Portfolio Review

Population and Public Health, 1990–2011

April 2013

wellcome trust

Population and Public Health, 1990–2011: Portfolio review

Strategic Planning and Policy Unit, Science Funding

Wellcome Trust

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The views expressed in this review are those of the Wellcome Trust project team.

Overview and key findings

Key abbreviations used in the report	
ALSPAC	Avon Longitudinal Study on Parents and Children
BCG	Bacille Calmette-Guérin
DOTS	Directly observed treatment, short-course
DSS	Demographic surveillance system
GAVI	Global Alliance for Vaccines and Immunisation
HRCS	Health Research Classification System
KEMRI	Kenya Medical Research Institute
LSHTM	London School of Hygiene and Tropical Medicine
MOPS	Major Overseas Programmes
MRC	Medical Research Council
NIH	US National Institutes of Health
PDP	Product development partnership
SARS	Severe acute respiratory syndrome
WHO	World Health Organization

1. This portfolio review aims to describe the key breakthroughs in population and public health-related research over the past two decades and attempts to identify the role of the Wellcome Trust within this. It is intended to help inform future funding strategy by bringing together expert reflections with views on current challenges and future research opportunities – both for the Wellcome Trust and for others involved in supporting population and public health research.

2. Between 1990 and 2011, the Wellcome Trust awarded 1741 grants (totalling £634 million) to population and public health-focused research, representing nine per cent of total funding commitment over this time period. Funding has been awarded within the UK and internationally, to researchers at different career stages and via project-based grants. In addition, more than £204m has been allocated during this time for core support and infrastructure at Wellcome Trust Centres and the Major Overseas Programmes (MOPs) in South-east Asia, Kenya and Malawi; much of their research has ultimate implications for population and public health research.

3. Using the UK Clinical Research Collaboration's Health Research Classification System to classify the portfolio, more than half of the Wellcome Trust's population and public health research supported over the past two decades has been 'aetiology' focused. Another 43 per cent has been 'infection' focused, covering research on infectious agents and pathogenic diseases. In addition, more than a quarter of funds (28.2 per cent) have been allocated to research of 'generic health relevance', which reflects the Trust's investments in cohort studies and prospective longitudinal research – where the subject focus of the research is broad – over this time.

The Wellcome Trust's key influences on the population and public health landscape

4. We conclude that there are four broad areas where the Wellcome Trust is thought to have made a significant impact on the field:

   - its long-term funding of projects and researchers, which has helped to nurture some of the current leaders in the field
   - its investment in research capacity building and infrastructure in low- and middle-income countries, which has helped to bring about several major discoveries of relevance to endemic health issues
   - its committed support to longitudinal studies, both in the UK and in low- and middle-income countries
   - its leading role in the open access and data sharing agenda, which is starting to have a significant impact upon research and associated research management, and policy in the field of population and public health.

The future of population and public health-related research

5. Through consultation with experts, two major priorities emerge for population and public health as a field: a need to continue to invest in and build research capacity in population and public health research, coupled with a need for more rigorous tools and methodologies to support the assessment and evaluation of interventions within populations.

6. Furthermore, emerging health-related challenges (including the increase in incidences of chronic diseases, ageing populations and the potential impact of climate change) are having an impact on potential priorities for researchers working in population and public health-related fields.

7. To conclude, there are four areas where active dialogue between funders, researchers and stakeholders is needed and action is required:

    - There is a need to consider whether existing funding mechanisms are appropriately structured to support the valuable multidisciplinary nature of population and public health research, both in the UK and beyond.
    - Population and public health research as a field needs to attract and retain high-quality researchers from a range of different backgrounds to build and sustain capacity. The current profile of population and public health, relative to other disciplines and other professions in which appropriately qualified researchers could work, may be deterring the retention of appropriately trained researchers. Could we do more?
    - One key factor that could enhance the profile and impact of the field would be the enhanced ability to rigorously evaluate public and population-based interventions and programmes – beyond the randomised controlled trial. Investment in the development of new methodologies is required to enable progress and innovation in population and public health.
    - More could be done to support the effective implementation and translation of research into practice. Can we now develop innovative solutions to speed up the translation of research findings into policy and practice?

Population and public health

Eighth century BCE
Earliest known reference to smallpox inoculation

Fifth century BCE
Hippocrates establishes foundations of modern medicine

Tenth to 15th century
People with leprosy isolated for disease control

1671
The Midwives Book published in England

1717
Malaria linked to exposure to mosquitoes

1753
Treatise on Scurvy published

1000 | 500 | CE | 500 | 1000 | 1500

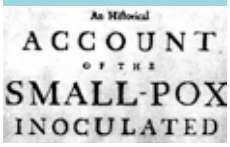
180–160 BCE
Concept of plague developed

1500s
Syphilis spreads through Europe

Mid-1500s
Regulations to prevent bubonic plague introduced in Europe

1700
Diseases of Workers published

1721–22
Inoculation for smallpox introduced in Britain



1796
Immunisation with matter from cowpox pustules is trialled

1840 | 1850 | 1860 | 1870 | 1880 | 1890 | 1900

1842
Chadwick's *Report on Sanitary Conditions* published

1845
The Lunacy Act

1848
The Public Health Act

1854
Spread of cholera attributed to contaminated water

1861
Florence Nightingale establishes school of nursing

1870
Pasteurisation process discovered

1882
Cause of tuberculosis identified as *Mycobacterium tuberculosis*

1898
Mosquitoes confirmed as malaria vector

Early 20th century
Germ theory developed

Key
- Scientific advance
- Advance in knowledge
- Funding development
- Policy development

1990
The National Surveys of Sexual Attitudes and Lifestyles (NATSAL) launched

Human Genome Project begins

1990s
Decline in sudden infant death syndrome (SIDS) after campaigns in Europe and the USA

1992
Hib vaccine becomes part of the routine childhood immunisation schedule in the UK

1994
The UN holds the International Conference on Population and Development in Cairo, Egypt; the meeting adopts recommendations for improving reproductive health services and the position of women in society

The WHO Region of the Americas (36 countries) is certified polio-free

1980 | 1981 | 1982 | 1983 | 1984 | 1985 | 1986 | 1987 | 1988 | 1989 | 1990 | 1991 | 1992 | 1993 | 1994 | 1995

1981
First documented cases of AIDS reported in the USA

1984
Researchers in France and the USA discover the retrovirus responsible for AIDS

Demographic and Health Surveys project launched

1986
Ottawa Charter frames the 'new public health'

1987
First antiretroviral HIV drug made available

WHO launches Global Programme on AIDS

1988
Widespread breast screening introduced in the UK

1991
A large-scale birth cohort study, the Avon Longitudinal Study of Parents and Children (ALSPAC), begins with the recruitment of more than 14 500 pregnant women in the Avon area of England

1993
WHO declares TB a global emergency

Cochrane Collaboration launched

World Development Report 1993: Investing in health published by the World Bank

1995
The Barker Hypothesis developed

Directly observed treatment, short-course (DOTS) strategy for controlling TB launched

