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Drivers of Longevity

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Drivers of Longevity

An actuarial and medical perspective

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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. 63.1 years (2015 healthy life expectancy at birth)



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)



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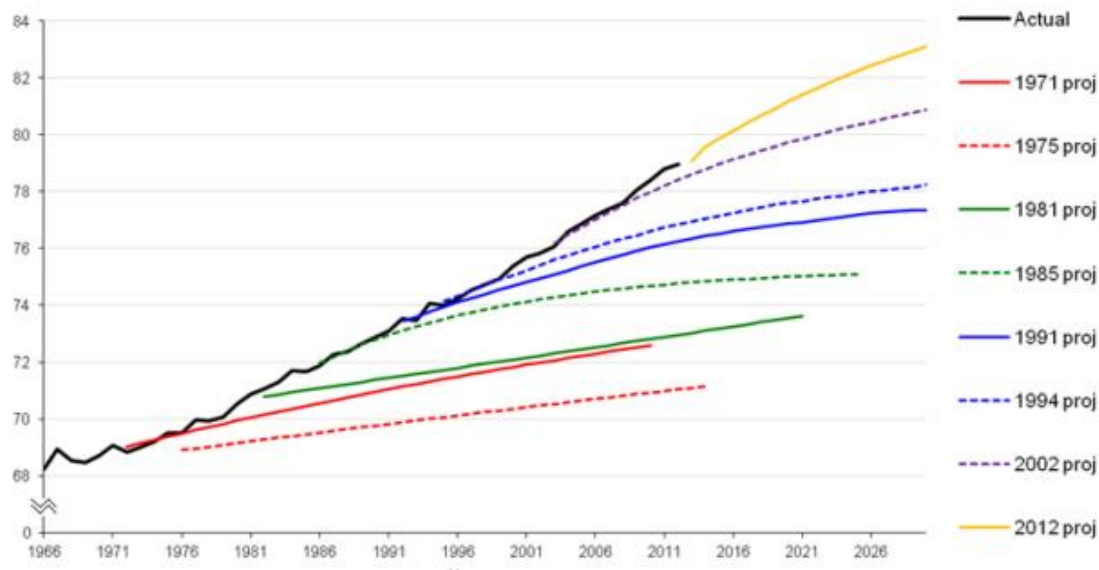
Quiz

What is the **socio-economic** gap in male life expectancy at birth in England and Wales?

1. 3.7 years (UK gender gap)
2. 5.9 years
3. 7.3 years (US gap between highest and lowest educational groups)
4. 9.3 years (gap between Mexico and Japan female life expectancy)



Why this presentation?



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



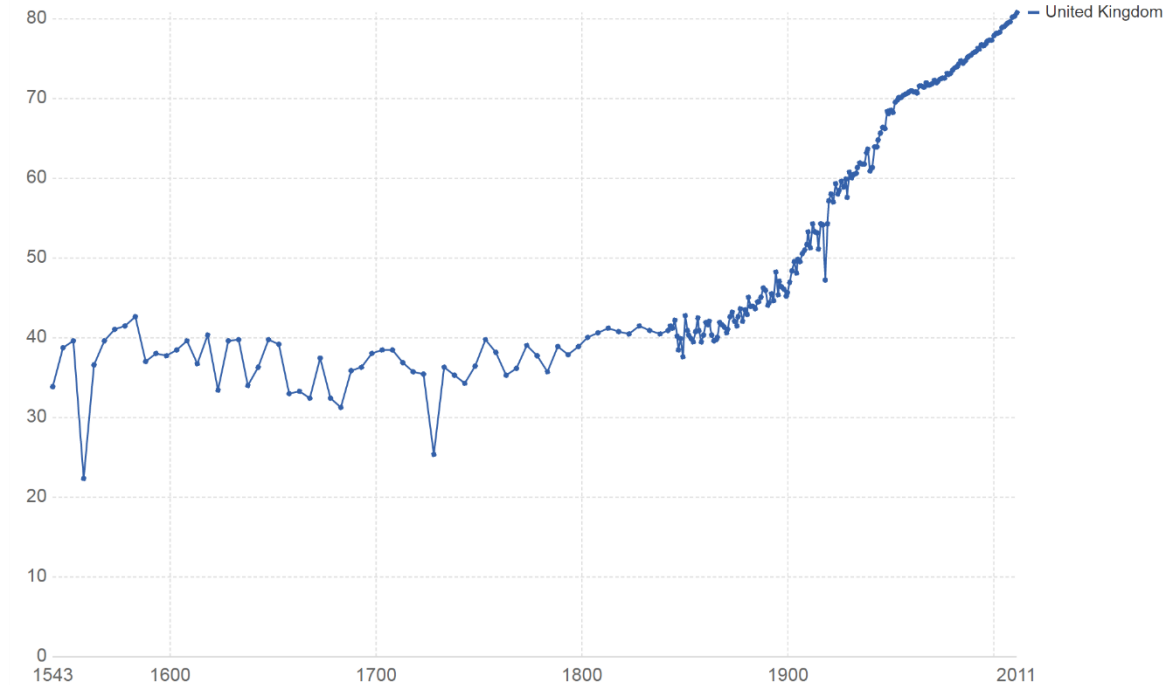
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Drivers of Future Longevity

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Development of Life Expectancy



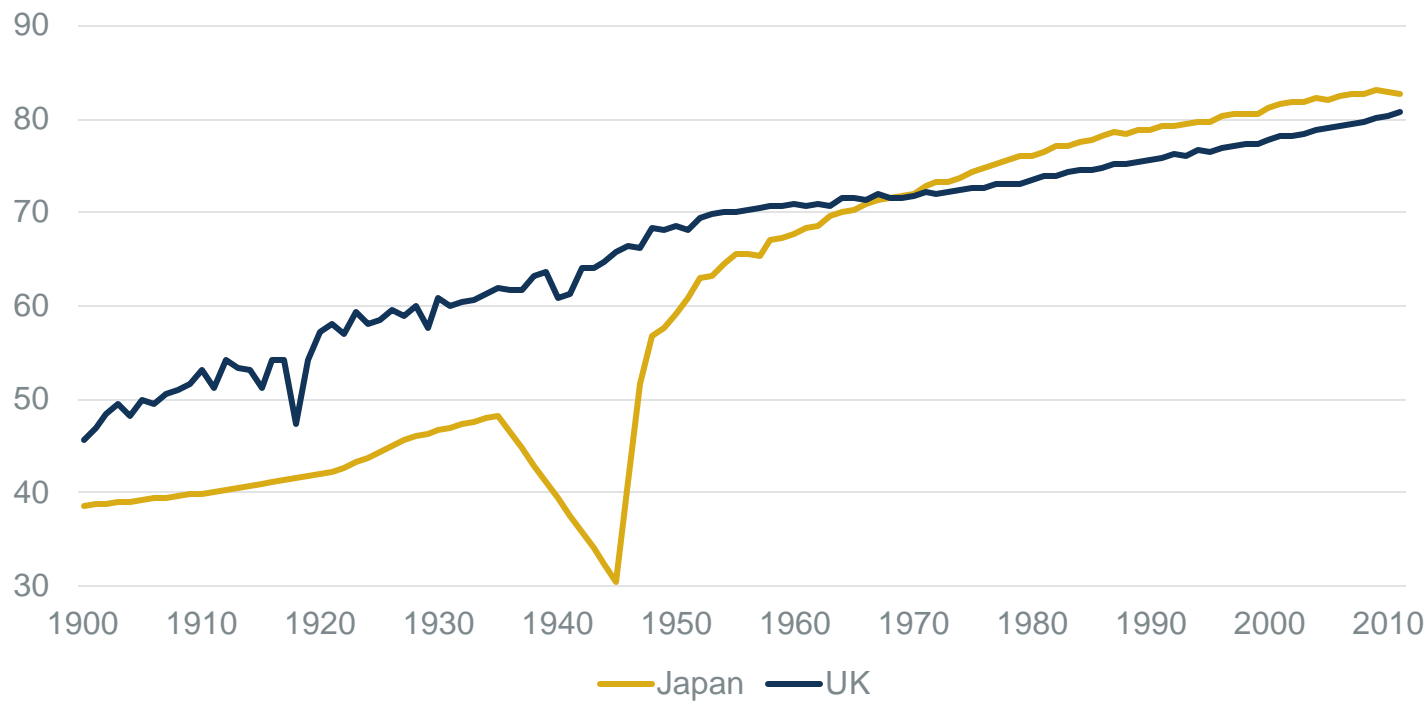
Source: Clio Infra (life expectancy, both genders)

