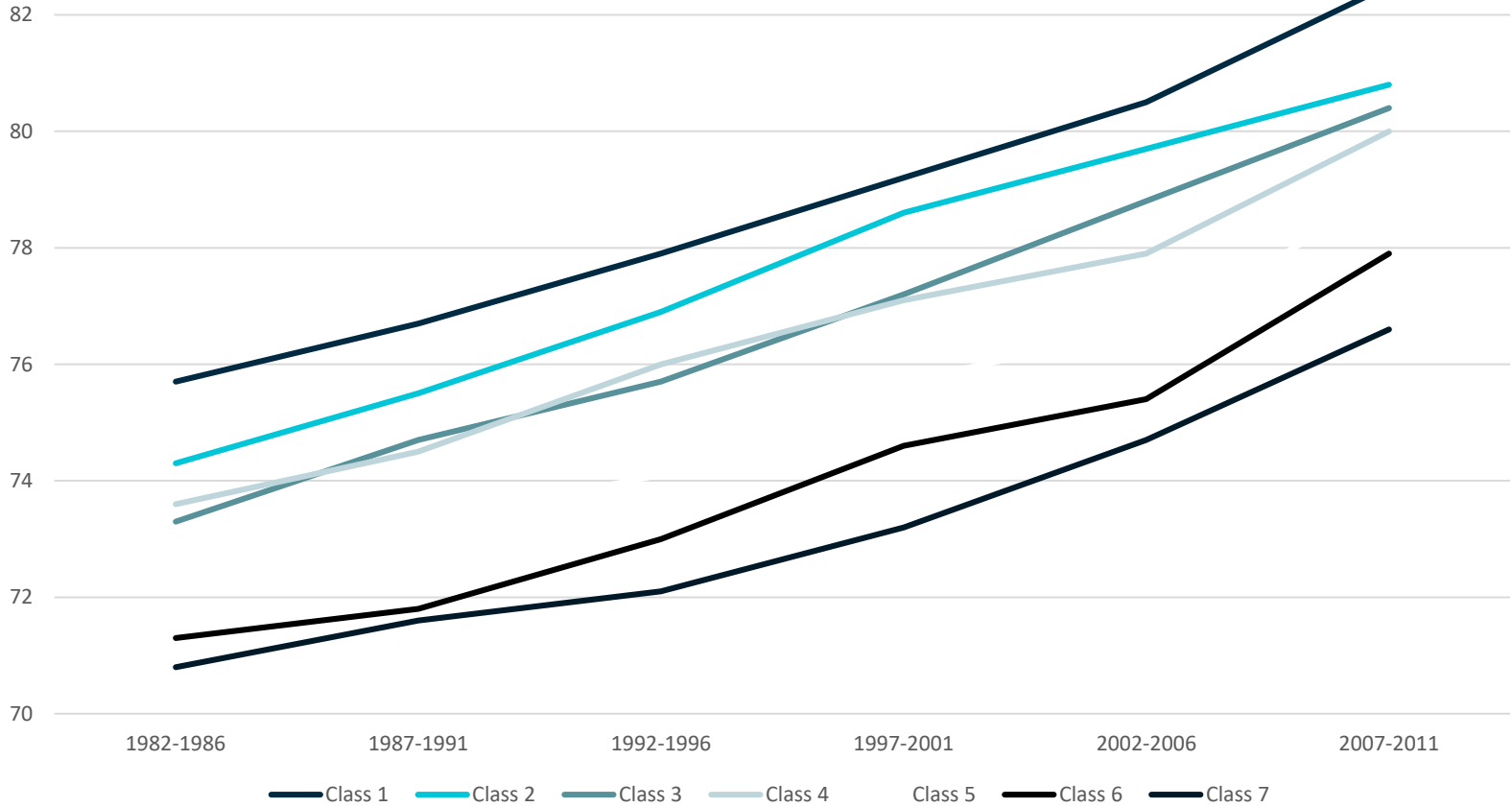
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Life Expectancy vs. GDP per Capita