Unless stated, all images are courtesy of the Wellcome Library, London (**images.wellcome.ac.uk**).
Fifth century BCE: Hippocrates. **180–160 BCE:** Galen of Pergamon, who wrote repeatedly about the Antonine Plague. **Tenth to 15th century:** A lepers' retreat (15th century). **1671:** The title page from the third edition of *The Compleat Midwife's Companion*. **1700:** Bernardino Ramazzini. **1717:** A mosquito feeding. **1721–22:** The title page from *An Historical Account of the Small-pox Inoculated in New England*. **1753:** The title page from *A Treatise of the Scurvy*. **1796:** A hand infected with cowpox. **1898:** Sir Ronald Ross. **Early 20th century:** The Germ Theory of Putrefaction, from the papers of Joseph Lister. **1921:** An early birth control clinic. **1928:** Sir Alexander Fleming. **1935:** A tube of Prontosil tablets. *Science Museum, London/Wellcome Images* **1939–45:** A colour lithograph to warn about mosquitoes. **1943:** A Salman Waksman. **1945:** Penicillin-resistant *Staphylococcus aureus*. *Wellcome Images* **1950s:** Polio vaccine is dropped onto a sugar lump for a child. **1954:** A woman smoking. *Anthea Sieveking/Wellcome Images* **1955:** A model of a vintage Porsche. **1960:** Oral contraceptive pills. *Wellcome Images* **1974:** Syringes and needles. *Paul Griggs/Wellcome Images* **1977:** Detail from a Japanese woodcut representing smallpox being repelled. **1978:** Digital artwork on diagnosis and treatment. *Neil Leslie/Wellcome Images* **1984:** Cut-away model of HIV. *John Wildgoose/Wellcome Images* **1987:** AIDS ribbon. *Stevie Taylor/Wellcome Images* **1988:** Mammography consultation. *Wellcome Images* **1990s:** A baby lying on his back (considered by doctors the best sleeping position to avoid SIDS). *Anthea Sieveking/ Wellcome Images* **1991:** Schoolchildren. *Fiona Pragoff/Wellcome Images* **1992:** A baby receives the Hib, diphtheria and whooping cough vaccine. *Wellcome Images* **1995:** Tuberculosis seen via X-ray. *Wellcome Images* **1998:** A mosquito on a bednet in contact with skin. *Wellcome Images* **2001:** A travelling HIV testing clinic. *Clive Chilvers/Wellcome Images* **2002:** Test-tubes at the UK Biobank. **2003:** SARS illustration. *Wellcome Images* **2009:** A model of the H1N1 virus ('swine flu'). *Anna Tanczos/Wellcome Images*

1918–19
Pandemic influenza causes more than 50 million fatalities across the world

1920
First human trials with the attenuated viable vaccine Bacille Calmette-Guérin (BCG)

1920s
Technology to mass produce latex condoms developed

1928
Penicillin discovered

1930
National Birth Control Council formed in the UK

1939–45
World War II prompts global action against malaria

1943
Streptomycin developed

1946
World Health Organization (WHO) founded

1950s
Vaccines for polio prevention developed by American medical researchers

1954
Link between smoking and lung cancer established

1958
The National Child Development Study (1958 Birth Cohort) launched

1960
First oral contraceptive pill approved

1970
Victoria, Australia, becomes first state to legislate compulsory seat belt use

1970s
Asylums to treat mental illness patients gradually replaced by pharmaceutical treatments

1977
Smallpox eradicated worldwide

1910 1920 1930 1940 1950 1960 1970

1921
UK's first family planning clinic founded

1935
Prontosil, the first commercially available antimicrobial, developed

1940s
Large-scale food fortification begins

1945
Penicillin-resistant *Staphylococcus aureus* emerges

1948
Britain's NHS established

Randomised controlled trials (RCTs) introduced

1953
BCG vaccination introduced in secondary schools in the UK

1955
Research on the link between seat belt use and injury prevention in automobiles published

1961
Methicillin-resistant *S. aureus* (MRSA) emerges in the UK

1967
Association for the Study of Obesity (ASO) established

1974
WHO launches Expanded Program of Immunization

1978
Declaration of Alma-Ata

2002
Global Fund to Fight HIV/AIDS, Malaria and Tuberculosis launched

UK Biobank project approved

2000
Millennium Development Goals (MDG) launched

The WHO Western Pacific Region (37 countries and areas, including China) is certified polio-free.

UN establishes the Millennium Development Goals

The WHO European Region (51 countries) is certified polio-free

2007
Health Act prohibits smoking in most enclosed spaces in the UK

The WHO and UNAIDS announce recommendations on male circumcision for HIV prevention

2009
WHO declares H1N1 pandemic

1996
World Health Assembly passes resolution on violence as a public health issue

2005
Framework Convention on Tobacco Control established

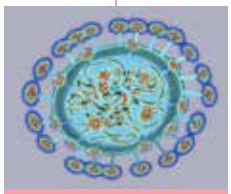
1996 1997 1998 1999 2000 2001 2002 2003 2004 2005 2006 2007 2008 2009 2010 2011

1998
Link between MMR vaccine and risk of autism suggested in the *Lancet*, causing major public health scare and a rise in measles in the UK, despite the later retraction of the findings

WHO launches the Roll Back Malaria Campaign

2001
First HIV testing in the Demographic and Health Surveys

UN holds special General Assembly session on HIV/AIDS



2003
Global outbreak of SARS

2006
European Commission launches *E-health ERA Project* to help establish a European e-health research agenda

ACTs (artemisinin-based combination therapies) developed and recommended by WHO as first-line malaria treatment

WHO reports evidence of human-to-human transmission of H5N1

2008
HPV vaccination for girls aged 12–13 provided in schools in the UK

Commission on the Social Determinants of Health publishes final report

GAIN-UNICEF Universal Salt Iodization Partnership Project established

2011
UN High-Level Meeting on Non-Communicable Diseases

UK Government calls for action on obesity in England

Phase III trial of RTS,S/AS01 malaria vaccine yields first results

UN High-Level Meeting on AIDS

1. Introduction

- Over the past two decades, the Wellcome Trust has committed more than £630m to population and public health research activities and initiatives through its traditional responsive-mode project and career-based funding mechanisms and, more recently, through its support for longitudinal and cohort-based research.

1. In 1996, the Trust first formally established a population-based research funding programme – the Population Studies Programme. The Programme was funded for five years and evolved to become the Health Consequences of Population Change Programme in 2000. In 2004, the Population and Public Health funding stream was established, with an expanded remit that removed the need for a fixed-term, focused programme. The Population and Public Health stream now supports research into the determinants of disease and the quality of life in populations and aims to provide a sound evidence base to inform decisions in public health.

2. In this field of research, the Trust has actively engaged in several funding partnerships; for example, one with the Medical Research Council (MRC) and UK Department of Health for UK Biobank, one with the UK Department for International Development in its Health Research Capacity Strengthening Initiative, and one with the Indian Government to support the Public Health Foundation of India to build capacity to translate research into practice. In this area of research, perhaps more than any other supported by the Trust in recent decades, funding has been international in much of its focus.

Portfolio review: aims and methodology

3. This is the fourth in a series of subject-based portfolio reviews intended to assess the impact of the Trust's funding in areas of strategic importance to the Wellcome Trust. The review has four specific aims:

    - to describe the landscape of Wellcome Trust funding in the area of population and public health research since 1990
    - to identify the key landmarks and influences on the population and public health research landscape over the past two decades (1990–2011)
    - to consider what the Wellcome Trust's key inputs and influences on the landscape have been
    - to consider the current and potential challenges for population and public health-related research and where there might be opportunities for the Wellcome Trust (and other funders).

4. With any review of research outcomes, a challenge for funders is to understand their role among the range of influences involved in shaping research. We have identified where the Wellcome Trust is thought to have had a significant and influential role in the field.

5. The review involved four specific streams of work:

    - A landscape analysis of major funding sources for population and public health research over the past two decades (see Annex C for details of the funding analysis). This is accompanied by the production of a Timeline of key advances and events, focusing particularly on 1990 to the present day (Annex E).
    - Narrative case studies of several major Wellcome Trust investments in the field and their impact to date. Case studies were selected to reflect the range of funding approaches adopted by the Trust in supporting this field over time.
    - An online consultation survey was used to gather current researchers' opinions on future priorities and opportunities in the field (see Annex B for details of the survey approach). A total of 235 active population and public health researchers were contacted, and 60 responses were received (28 per cent).
    - An expert group (n = 15, plus a Chair) were invited to discuss the status of population and public health research between 1990 and 2011. Experts were selected to cover the range of interests in population and public health and to ensure maximum relevance to the review's aims. Half of the experts had a working knowledge of the Wellcome Trust over the period in question (i.e. they were in receipt of significant Trust funding or involved in a Funding Committee). The specific goals of this meeting were to discuss important research priorities, identify factors preventing future progress and provide recommendations to overcome these obstacles.

Definition of population and public health

6. The field of 'population and public health research' is broad, and it is difficult to define what should be included. Nevertheless, 'population and public health' is a well-used term to describe a particular research field.