OurWorldInData.org/life-expectancy/ • CC BY-SA



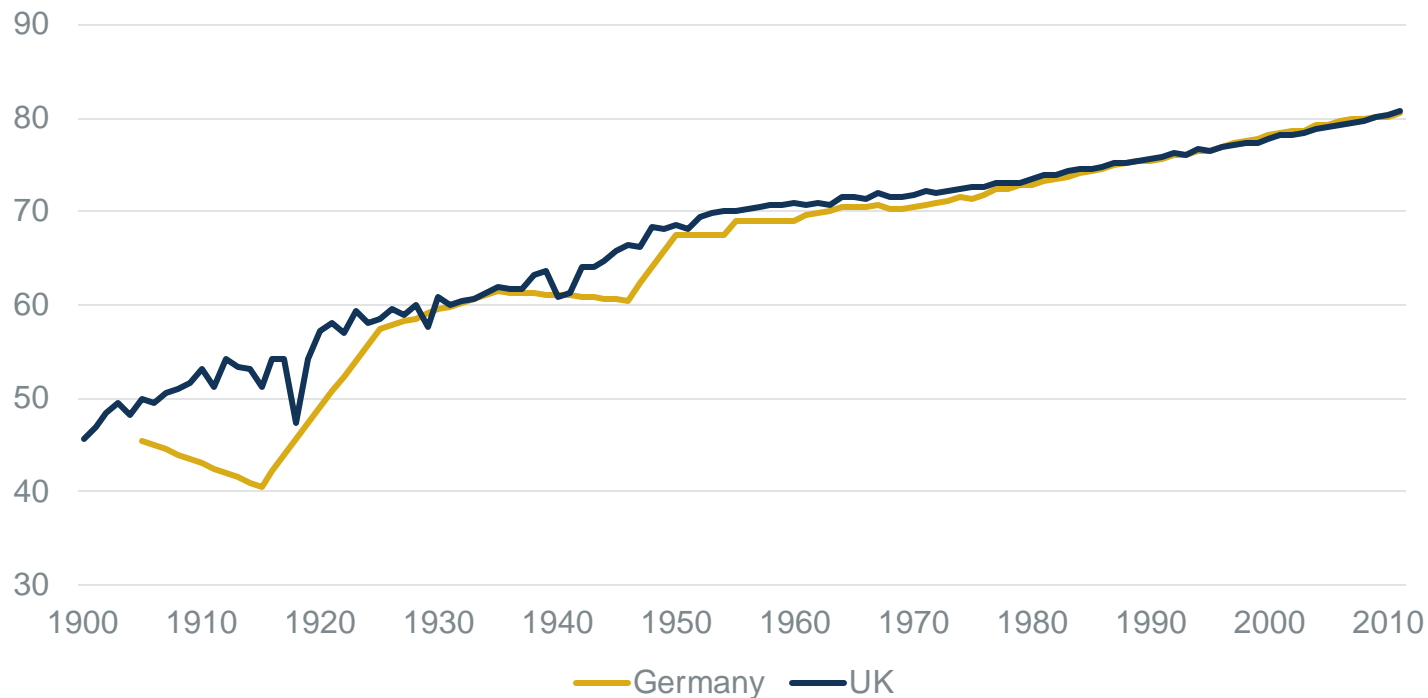
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Development of Life Expectancy



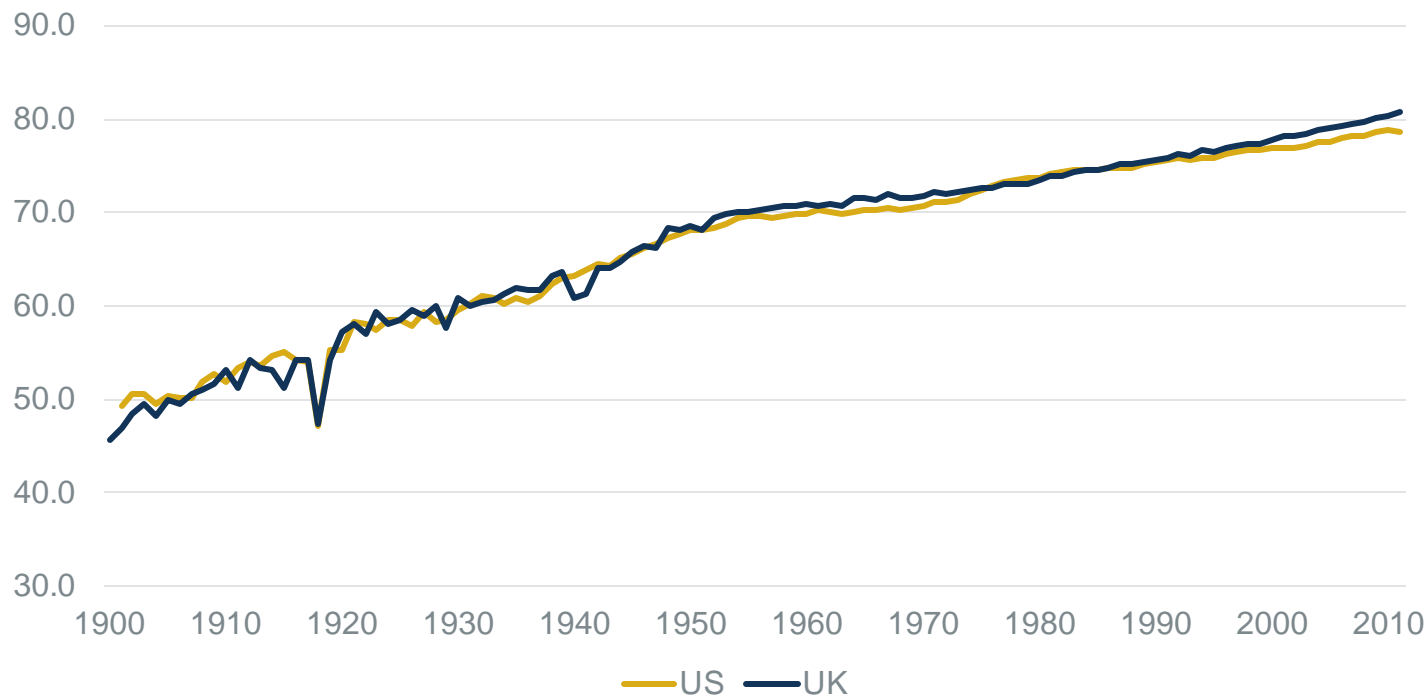
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Development of Life Expectancy