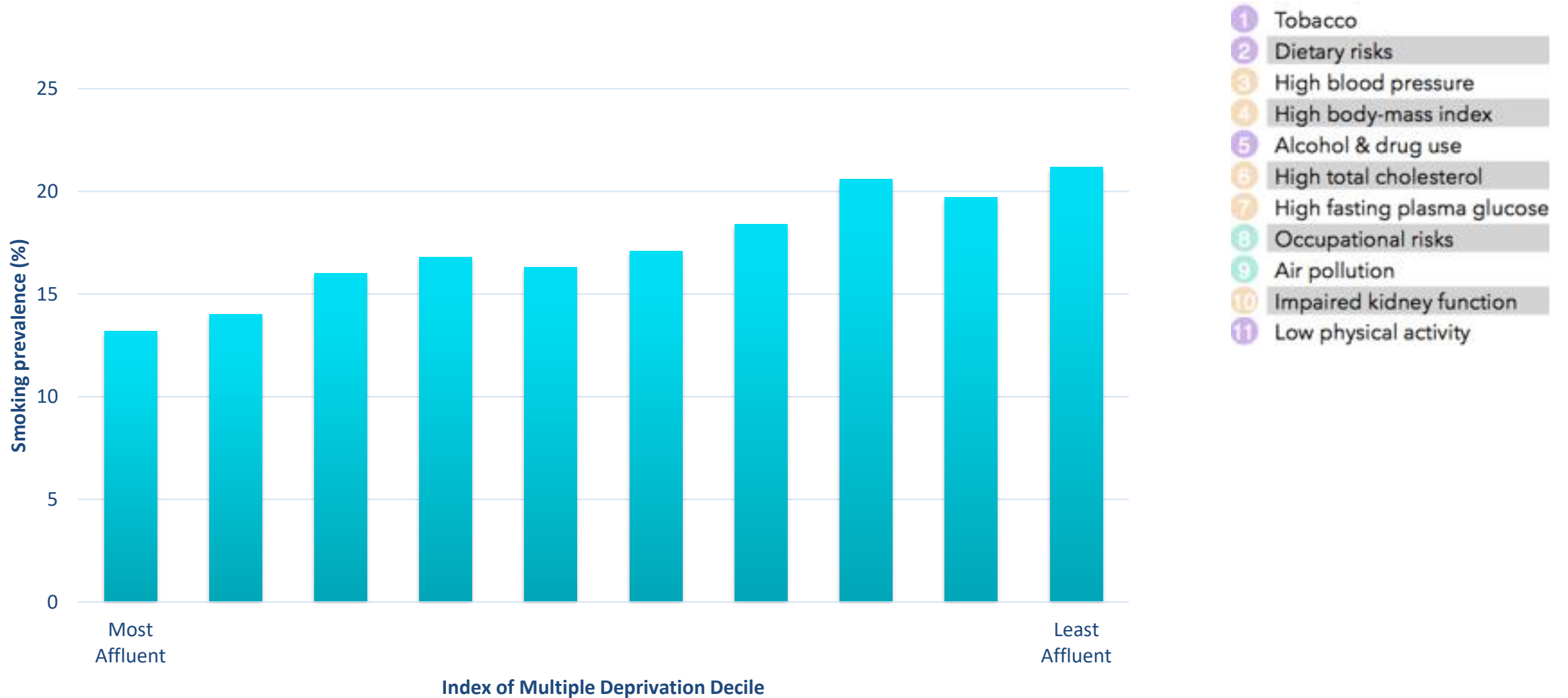
Source: gapminder.org

Social disparity – Life expectancy



Source: ONS Longitudinal Study

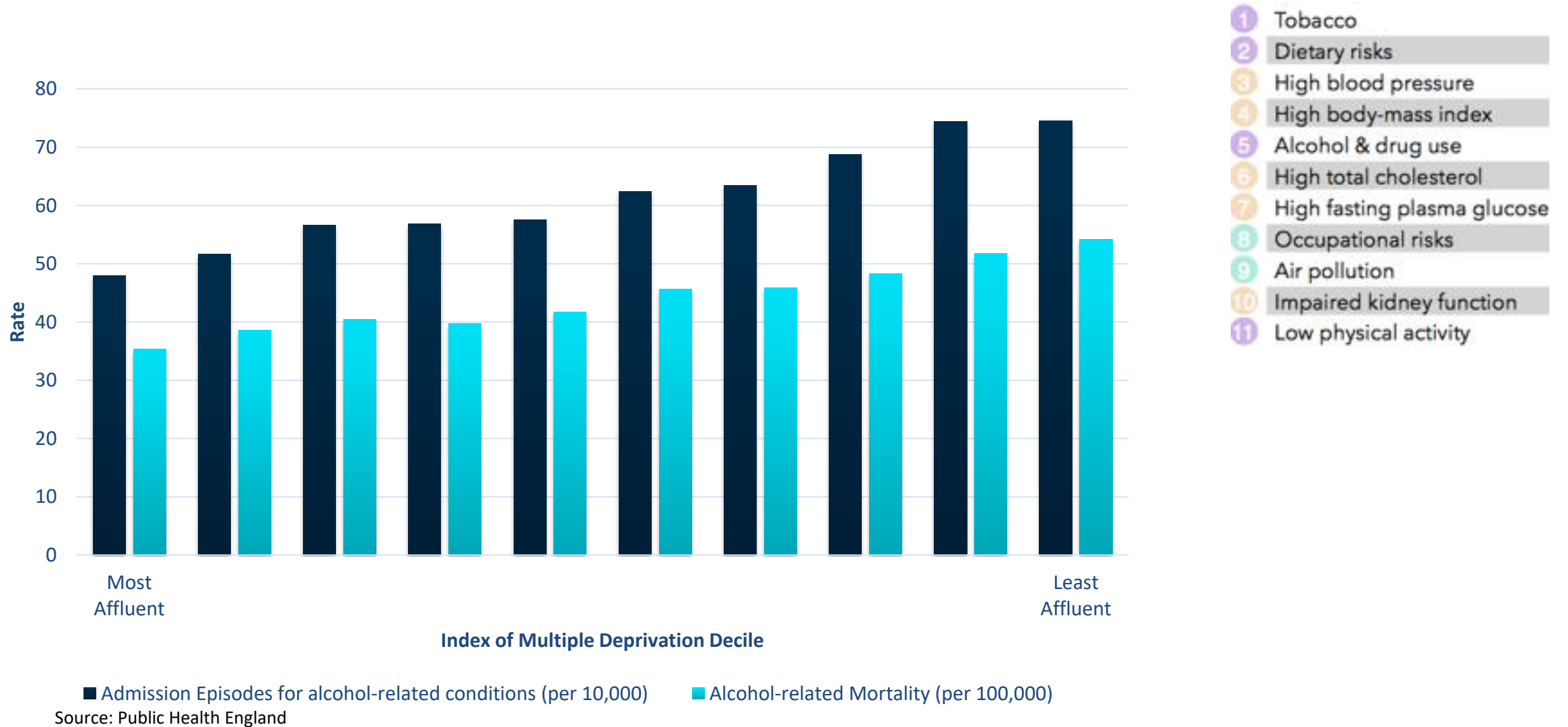
Social disparity – Smoking prevalence



- 1 Tobacco
- 2 Dietary risks
- 3 High blood pressure
- 4 High body-mass index
- 5 Alcohol & drug use
- 6 High total cholesterol
- 7 High fasting plasma glucose
- 8 Occupational risks
- 9 Air pollution
- 10 Impaired kidney function
- 11 Low physical activity