7. For the purposes of this review, research supported by the Wellcome Trust and classified as 'population and public health-related' is as follows:

    - all grants reviewed by the Wellcome Trust 'Population and Public Health' and 'Consequences of Population Change' funding committees[1]
    - all grants focusing on the measurement, study and evaluation of risk factors
    - population-based clinical trials and interventions that have had a direct impact on the health of the population studied, such as vaccines or bednets
    - MH&E grants focused on population health and health services
    - health-focused genetic research grants not included in the 2010 Human Genetics Portfolio Review.

8. Although we acknowledge that some population genetics and genomics research can be considered 'population science', the review excluded any detailed consideration of the following:

    - animal population studies
    - non-human genome projects
    - pathogen population genetics.

[1] This includes areas such as epidemiology, demography, reproductive health, social science and health economic studies, multifactorial studies of disease and complex interactions using longitudinal and case–control studies, health informatics, healthcare systems and policy research, and small or pilot non-pharmacological intervention studies, particularly those investigating behavioural change.

2. Population and public health: research landscape

9. Modern population and public health has a long history. The first mortality and morbidity statistics were collected in the 19th century by the 'Sanitarians', who were responsible for many key social and sanitary reforms. Important figures include John Snow, often called 'the father of epidemiology' for his work in identifying the source of a cholera outbreak in Soho in 1854, and Edwin Chadwick, whose studies secured the passing of the Public Health Act in 1848.

10. The development of the germ theory of disease in the latter half of the 19th century caused the field of public health to undergo a huge change. Although the theory received initial resistance, the evidence supporting it increased with the identification of the agents responsible for several diseases, including tuberculosis, diphtheria and cholera. Germ theory evolved to include concerns about disease hosts and the environment, and ultimately led to the development of interventions including pasteurisation, vaccinations and antibiotic use.

11. In the second half of the 20th century, high-income countries experienced an 'epidemiological transition'. As mortality from infectious diseases decreased, levels of chronic diseases – such as heart disease or cancer – increased to become significant causes of morbidity and mortality. As these diseases were not found to have a specific or single cause, public health research shifted from 'mono-causal' to 'multi-causal' to understand the causes of chronic disease.

12. The scope of public health began to broaden with the recognition that personal behaviours (such as diet or alcohol, tobacco and drug use) could contribute to chronic diseases. One of the most significant changes in public health thinking and strategy in recent years has been the recognition that social factors such as income, education and the environment affect health.

13. In Britain, the 1980 Black Report provided comprehensive documentation of the massive social inequalities in public health in the UK.[2] This was followed by the 1998 Acheson Report and the 2004 Wanless Report, which highlighted the need for healthcare to place greater emphasis on the prevention of illness and the promotion of good health.[3,4]

14. As the field has evolved, so have the research tools and statistical methodologies needed to measure population health and evaluate the impact of interventions. Developments in techniques to support health and disease surveillance have led to improved estimates of disease burden and are helping to define research priorities, although there is a considerable way to go to ensure accurate, global estimates of morbidity and mortality.

Today's major global research funders of population and public health research

15. The USA is the largest overall funder of public health programmes and research, mainly through the National Institutes of Health (NIH). The Centers for Disease Control and Prevention also takes a leading role in disease monitoring.

16. In the past decade, the Bill and Melinda Gates Foundation has become the largest non-governmental funder of population and public health programmes; it spent more than $455m in 2010.[5] Its Global Health Programme focuses on reducing the overall burden from HIV/AIDS, malaria, tuberculosis and neglected diseases. The Programme also works across other relevant areas, including nutrition, vaccine-preventable diseases, contraception, and maternal and child health.

17. According to the 2011 Global Funding of Innovation for Neglected Diseases (G-FINDER) survey, the three diseases that received the most research funding in 2010 were HIV/AIDS, tuberculosis, and malaria.[6] Total funding for HIV/AIDS research was $1.07bn, a reduction of 5.9 per cent from 2009. More than 60 per cent of this funding was awarded by the US National Institutes of Health. Total

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[2] DHSS. Black Report: Inequalities in Health: Report of a research working group. 1980. **www.sochealth.co.uk/public-health-and-wellbeing/poverty-and-inequality/the-black-report-1980/**
[3] Department of Health. Acheson Report: Independent inquiry into inequalities in health report. 1998.
[4] Department of Health. Wanless Report: Securing good health for the whole population. 2004.
[5] G-FINDER Report 2011: Neglected Disease Research and Development: Is innovation under threat?
[6] Source: G-FINDER Report 2011.

funding for tuberculosis research was $575.4m in 2010; the majority of funding came from industry sources, the NIH and the Gates Foundation. $547m was spent on malaria research, spread among the top funders.[6]

18. The Wellcome Trust is the UK's largest non-governmental funder of biomedical research and had a total expenditure of £642m in 2011. Over the past two decades, the Trust has committed more than £630m to population and public health research activities and initiatives. The Trust also funds work to place public health and policy research into its historical and cultural context, through its medical history and humanities and public engagement programmes.

19. In 2007, the European Commission published *Together for Health: A strategic approach for the EU 2008-13*, which set out a strategy to tackle growing health issues. This document included recommendations to support healthy ageing, respond rapidly to global health threats and promote the use of new technologies to improve health. Public health projects were funded by the EU Health Programme 2008–2013, which had an overall budget of €321.5m.[7] The European Commission Seventh Framework Programme for 2007–2013 contained a budget of €6.1bn for health research.[8] The next framework programme, Horizon 2020, is currently under development with a dedicated science budget of €24.5bn.[9]

20. In the UK, population and public health funding is provided by the Research Councils, notably the MRC and the National Institute for Health Research. The Economic and Social Research Council also funds research into public health.

21. Over the past decade, product development partnerships (PDPs), public–private partnerships that aid drug development in low- to middle-income countries, have become increasingly important in supporting research in the population and public health field. PDPs bring together partners from academia, industry, the public sector and international agencies to overcome the difficulties associated with developing products that have high R&D costs and long development times. Today, the PDP pipeline is estimated to have more than 90 biopharmaceutical candidates and 32 diagnostic and vector control candidates in development for a range of neglected diseases.[10]

22. With their continuing economic and population growth, middle-income countries are playing an increasing part in population and public health research. In February 2012, India announced plans to increase overall health funding from around 1.4 per cent of GDP to 2.5 per cent by the end of their Twelfth Five Year Plan (2012–2017). This is projected to include proposals for strengthening health facilities, extending universal health coverage and improving disease surveillance and prevention.

23. China has seen a significant rise in health and research spending over the past decade, and overall spending is expected to reach $36.1bn in 2012. In 2011, the Chinese Academy of Sciences announced its 'Innovation 2020' plan, focusing on translational research, which includes health as one of its key focus areas. Pilot projects have been initiated in seven areas, including public health and the environment.

24. Several African countries have also seen significant expansion in the number of public health research centres and programmes, such as the South African Medical Research Council, which in 2012 had more than 40 research units and groups. Population and public health research has also become an increasing priority across other middle-income countries such as Brazil.

A growing field of research?