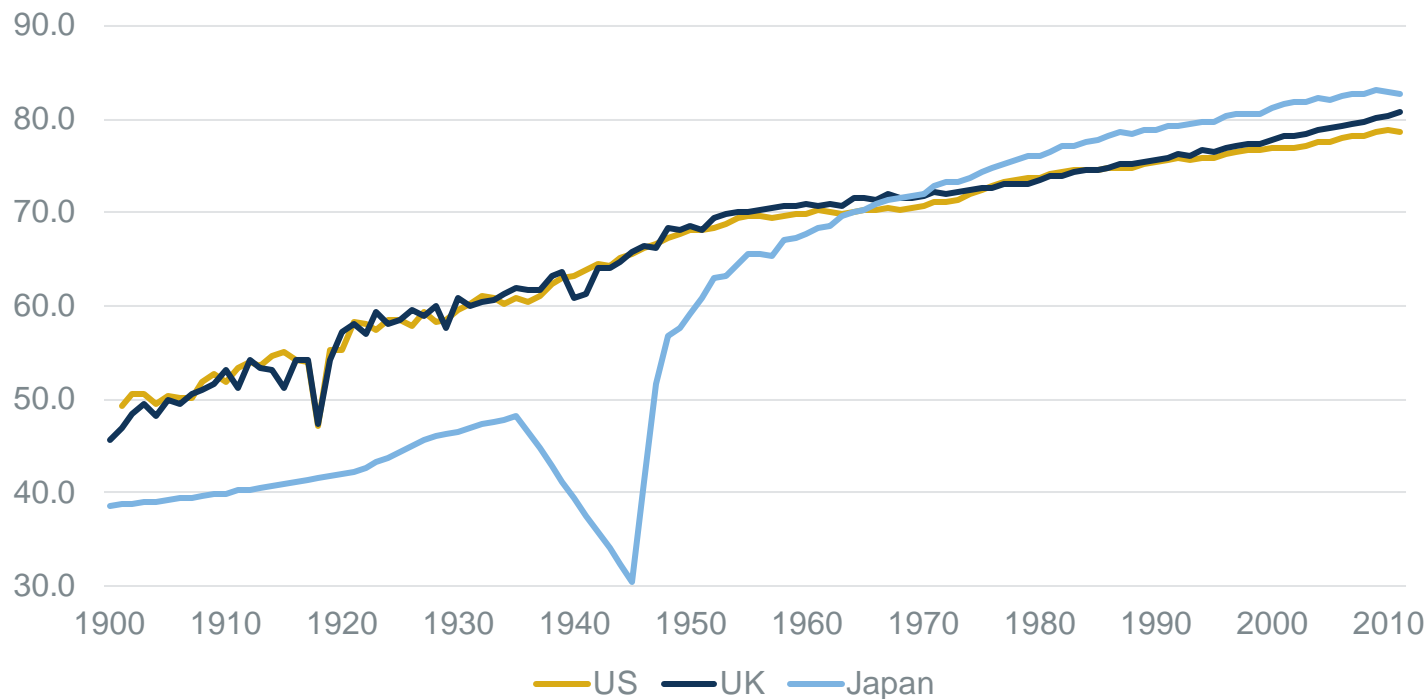
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Development of Life Expectancy



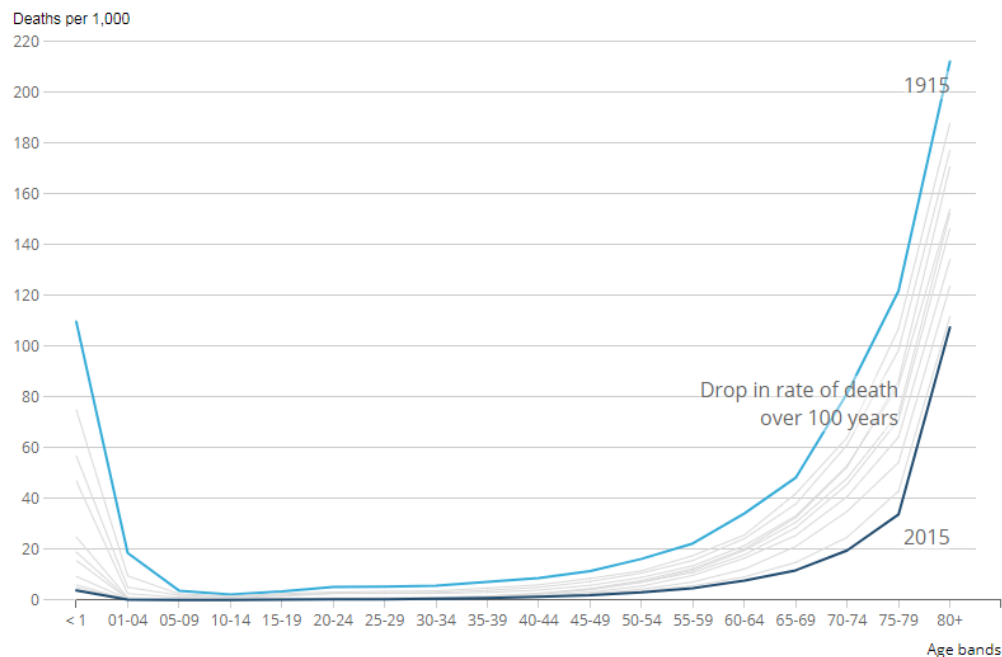
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Development of Life Expectancy



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

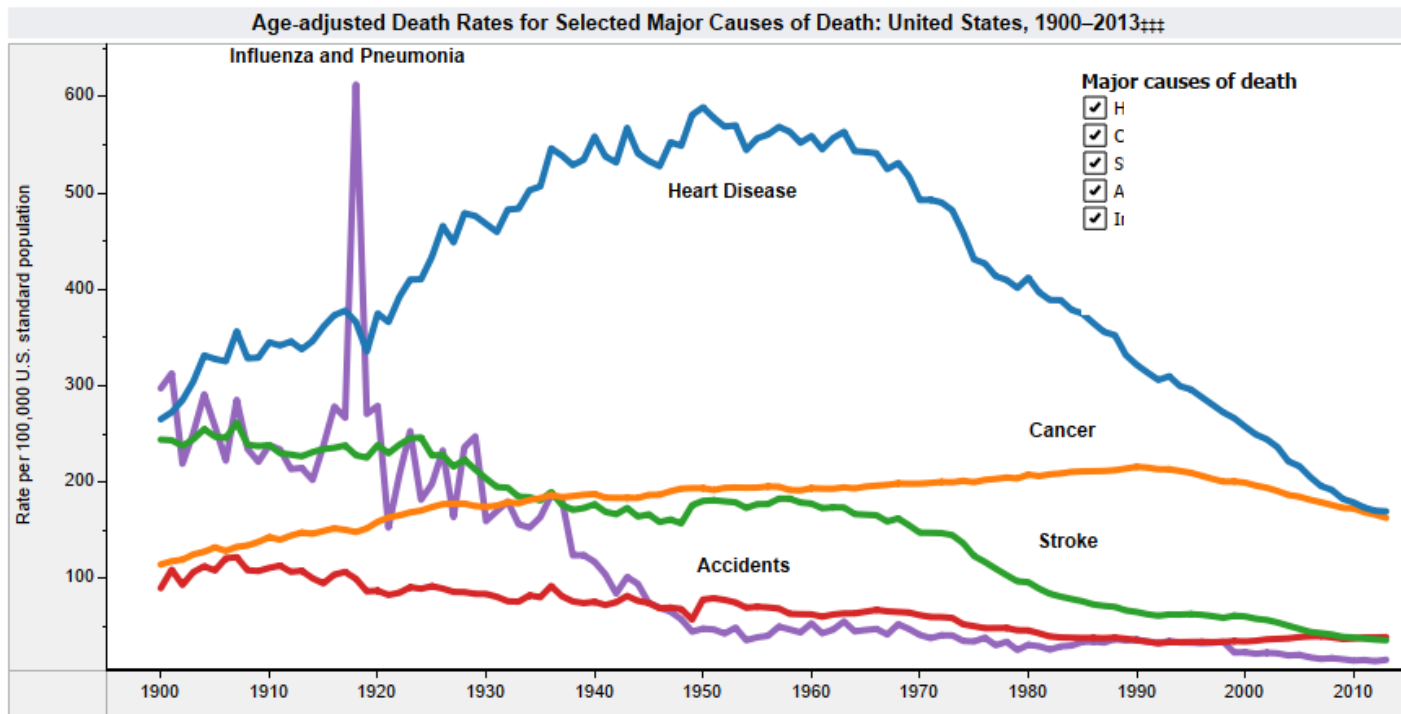


Source: 21st century mortality files, ONS
and 20th century mortality files, ONS



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What happened in the 20th century?