Source: Public Health England

Social disparity – Alcohol use



Social disparity – Childhood diet

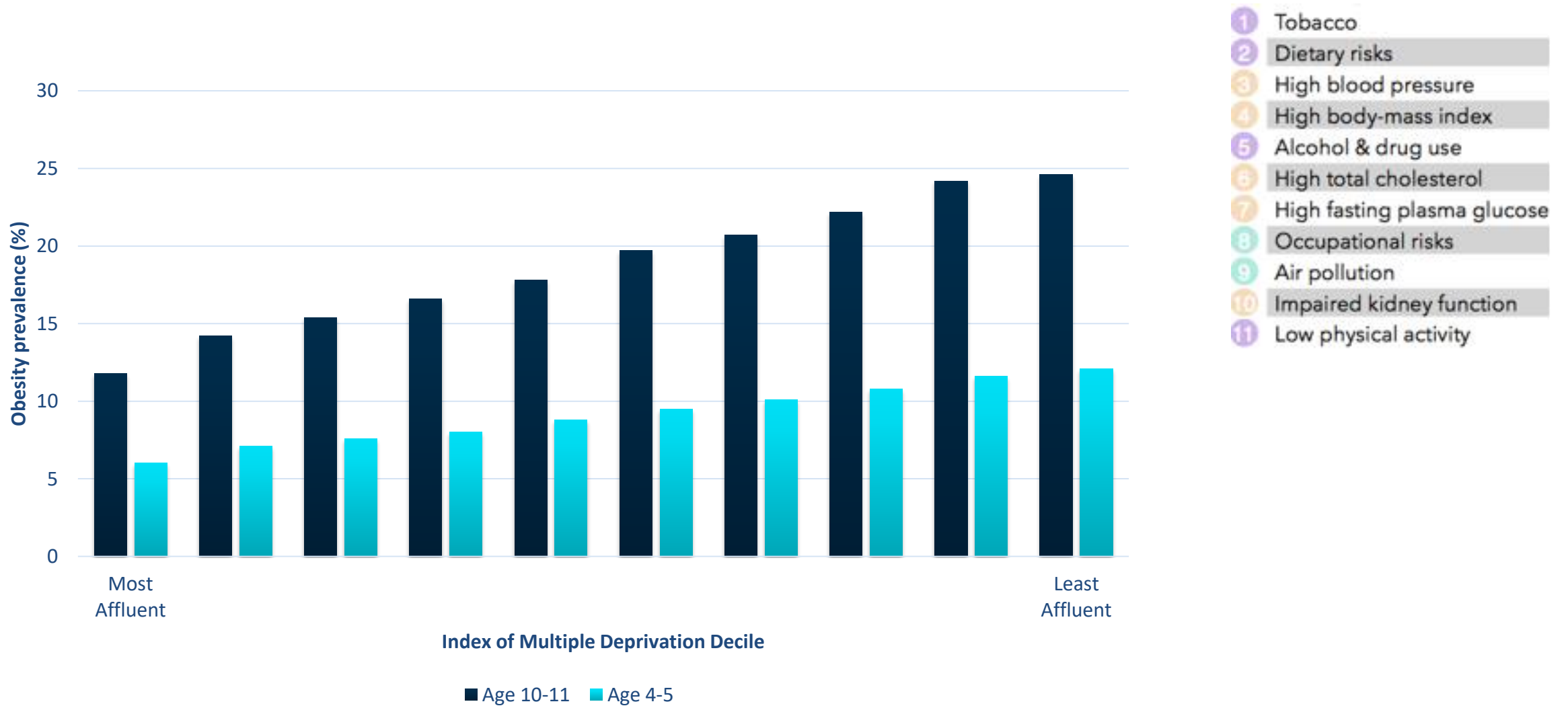
Daily fruit and vegetable consumption



- 1 Tobacco
- 2 Dietary risks
- 3 High blood pressure
- 4 High body-mass index