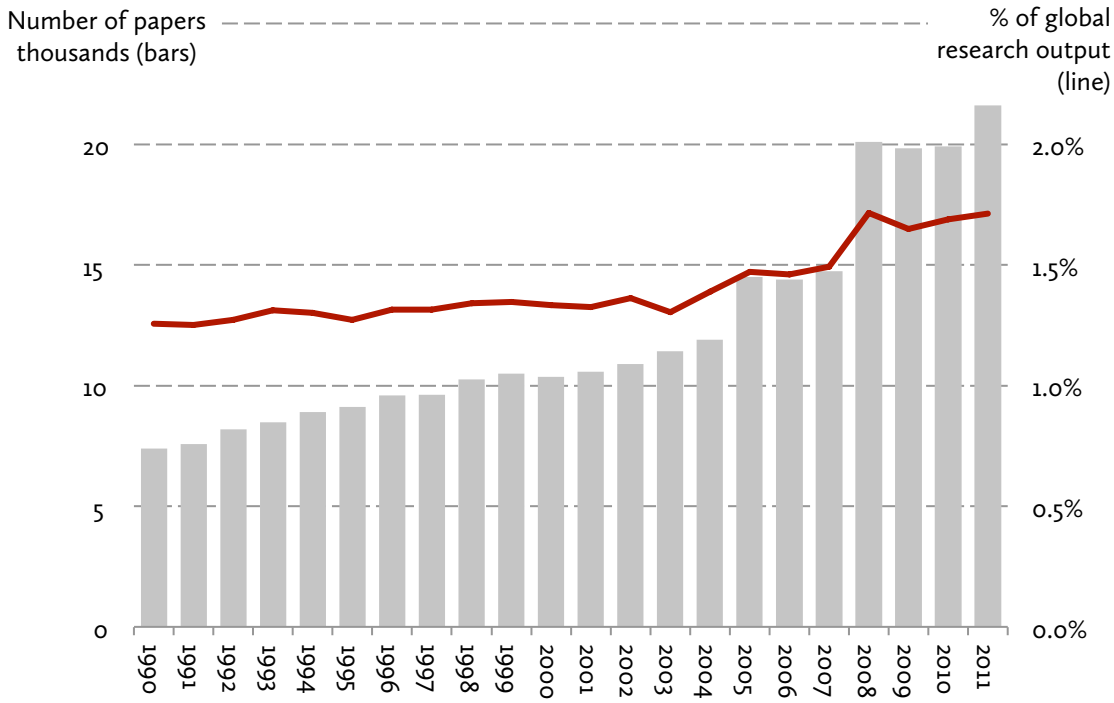
25. The increase in funding for population and public health-related research over the past two decades is reflected in the associated peer-reviewed publication output. Using the predefined Thomson Reuters category 'public, environmental and occupational health' as a proxy for population and public health, the absolute volume of publications has increased from 7568 papers in 1991 to more than 21 000 papers in 2011, as shown in Figure 1. In 1991, these research papers

[7] **ec.europa.eu/health/programme/policy/2008-2013/index_en.htm**
[8] **cordis.europa.eu/fp7/health/**
[9] **ec.europa.eu/research/horizon2020/index_en.cfm?pg = h2020**
[10] **www.dfid.gov.uk/Documents/publications1/hdrc/lssns-pdps-estb-dev-new-hlth-tech-negl-diseases.pdf**

represented about 1.3 per cent of all global research publications; by 2011, this proportion had increased to 1.7 per cent.

26. Although the Thomson Reuters category covers broadly similar areas of research to the Wellcome Trust's own population and public health portfolio, it is not an exact representation of this area of research. In addition, given the complexity in defining population and public health and the likelihood that publication outputs will be found across other Thomson Reuters categories, this trend should be interpreted with the usual cautions surrounding bibliometric data.

Figure 1. Growth in 'public, environmental and occupational health' papers – number and percentage of all research papers, 1990–2011



Data: Thomson Reuters National Science Indicators 2011.

Key developments

27. We asked the respondents of our online survey (see Annex B for details) what they believed were the most important developments in population and public health research. Table 1 shows their responses, highlighting that improvements in methodology and results analysis were considered most important.

Table 1. Top five key developments in population and public health research

Development	Frequency
Development in study design and analysis	24
Recognition of the importance of social determinants of health; the application of economic and social science theories and methods to public health research	20
Research on the prevention, control and treatment of HIV/AIDS	15
The emergence of genetic epidemiology	14
Recognition of the importance of evidence-based medicine and interventions and their link with policy	11

Source: Population and public health consultation survey, Wellcome Trust Evaluation Team, April 2012.

3. Wellcome Trust and population and public health research: detailed view

28. Over the past two decades, the Wellcome Trust has supported a range of population and public health-based research activities and initiatives (both in the UK and in low- and middle-income countries) that have contributed to key developments in the field, such as new guidelines for HIV and malaria prevention.

Wellcome Trust funding analysis

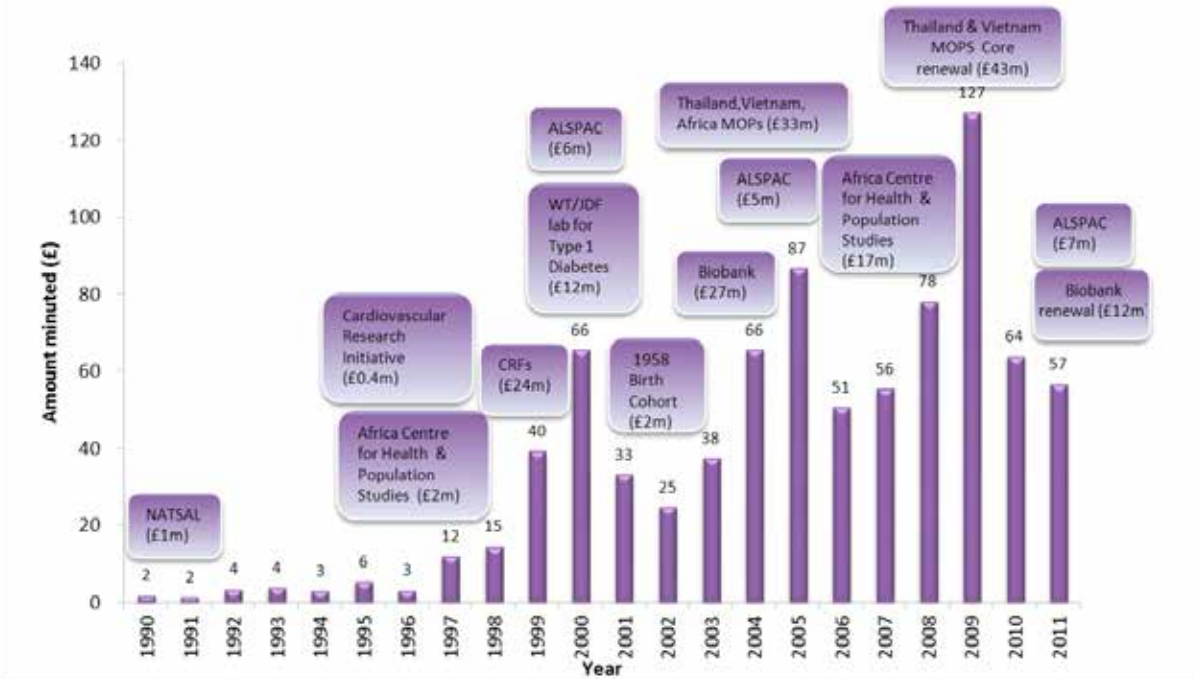
29. Between 1990 and 2011, the Trust awarded 1741 grants (totalling £634m) to population and public health-focused research, representing more than nine per cent of the Trust's total funding commitment for the period (Figure 2 and Table 2). Funding has been awarded within the UK and internationally to researchers at different career stages and via a range of schemes.

30. A total of 546 population and public health grants, totalling £145m, have been career-based, supporting individual researchers. These include studentships (£15m), early career fellowships (£31m), intermediate fellowships (£35m), Senior and Principal research fellowships (£61m), and the Investigator Awards scheme (£3m) (Table 3).

31. 1195 grants, totalling £489m, were awarded to research and project support. These include strategic awards (£60m), equipment grants (£5m), project grants (£132m) and programme grants (£120m).

32. An additional 47 grants, totalling £204m, were allocated for core support and infrastructure at Wellcome Trust Centres and the MOPs in South-east Asia, Kenya and Malawi. These grants were kept separate during analysis as the funds mainly support infrastructure that facilitates population and public health research.

Figure 2. Wellcome Trust funding for population and public health research, including core support and infrastructure funding for Wellcome Trust Centres and MOPs, 1990–2011 (£m)[a,b,c]



[a] Data from the Wellcome Trust grants system are 'commitment'.
[b] Data are rounded to the nearest £m.
[c] Excludes Wellcome Trust running costs.
Base: 1788 Wellcome Trust population and public health grants associated with population and public health research, including core support and infrastructure for Wellcome Trust Centres and MOPs.
Source: Wellcome Trust AS400.