Source: CDC



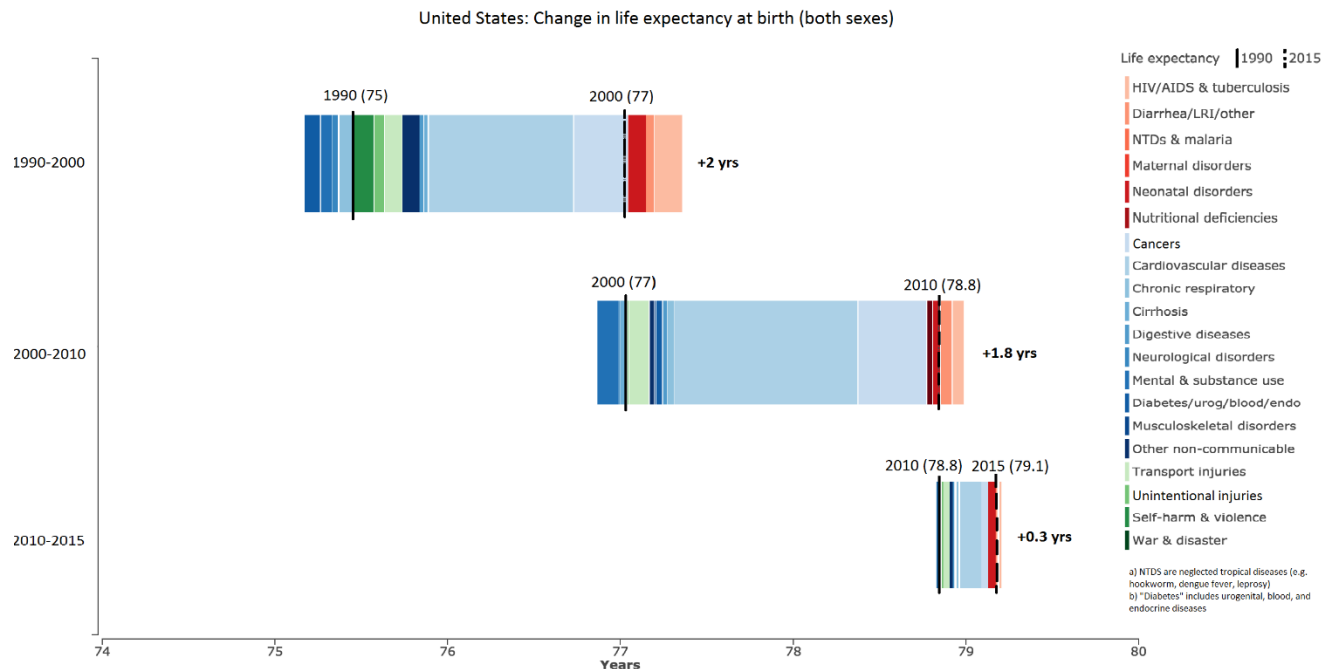
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Gains in life expectancy are dropping



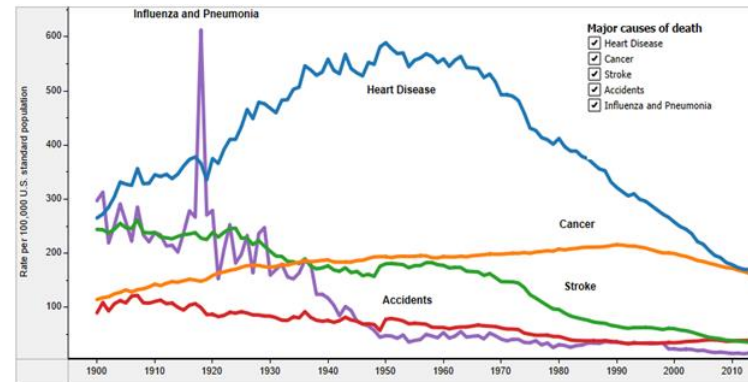
Source: Institute for Health Metrics and Evaluation



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Heart disease: past and present

- Medical innovations
 - CAD investigation & treatment: ICU, coronary angiogram, clot busters, CABG, stents
 - BP control and new drugs – ACE inhibitors
 - Lipid research, treatment with statins
 - Heart rhythm control, atrial fibrillation, anticoagulants, pacemakers, ICD
- Public health, lifestyle
 - Immunization
 - Education, screening for BP, cholesterol, smoking, diabetes, diet, exercise



- Other heart
 - Congenital heart defect surgery
 - Disappearance of rheumatic heart disease

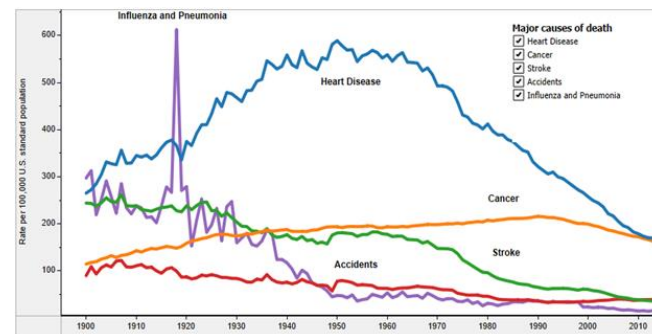


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Heart disease: future

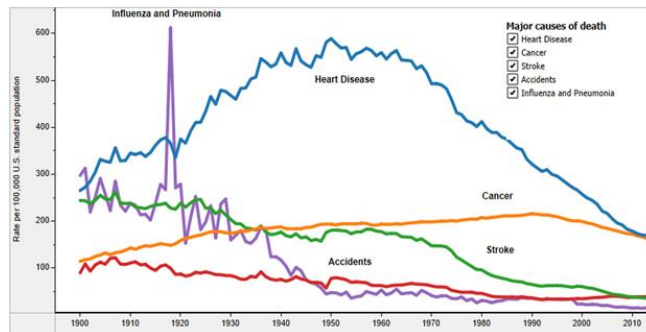
- Future

- Primary goal is prevention of coronary artery disease
- Established 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, smoking cessation, treatment
- Political role, e.g. banning soft drinks in schools, smoking in public places, and more?
- Continued mortality improvement may prove difficult with obesity epidemic



Cancer: present and future

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



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



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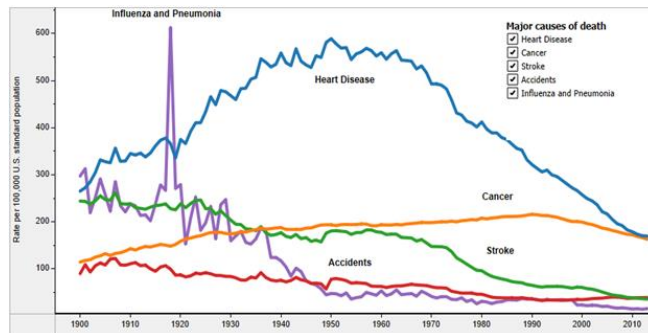
Cancer: present and future