- 5 Alcohol & drug use
- 6 High total cholesterol
- 7 High fasting plasma glucose
- 8 Occupational risks
- 9 Air pollution
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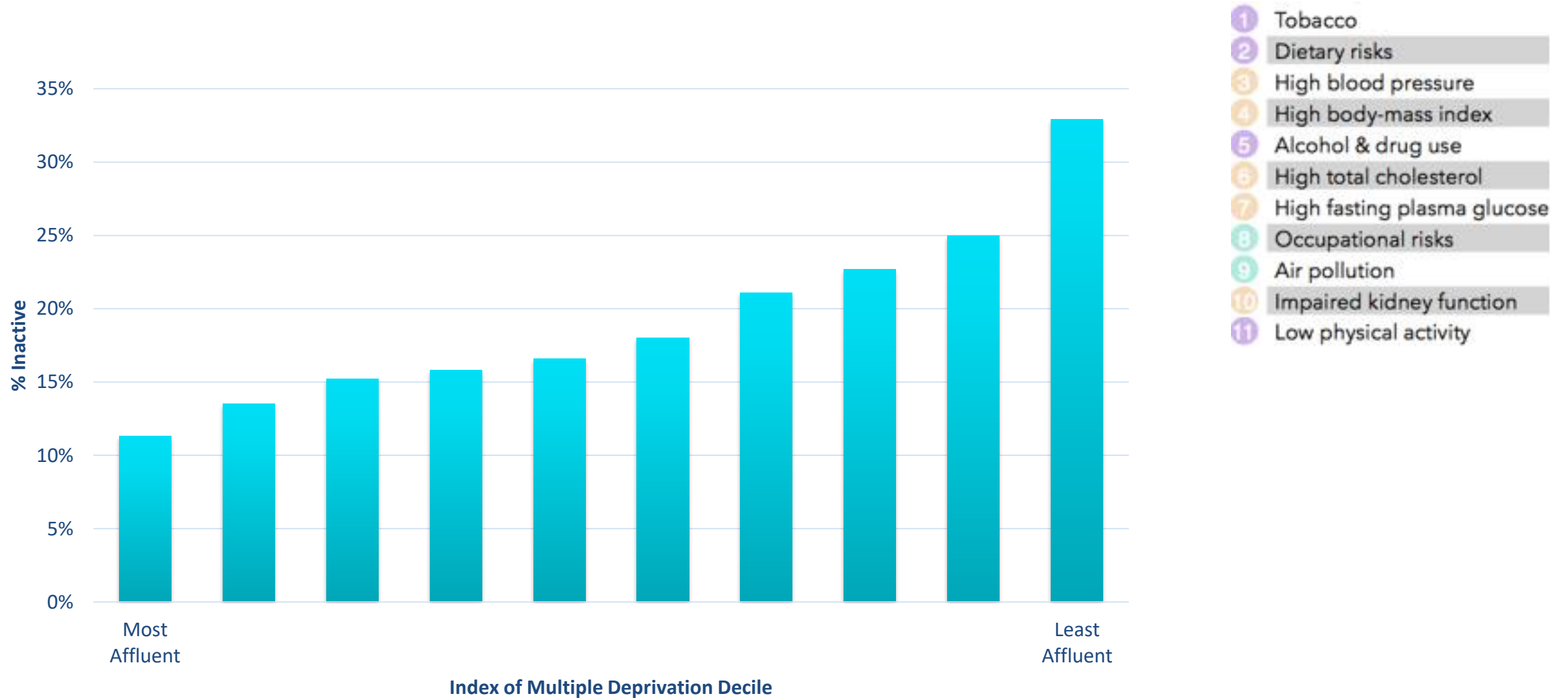
Source: Public Health England