Table 2. Wellcome Trust funding for population and public health research, 1990–2011[a,b]

Year	Wellcome Trust grant funding (commitment, £m)[c]	Wellcome Trust population and public health funding[d]	
		£m	Percentage of WT grant funding
1990	53	2	4%
1991	60	1	2%
1992	86	4	5%
1993	437	4	1%
1994	193	3	2%
1995	198	6	3%
1996	168	3	2%
1997	222	11	5%
1998	212	15	7%
1999	354	15	4%
2000	480	41	9%
2001	388	33	9%
2002	419	25	6%
2003	395	37	9%
2004	258	66	26%
2005	344	43	13%
2006	325	41	13%
2007	359	56	16%
2008	525	51	10%
2009	531	78	15%
2010	473	42	9%
2011	437	57	13%
Total	6917	634	9%

[a] Data from the Wellcome Trust grants system are 'commitment'.
[b] Data are rounded to the nearest £m.
[c] Excludes Wellcome Trust running costs.
[d] Excludes core support and infrastructure funding for Wellcome Trust Centres and MOPs. One Wellcome Trust MOP, the Africa Centre for Health and Population Studies, is included because its core support and infrastructure has been used to support population and public health research; see funding analysis methods in Annex B.
Base: 1788 Wellcome Trust grants associated with population and public health research.
Source: Wellcome Trust AS400.

Table 3. Wellcome Trust funding for population and public health research by grant type, excluding core support and infrastructure funding for Wellcome Trust Centres and MOPs[a]

Grant type	Number of grants	Amount (£m)[c]	Percentage of total population and public health funding
Personal funding			
Studentship	190	15	2%
Early career fellowship	186	31	5%
Intermediate fellowship	123	35	6%
Senior/principal research fellowship	46	61	10%
Investigator Award	1	3	0.50%
Total personal funding	546	145	23%
Research funding			
Project	594	132	21%
Programme	78	120	19%
Strategic Award	20	60	9%
Strategic Translation Award	7	26	4%
Technology Development Grant	8	9	1%
Translation Award	7	3	0.50%
HCPC Major Award to Latin America*	4	4	1%
Affordable Healthcare In India	2	12	2%
Health Innovation Challenge Fund	1	1	0.20%
Global Health Trials Award	1	0.4	0.10%
UK Biobank	4	41	6%
Africa Centre for Health and Population Studies	31	47	7%
African Institutions Initiative	5	6	1%
Cardiovascular Research Initiative	1	0.4	0.10%
Equipment	12	5	1%
Joint Infrastructure Award	1	7	1%
University Award	11	4	1%
Biomedical Ethics	49	1	0.20%
History of Medicine	137	5	1%
Public Engagement	73	4	1%
Other**	149	3	0.50%
Total research funding	1195	489	77%
Total	1741	634	

[a] One Wellcome Trust MOP, the Africa Centre for Health and Population Studies, is included because all of the core support and infrastructure has been used to support population and public health research; see funding analysis methods in Annex B.
[b] Data are rounded to the nearest £m.
[c] Percentages are rounded and might not equal 100 per cent.
* The Health Consequences of Population Change Programme.
** 'Other' includes Symposium (£2m), Research Leave and Travel Awards (£1m); see Table 2 in Annex C.
Base: 1741 Wellcome Trust grants associated with population and public health research, excluding core support and infrastructure funding for Wellcome Trust Centres and MOPs.
Source: Wellcome Trust AS400.

33. To provide an overview of the subject focus of the population and public health grants funded by the Trust over the past two decades, all grants were classified according to the Health Research Classification System (HRCS).[11] The distribution of Trust grants by research activity type is represented in Figure 3. Between 1990 and 2011:

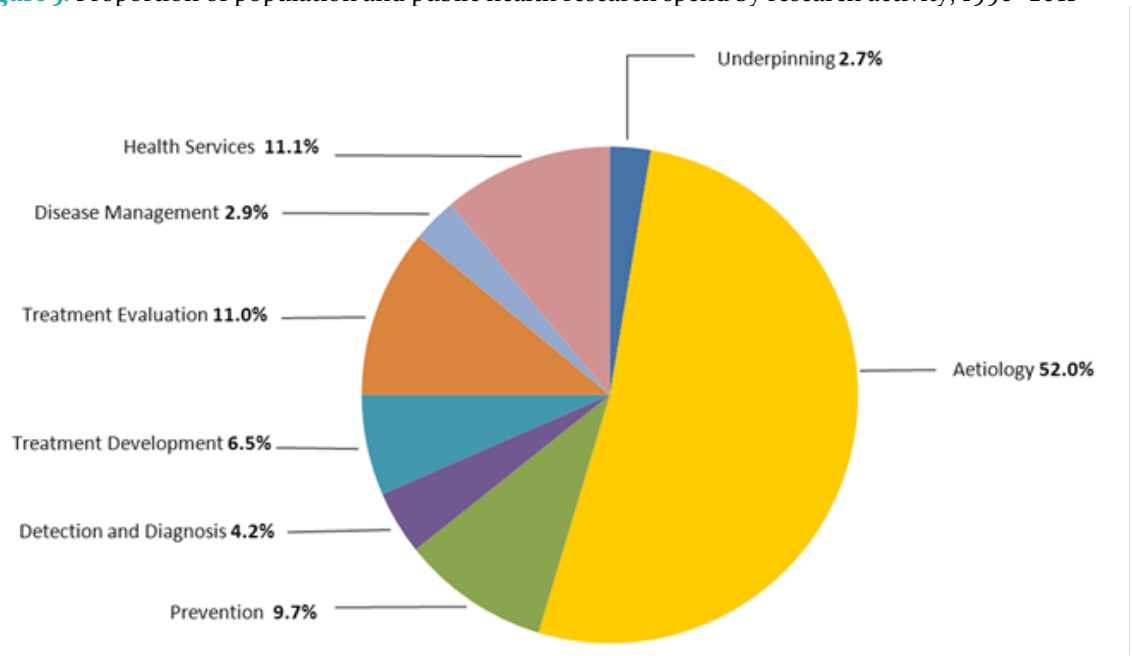
    - More than half (52 per cent) of Trust population and public health funding supported aetiology-focused research, which includes modelling complex epidemiological data.

[11] The HRCS, which was developed in 2004/05, categorises research according to area of health or disease and the type of research activity taking place. Full details of the HRCS can be found on the UK Clinical Research Collaboration's website, **www.ukcrc.org/researchcoordination/**.

- 11.1 per cent of research supported health services research, which includes the evaluation of health and social care interventions, and healthcare policy.
- Treatment development and treatment evaluation accounted for 6.5 per cent and 11 per cent of funding, respectively. Treatment development includes therapeutic discovery, development and testing in model and preclinical systems. Treatment evaluation includes the testing and evaluation of therapeutic interventions.

34. A breakdown of the major research activity codes into their sub-codes is shown in Table 4.

Figure 3. Proportion of population and public health research spend by research activity, 1990–2011



Base: 1765 Wellcome Trust grants associated with population and public health research. Total spend: £837m.
Source: Wellcome Trust AS400.

Figure 4. Top 20 population and public health research grants by research activity code, 1990–2011