- Future

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

- Challenges and limitations

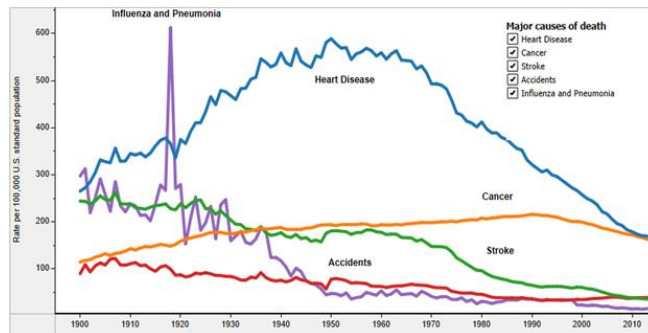
- Widespread, unselected screening – too many false positives
- Personalized treatments will be very expensive, and regulatory barriers
- Current treatment effective, breast cancer 92% 5 yr survival, but lung cancer still lags at 19%
- Improvements in LE slowing



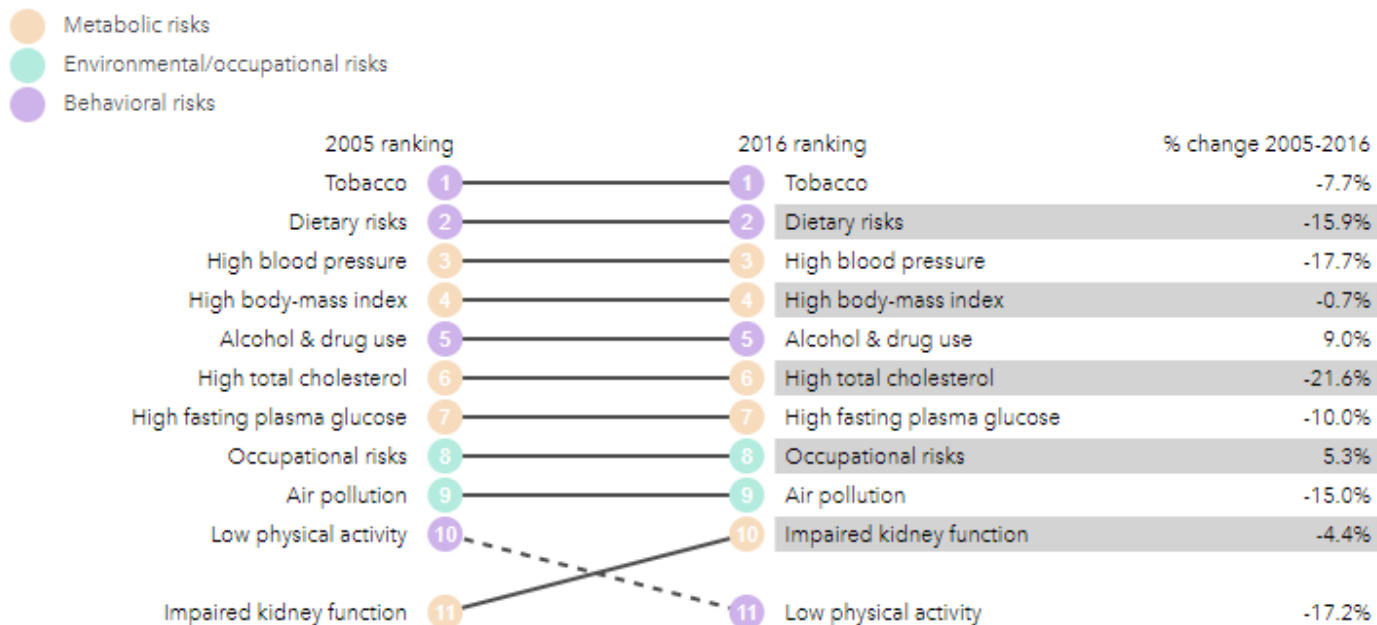
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Stroke: present and future

- Medical innovations
 - Dedicated stroke units
 - Thrombolytics
 - BP control and new drugs – ACE inhibitors
 - Lipid research, treatment with statins
 - Heart rhythm control, atrial fibrillation, anticoagulants, ablation
- Future
 - Regrowth of dead brain tissue unlikely
 - Improvements more in disability
 - Benefits at older ages have less impact on longevity



What risk factors most drive death and disability – UK?



Source: Institute of Health Metrics and Evaluation

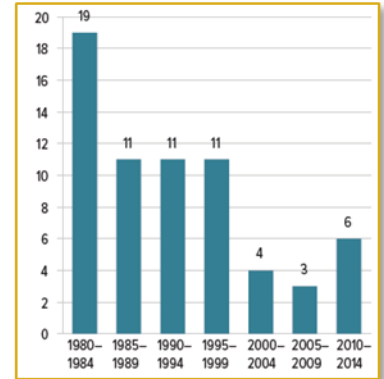


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Antimicrobial resistance - AMR

- 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 supported and made safe by antibiotics
- Steady fall in new antibiotic development last 30 years, inadequate to replace obsolescence from AMR
- More difficult to find new antibiotic than other drugs & less profit
- Patents expire before R&D costs recouped

**New Antibiotic Approvals
in the US**



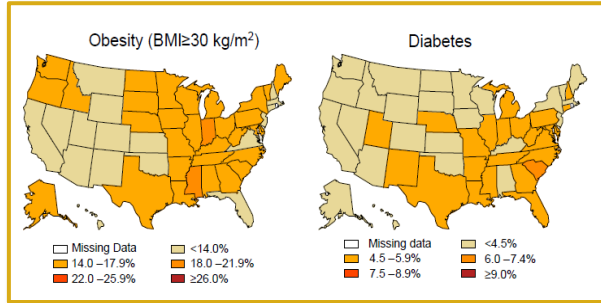
Source: P T. 2015 Apr;40(4):277-83.



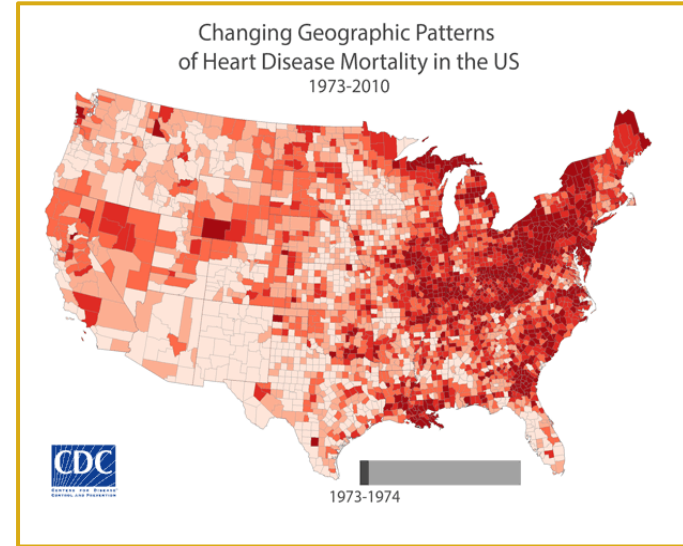
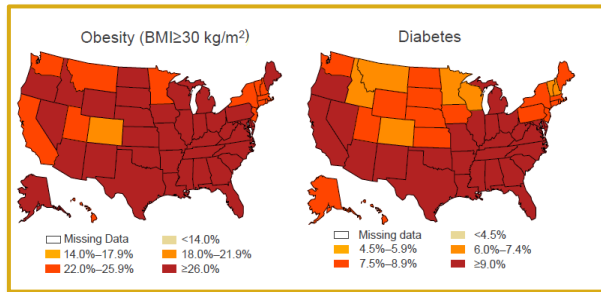
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Obesity Epidemic