Social disparity – Child obesity



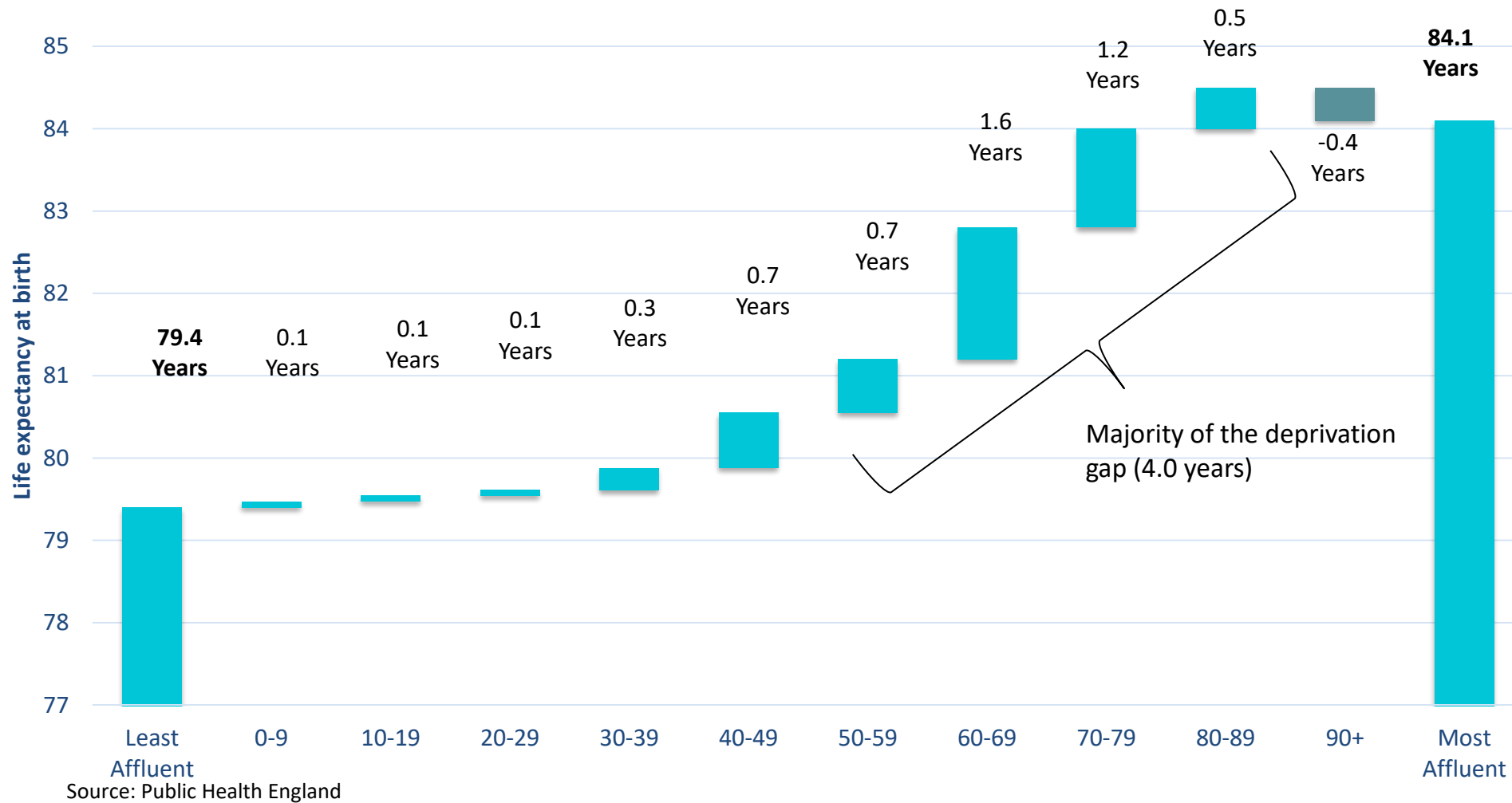
Source: Public Health England

Social disparity – Physical inactivity



Source: Public Health England

Female Life Expectancy Deprivation Gap – Decomposition by Age



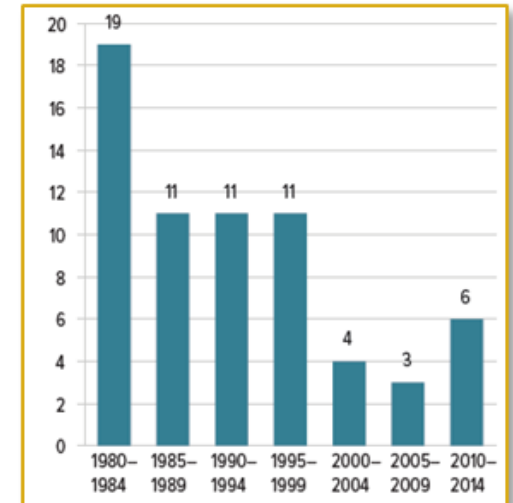
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Antimicrobial resistance - AMR

- Rapid growth of antibiotic resistance
- Primary causes - overuse of antibiotics in human and veterinary care
- Methicillin-Resistant Staphylococcus Aureus (MRSA): kills more Americans than HIV/AIDS, Parkinson's, Emphysema & Homicide
- Caesarean deliveries, joint replacements, cancer drugs and organ transplants are supported and made safe by antibiotics
- Steady fall in new antibiotic development over the last 30 years
- More difficult to find new antibiotics than other drugs & less profit to be made
- Patents expire before R&D costs recouped

New Antibiotic Approvals in the US



Source: P.T. 2015 Apr;40(4):277-83.