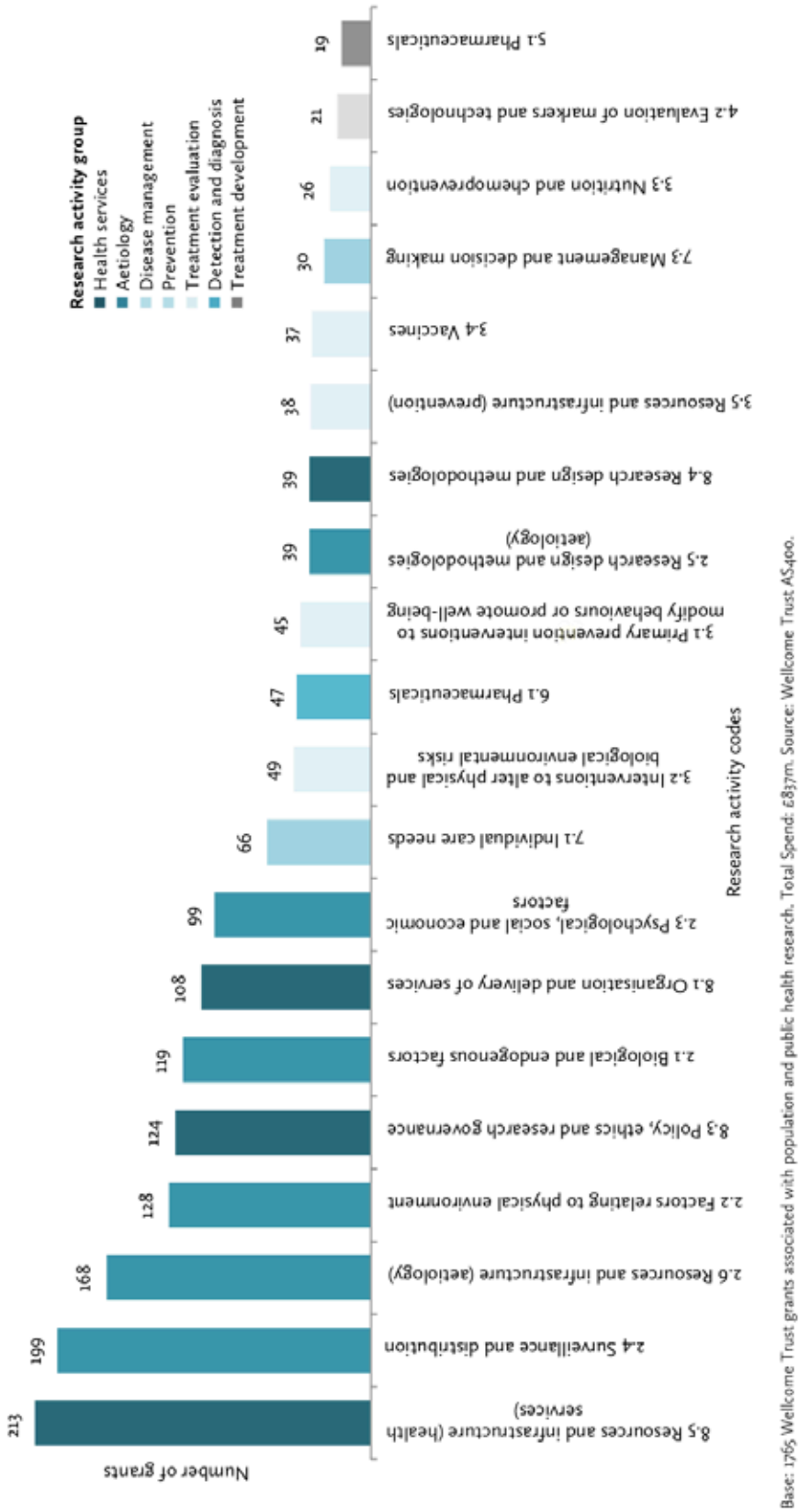


Table 4. Proportion of population and public health research spend by research activity sub-code

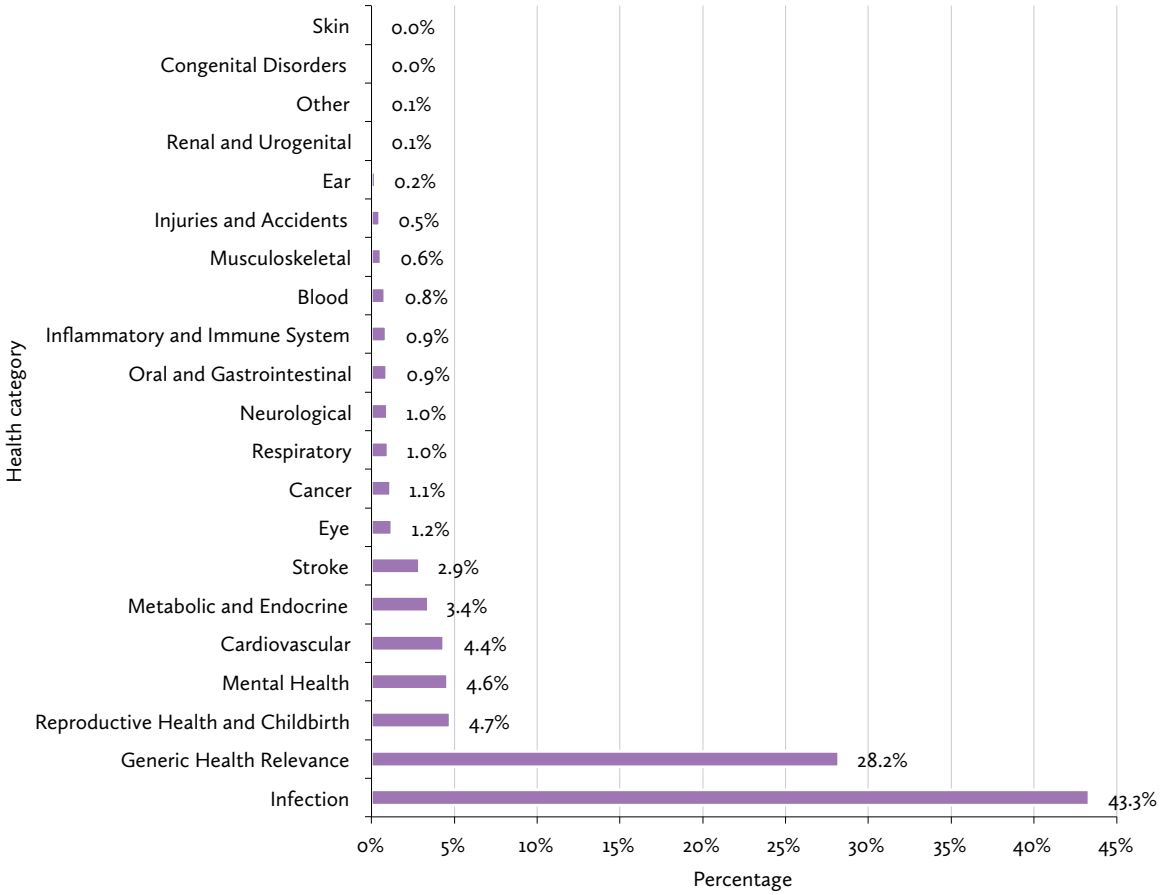
	Percentage of total spend
Underpinning research (2.7%)	
1.1 Normal biological development and functioning	1.5%
1.2 Psychological and socioeconomic processes	0.2%
1.3 Chemical and physical sciences	<0.1%
1.4 Methodologies and measurements	0.1%
1.5 Resources and infrastructure (underpinning)	0.9%
Aetiology (52%)	
2.1 Biological and endogenous factors	11.8%
2.2 Factors relating to physical environment	5.2%
2.3 Psychological, social and economic factors	3.5%
2.4 Surveillance and distribution	13.7%
2.5 Research design and methodologies (aetiology)	1.5%
2.6 Resources and infrastructure (aetiology)	16.3%
Prevention of disease and conditions, and promotion of well-being (9.7%)	
3.1 Primary prevention interventions to modify behaviours or promote well-being	1.7%
3.2 Interventions to alter physical and biological environmental risks	1.9%
3.3 Nutrition and chemoprevention	1.2%
3.4 Vaccines	4.2%
3.5 Resources and infrastructure (prevention)	0.6%
Detection, screening and diagnosis (4.2%)	
4.1 Discovery and preclinical testing of markers and technologies	2.2%
4.2 Evaluation of markers and technologies	1.2%
4.3 Influences and impact	0.1%
4.4 Population screening	0.5%
4.5 Resources and infrastructure (detection)	0.1%
Development of treatments and therapeutic interventions (6.5%)	
5.1 Pharmaceuticals	4.0%
5.2 Cellular and gene therapies	0.7%
5.3 Medical devices	0.3%
5.4 Surgery	<0.1%
5.6 Psychological and behavioural	0.2%
5.7 Physical	<0.1%
5.9 Resources and infrastructure (development of treatments)	1.2%
Evaluation of treatments and therapeutic interventions (11%)	
6.1 Pharmaceuticals	5.7%
6.2 Cellular and gene therapies	<0.1%
6.3 Medical devices	<0.1%
6.4 Surgery	<0.1%
6.6.Psychological and behavioural	0.6%
6.7 Physical	0.1%
6.8 Complementary	<0.1%
6.9 Resources and infrastructure (evaluation of treatments)	4.4%
Management of diseases and conditions (2.9%)	
7.1 Individual care needs	1.8%
7.2 End of life care	<0.1
7.3 Management and decision making	1.1
7.4 Resources and infrastructure (disease management)	0.1%
Health and social care services research (11.1%)	
8.1 Organisation and delivery of services	2.9%
8.2 Health and welfare economics	0.1%
8.3 Policy, ethics and research governance	2.3%
8.4 Research design and methodologies	0.8%
8.5 Resources and infrastructure (health services)	5.0%

Base: 1765 Wellcome Trust grants associated with population and public health research. Total spend: £837m.
Source: Wellcome Trust AS400.