1994



2015

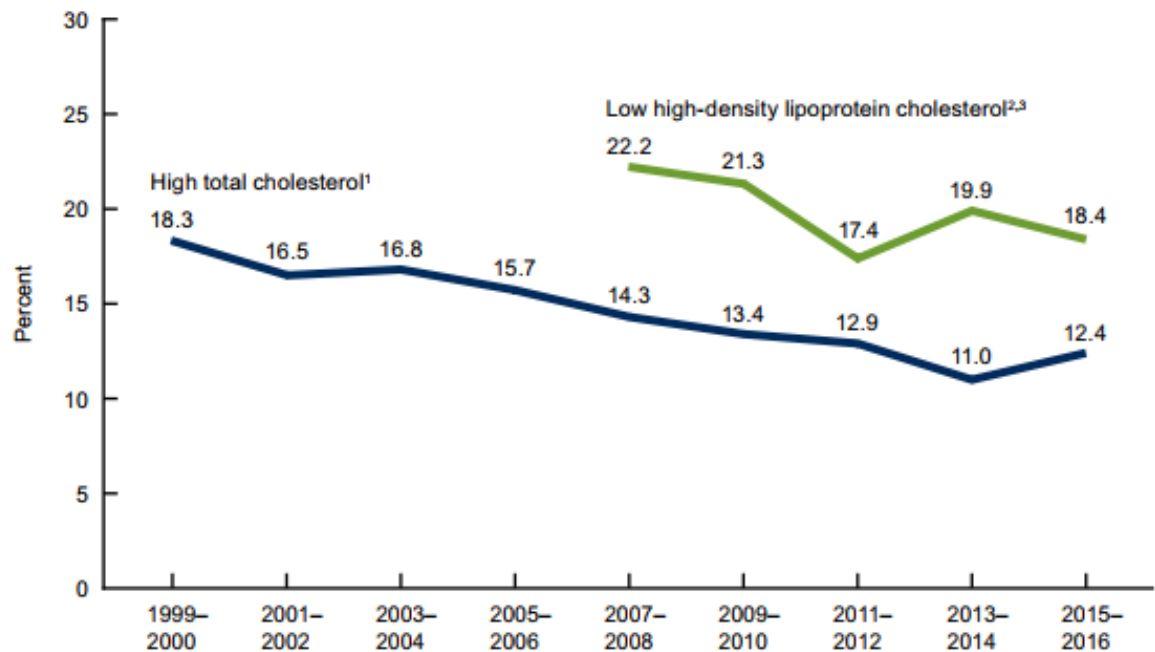


Sources: <http://www.cdc.gov>



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Age-adjusted high total cholesterol and low HDL among US adults 1999–2000 to 2015–2016



<https://www.cdc.gov/nchs/data/databriefs/db290.pdf>



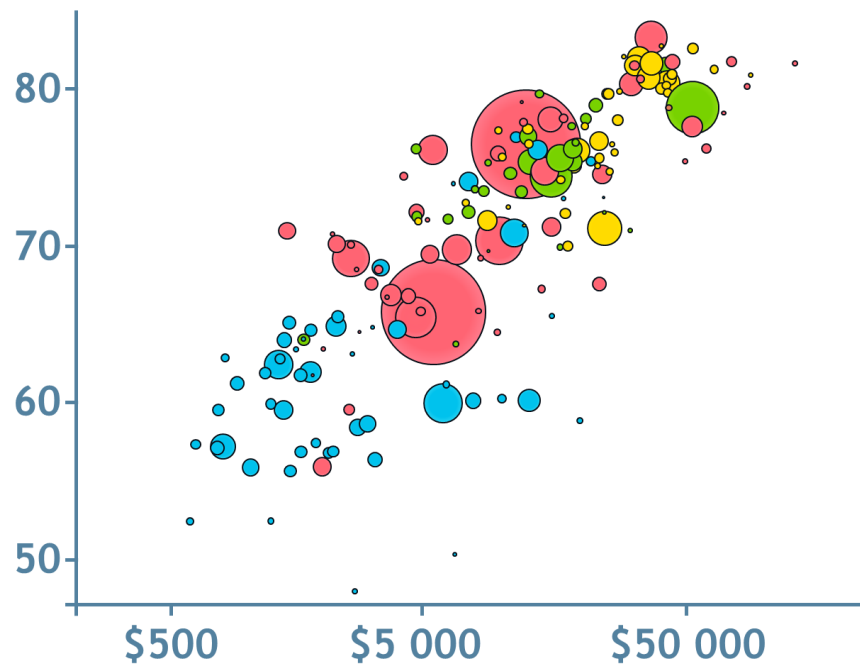
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Life Expectancy vs. GDP per Capita

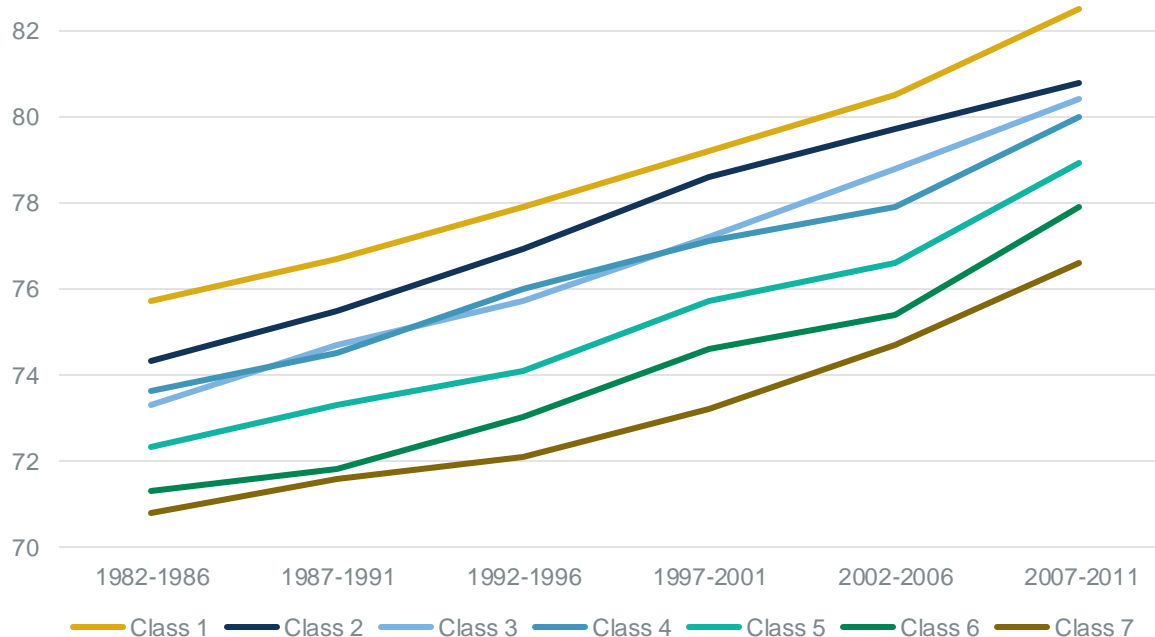


Source: gapminder.org



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Social disparity – Life expectancy