Medical Progress – the Next Generation

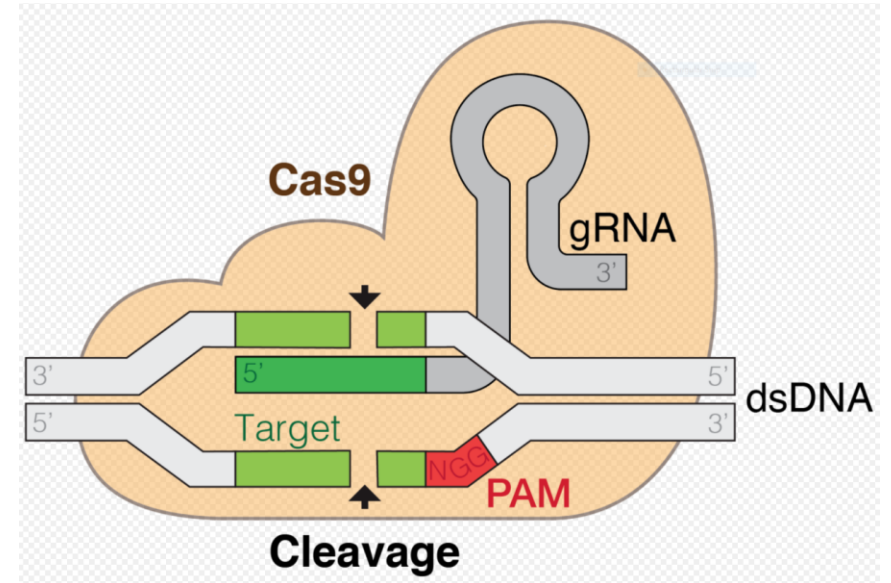
- Gains from medical progress can't repeat the old and will need new direction
The basics remain very important:
 - Prevention,
 - Early diagnosis,
 - Lifestyle improvements
- What will make the difference?
 - Artificial intelligence
 - Genomics
 - Stem cell therapy

The Next Generation – Artificial Intelligence

- **Diagnosis**
 - AI software to analyse symptoms and signs and interpret images
- **Online consultations**
 - Babylon Health app asks questions, arranges online GP appointment and sends prescriptions
- **Treatment**
 - IBM Watson assisting in cancer therapy
- **Precision medicine**
 - search and match mutations with diseases in huge data sets of genetic information and medical records
- **Drug creation**
 - AI technology can do 2 months work in one day searching therapies based on molecular structure

The Next Generation - Genomics

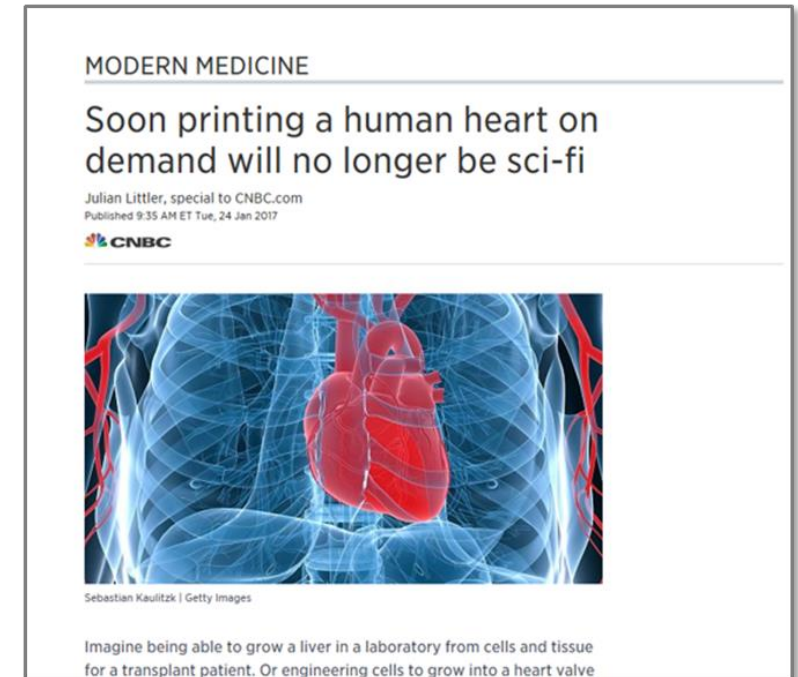
- Gene editing
 - CRISPR/Cas9 and other molecular scissors
 - Molecular scissors are activated in target tissue
 - Still in R&D
 - Potential for single-gene disorders such as cystic fibrosis, haemophilia, and sickle cell disease
- Precision or personalized medicine
 - Mining data sets of genetic information and medical records to find links between mutations and disease
 - Developing cancer drugs for mutations found in tumours