35. The HRCS includes categories for the classification of 'health' (or disease) type; the relative distribution of Wellcome Trust population and public health research funding across these categories is presented in Figure 5.

36. The highest proportion of funds (43.3 per cent) have been directed at 'infection', which includes pathogenic diseases, HIV/AIDS, sexually transmitted infections and research on infection and infectious agents. In addition, more than a quarter of funds (28.2 per cent) have been allocated to research of 'generic health relevance', which is likely to reflect the Trust's investments in cohort studies and prospective longitudinal research.

Figure 5. Proportion of population and public health research spend on health-specific categories, 1990–2011



Base: 1765 Wellcome Trust grants associated with population and public health research. Total spend: £837m.
Source: Wellcome Trust AS400.

37. The change in the proportion of Wellcome Trust population and public health research spending can be seen in Figure 6, below. Research funding has diversified from 1990, when it was spent almost entirely on aetiology, to include all the disciplines listed, albeit at lower levels.

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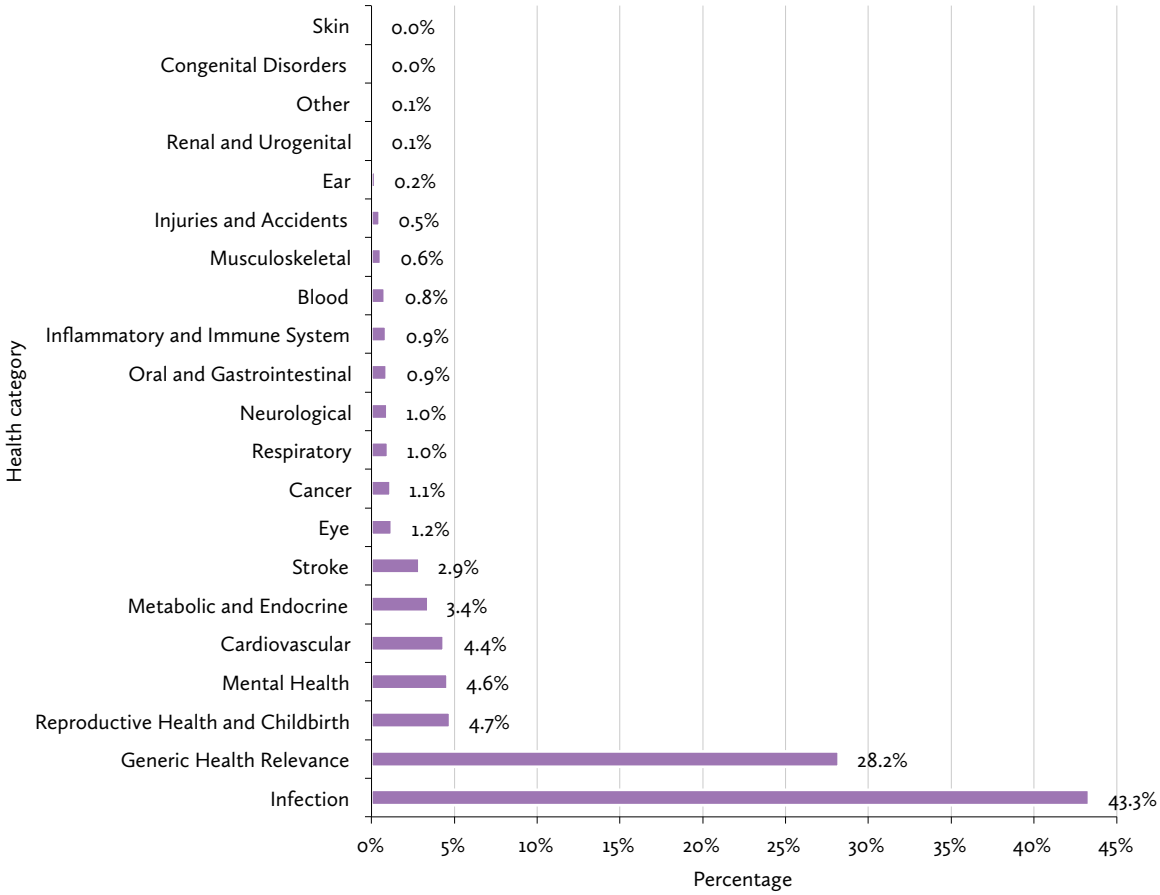

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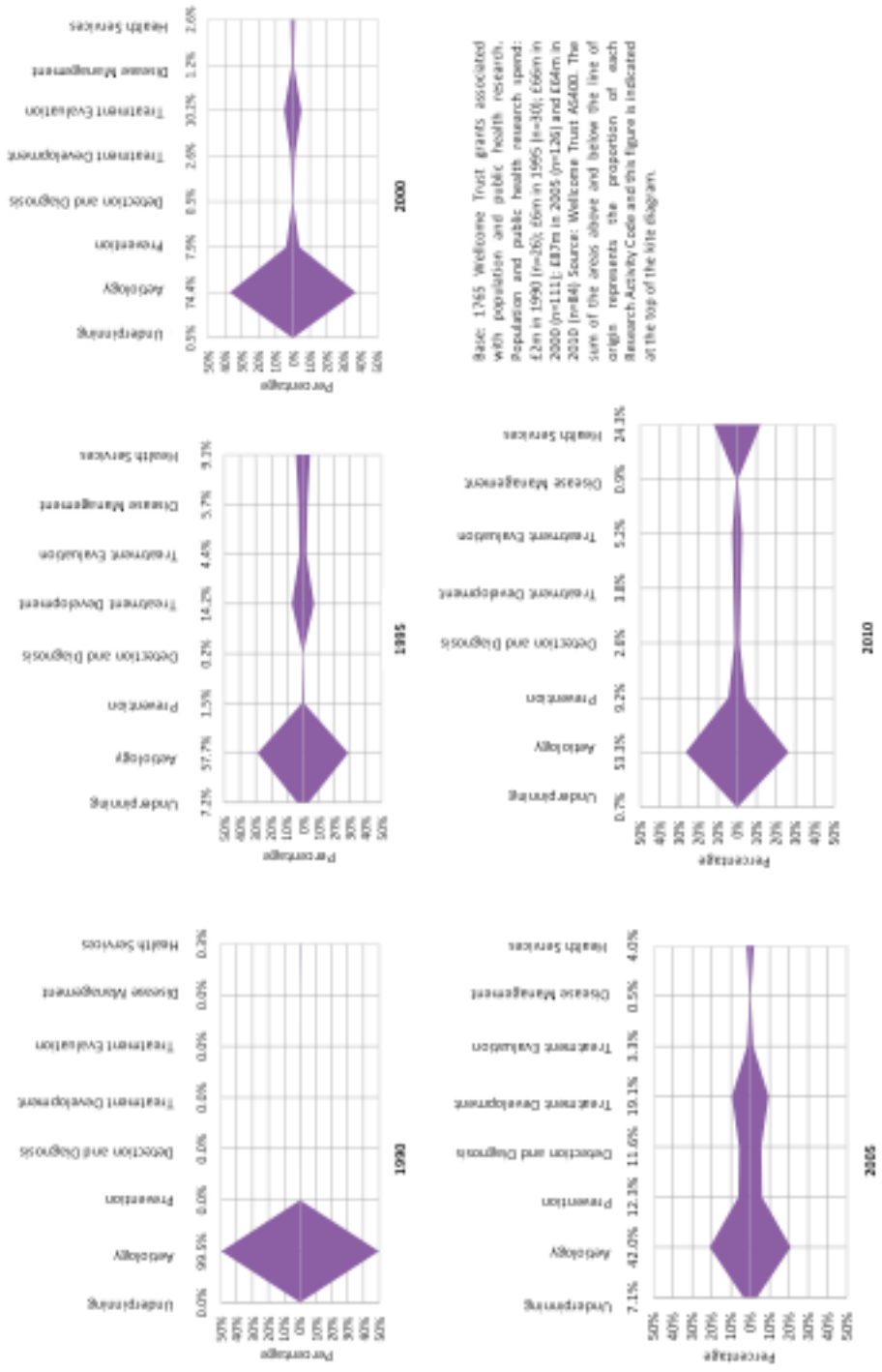


Wellcome Trust strategic funding initiatives

38. In addition to the traditional response-mode funding mechanisms on offer to research in this field – such as Fellowships and Programme and Project grants – the Trust has established several specific funding programmes designed to support and build capacity in the broad field of population and public health.