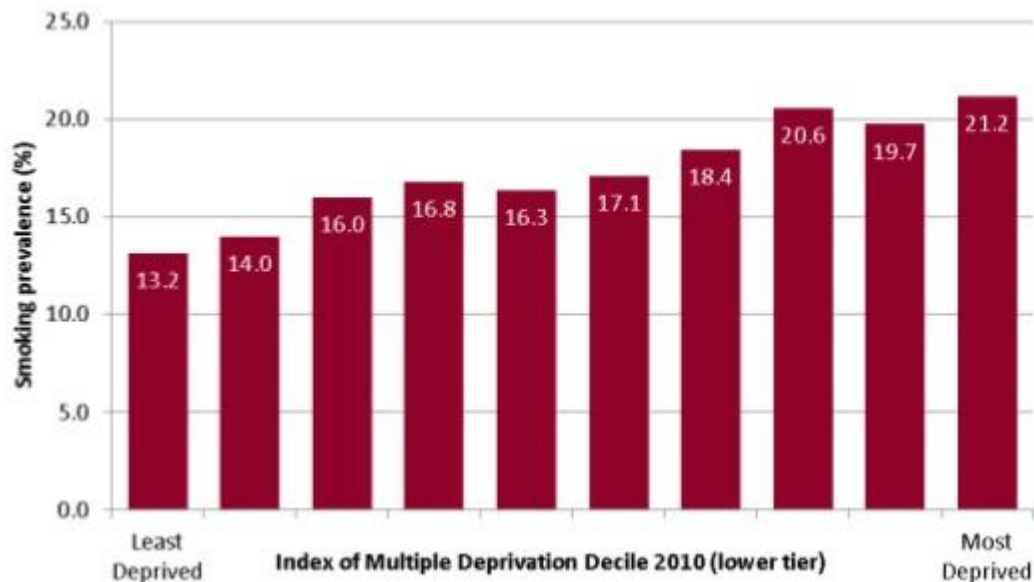


Source: ONS Longitudinal Study



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Social disparity – Tobacco prevalence



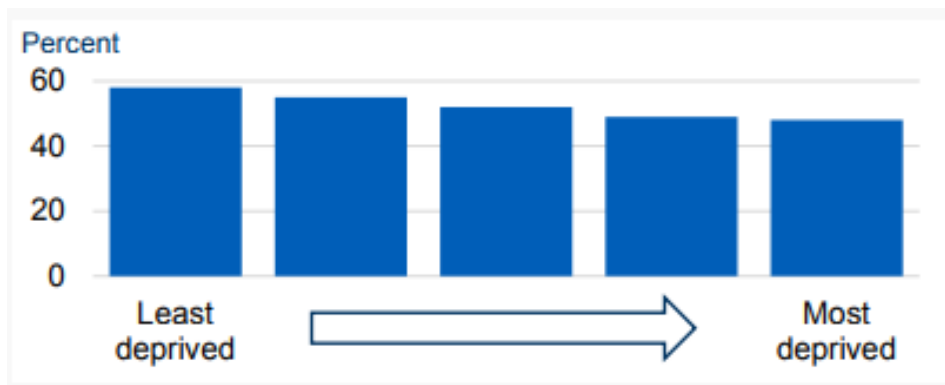
Source: Public health England



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Social disparity – Childhood diet

Consume 5 or more portions of fruit and vegetable a day

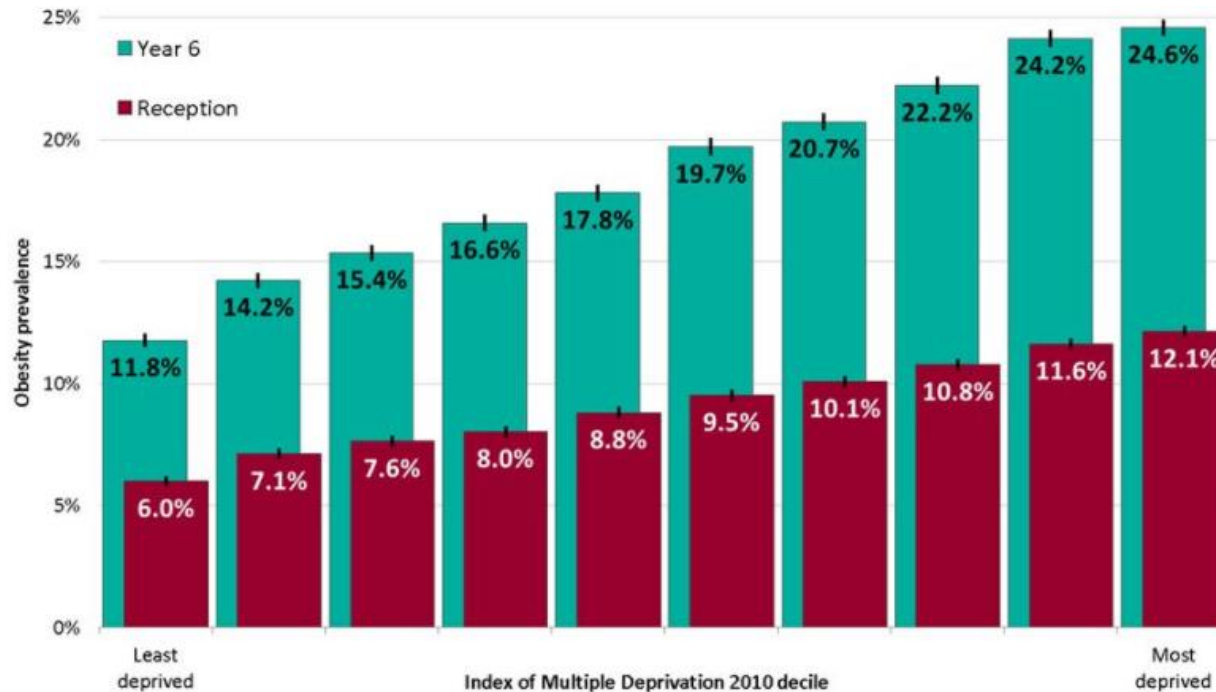


Source: Health and Social Care Information Centre (HSCIC)



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Social disparity – Child obesity

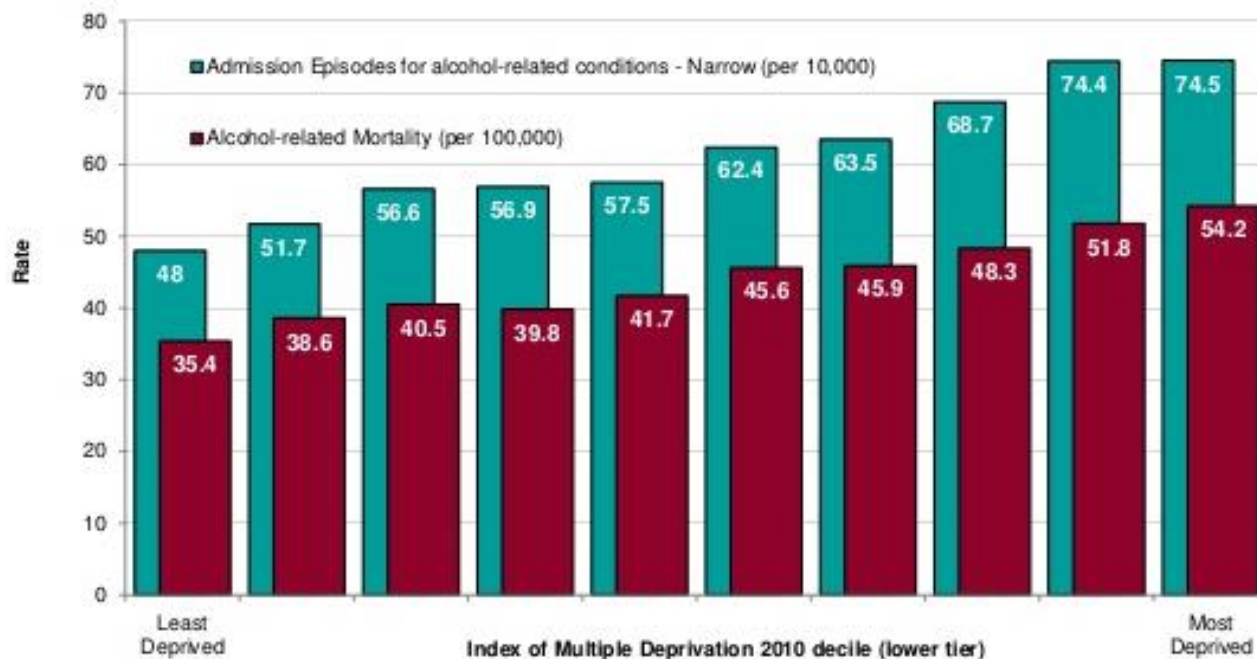


Source: Public Health England



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Social disparity – Alcohol use