<https://upload.wikimedia.org/wikipedia/commons/5/51/GRNA-Cas9.png>

The Next Generation - Stem cell therapy

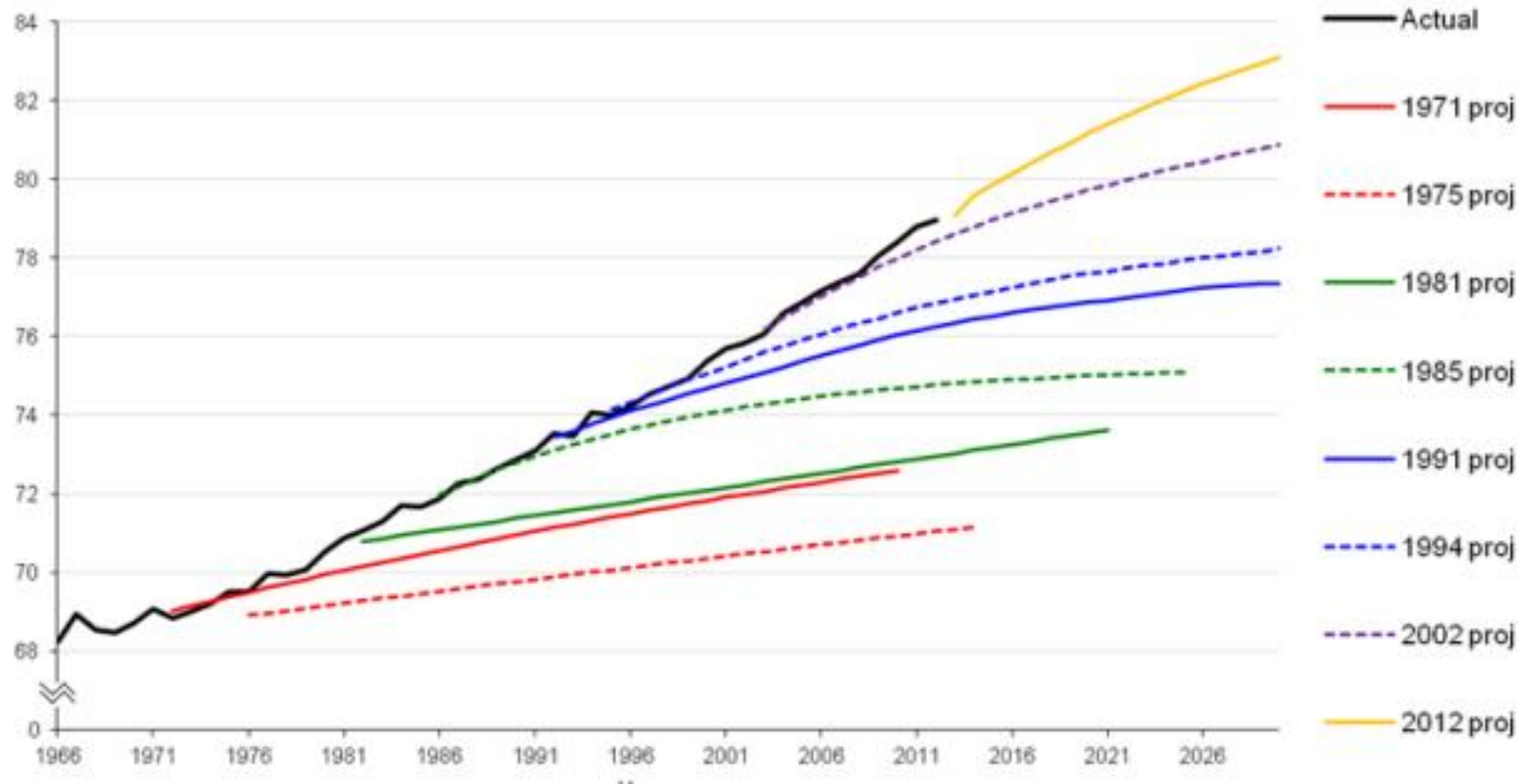
- Regenerative medicine
 - Heart damage repair
 - Diabetes type 1
 - Replacing organs - joints, trachea, skin, bladder, heart
- Hematopoietic stem cell transplantation:
 - bone marrow or umbilical cord
 - thalassaemia, sickle-cell disease, leukaemia



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Conclusion



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Conclusion

- Future medical gains in Life Expectancy?
 - Artificial intelligence
 - Genomics
 - Stem cell therapy
- Potential losses in Life Expectancy?
 - AMR, obesity, alcohol and drug abuse, pollution
 - climate change, population growth, food shortage, conflicts

Conclusion



Source: Adobe Stock



Source: Adobe Stock

Source: ONS, National Population Projections Accuracy Report, July 2015



Questions



Comments