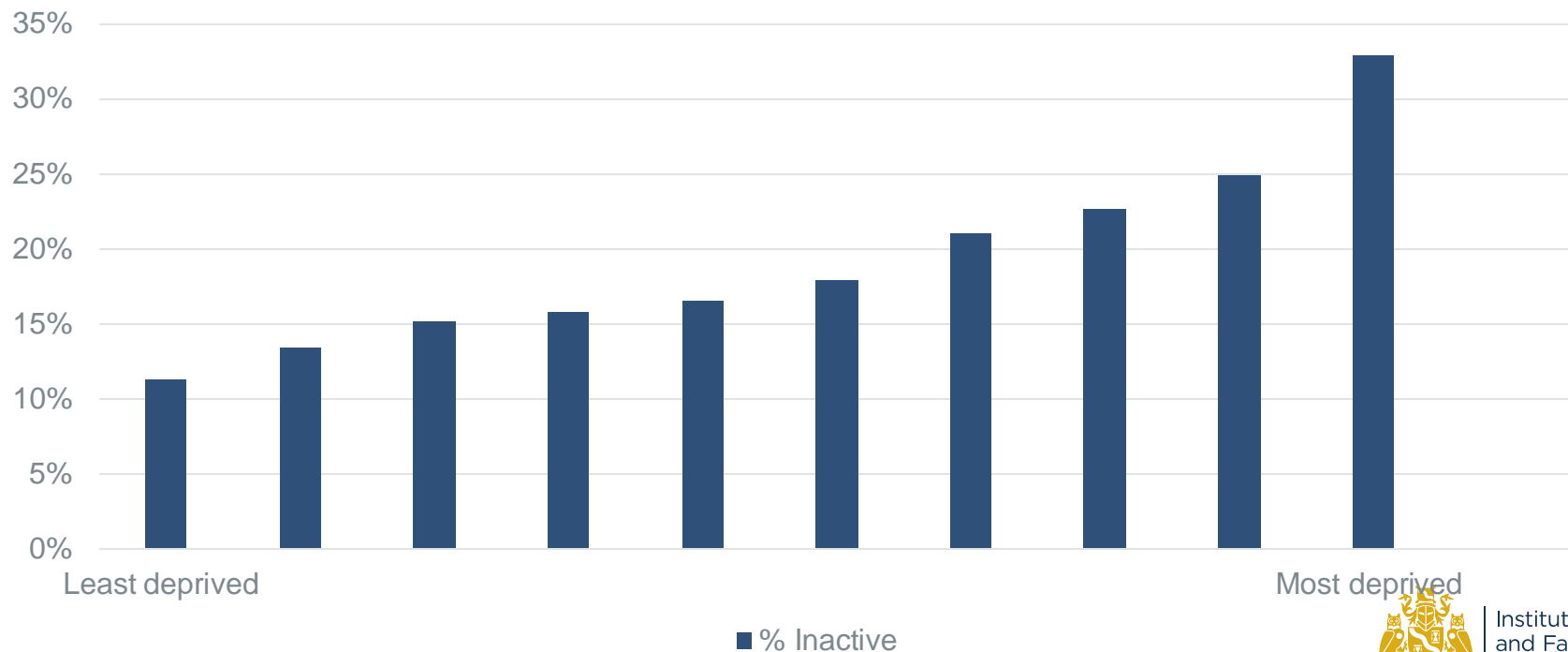


Source: Public health England



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Social disparity – Physical inactivity



Source: Public health England



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Medical Progress – the Next Generation

- Gains of medical progress can't repeat the old and will need new directions, but basics remain.....
- Prevention, early diagnosis, lifestyle improvements remain important
- What will make the difference?
 - Artificial intelligence
 - Genomics
 - Stem cell therapy



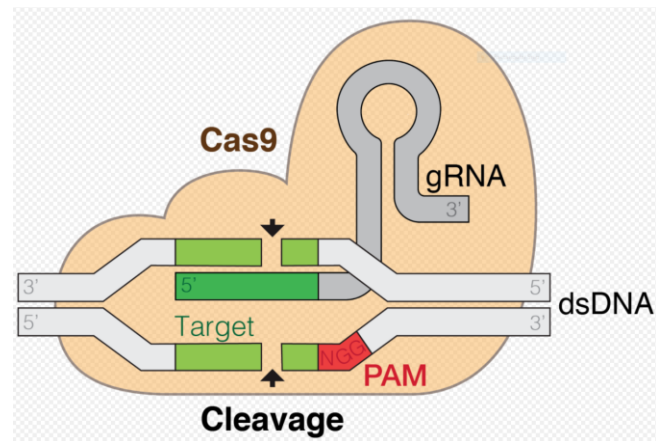
The Next Generation – Artificial Intelligence

- Diagnosis
 - interpreting images, AI software to analyse symptoms and signs
- Online consultations
 - Babylon 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
- Healthcare revolution
 - possible only if available to mainstream users



The Next Generation - Genomics

- Gene editing
 - CRISPR/Cas9 and other molecular scissors on cells outside body and re-infusing them
 - Infusing molecular scissors which are activated in target tissue, e.g. Hunter's syndrome in liver
 - 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



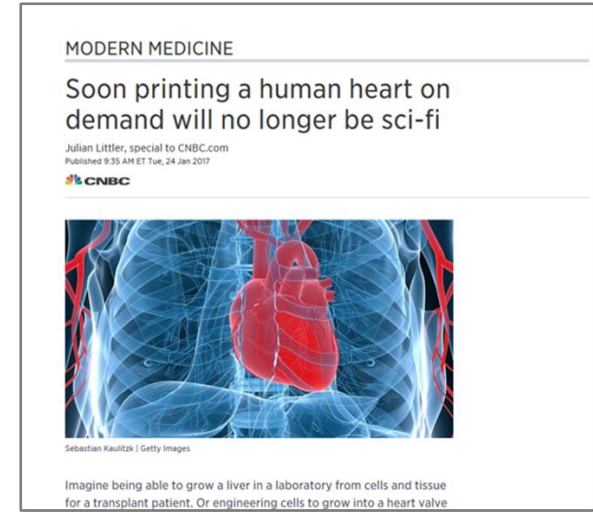
<https://upload.wikimedia.org/wikipedia/commons/5/51/GRNA-Cas9.png>



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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 blood)
 - thalassaemia, sickle-cell disease, leukaemia
- Microtissue platforms (“Organ on a chip”) mimics specific organ functions
 - Heart, kidney, lung
 - Testing of drugs & replace animal testing
 - Modelling diseases (cancer)



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Conclusions

- Gains in medical progress can't repeat the old and need new directions, but basics remain.....
- Prevention, immunization, screening, early diagnosis, lifestyle improvements
- Future medical gains in LE?
 - Artificial intelligence
 - Genomics
 - Stem cell therapy
- Potential losses in LE?
 - AMR, obesity, alcohol and drug abuse, pollution, climate change, population growth, food shortage, conflicts



Questions

Comments

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