39. In 1996, the Trust established its Population Studies Programme, which was funded for five years before evolving to become the Health Consequences of Population Change Programme in 2000. This five-year, £65m programme was designed to support researchers and projects that addressed the changing pattern of disease in low- and middle-income countries, and the relationship between five key drivers of population change: growth, migration, urbanisation, ageing and lifestyle changes.

40. In 2004, the population and public health stream was established, with an expanded remit that removed the need for a fixed-term, focused programme. The stream covers research into the determinants of infectious and non-communicable disease and the quality of life in populations, and it aims to provide a sound evidence base to inform decisions in public health. Promoting translation into policy and practice, and fostering disease prevention approaches, are other important aims. The stream also provided for major resources, such as ongoing, large-scale prospective cohort studies in the UK and overseas.

41. The Trust has a long history of supporting population and public health capacity building, notably through its MOPs in Africa and South-east Asia and through its Fellowship programmes. The MOPs undertake research on health population problems of regional and global significance with an emphasis on clinical- and field-based studies, and they have played an important part in local capacity building. They are closely integrated with institutions in the host country to ensure long-term sustainability. The MOPs are viewed as world-leading centres and have either led or played a major part in several important discoveries and clinical studies that have delivered proven, cost-effective interventions with a direct benefit on human health.

42. In 2008, the Wellcome Trust and the UK Department for International Development jointly provided £10m over five years to fund the Health Research Capacity Strengthening Initiative.[12] Its aim is to strengthen capacity for the generation of health research knowledge and to improve its use in evidence-based decision making and policy formulation. The Health Research Capacity Strengthening Initiative has led to the establishment of the Consortium for National Health Research in Kenya and the National Commission for Science and Technology in Malawi.

43. In 2009, the Wellcome Trust introduced the £30m African Institutions Initiative to help African universities and research institutions to effectively manage research projects and train promising scientists.[13] In 2009, the Trust made awards to seven international and pan-African consortia, each led by an African institution. In total, 51 institutions from 18 African countries are involved.

44. Four awards for initiatives in Africa (totalling £20m) and three awards to programmes in India (totalling £15m) were made in 2008. They included a partnership between the Public Health Foundation of India (PHFI) and a consortium of UK universities to train multidisciplinary researchers who will populate the Indian Institutes of Public Health and strengthen the national public health workforce (see the PHFI case study).[14] The Wellcome Trust/DBT India Alliance, a joint initiative between the Wellcome Trust and the Indian Department of Biotechnology, was also launched in 2008, to support research fellowship programmes that strengthen biomedical sciences in India.

45. Fellowships in Public Health and Tropical Medicine were introduced in 2006, to provide support for researchers from low- or middle-income countries wishing to carry out work on diseases of importance to local, national and global health. To nurture and build research capacity in public health and tropical medicine, the Wellcome Trust set up the Public Health and Tropical Medicine Interview Committee (PHATIC) to interview fellowship candidates at training, intermediate and

[12] The HRCS was not included in our funding analysis, which covered Wellcome Trust financial years 1989/1990 and 2007/2008.
[13] **africaninstitutionsinitiative.org/**
[14] **www.phfi.org/**

senior levels. Between 2006 and 2011, the Trust received 502 applications for Public Health and Tropical Medicine Fellowships, and 109 awards have been made across 27 countries.

46. Global Health Trials is a joint £36m initiative between the UK Department for International Development, the MRC and the Wellcome Trust for late-stage clinical trials of interventions that will improve health in low- and middle-income countries.

47. In 2010, Professor Feiko ter Kuile was awarded a Global Health Trials Award to conduct a multicentre cluster-randomised controlled trial in two rural sites in Eastern Indonesia. The aim of the trial was to evaluate the efficacy, safety and cost-effectiveness of interventions for malaria in pregnancy, specifically intermittent preventive therapy and intermittent screening and treatment. The trial was designed in close collaboration with the policy makers and main implementers in Indonesia, notably the Ministry of Health, the World Health Organization and UNICEF Indonesia. It is hoped that it will inform national, regional and global policy.

48. The Trust's Technology Transfer Division supports a wide range of translational initiatives with relevance to the population and public health arena. These include:

    - R&D for Affordable Healthcare in India initiative
      In July 2010, the Trust announced a second initiative with the Indian Government's Department of Biotechnology, which aims to deliver safe and effective healthcare products. For example, a research group at Cadila Pharmaceuticals Limited, headed by Dr Rajiv Indravadan Modi, received £10m to support a phase III clinical trial of Polycap™, a five-in-one combination pill to reduce the risk of cardiovascular disease.
    - Health Innovation Challenge Fund
      This collaboration between the Trust and the Department of Health, which was launched in 2009, aims to stimulate the creation of new products and to encourage collaboration between companies, academia and clinicians. For example, Professor Lionel Tarassenko from the University of Oxford was awarded £1.4m to support the development of an open-architecture telehealth platform for chronic obstructive pulmonary disease.

49. Since 1996, the Wellcome Trust has contributed approximately £90m in funding to 23 major longitudinal studies, including cohort studies and demographic surveillance sites in the UK and in low- and middle-income countries, in partnership with various other funders (Table 5).

Table 5. Wellcome Trust major longitudinal studies in the UK and in low- and middle-income countries

Cohort	Wellcome Trust funding
Childhood cohorts	
The National Child Development Study (1958 birth cohort) Aim: Initially medical and social science, then genetic association studies.	• £2.0m over five years to 2006 • £0.22m over two years to 2010 to support sample storage and handling and the Access Committee for CLS Cohorts • Co-funded with the MRC
ALSPAC (Avon Longitudinal Study on Parents and Children) Aim: Childhood development – genes and environment.	• £4.5m over five years to 2010 • Co-funded with the MRC
The Twins UK Study Aim: Using a cohort of 12 000 twins to study the genetic and environmental aetiology of age-related complex traits and diseases.	• £1.8m over five years to 2006 • Renewed for £1.0m over five years to 2011
Pelotas birth cohorts, Brazil (1982–1993) Aim: Measuring the impact of socioeconomic, behavioural, healthcare and biological factors on health.	• £1.1m over five years to 2008 • Renewed for £2.7m over five years to 2013
Birth to Twenty (BT20) cohort, South Africa Aim: Investigating how inter-generational, developmental and situational risk factors are related to (a) sexuality and reproduction and (b) non-communicable diseases.	• £1.7m over five years to 2007 • £1.5m over three years to 2010 • Renewed for £1million over five years to 2015
COHORTS (Consortium of Health Outcome Research in Transitional Societies) Aim: To pool the results from a group of longitudinal studies to assess the long-term determinants of health.	• £0.66 over three years to 2012 (third round of funding)
Adult cohorts	
UK Biobank Aim: A long-term epidemiological resource to help identify the causes of a wide range of disabling and fatal conditions.	• £28m over six years to 2010 • Co-funded with the MRC, the UK Department of Health and regional governments
Kadoorie Biobank Aim: A blood-based prospective cohort study of 500 000 adults in China to assess the environmental risk factors and genetic risk factors for common chronic diseases.	• £2.5m over five years to 2014
Demographic surveillance systems (DSSs)	
Africa Centre for Health and Population Studies Aim: To describe the demographic, social and health impact of HIV in a population going through the health transition and to monitor the impact of intervention strategies.	• £8.3m over six years to 2007 for DSS • Core grant of £16m to 2012
Agincourt DSS, South Africa Aim: To investigate and respond to health, population and social transitions.	• £0.9m over five years to 2008 • Renewed for £2.8m over five years to 2013
KEMRI-Wellcome Trust Research Programme, Kilifi, Kenya Aim: An established DSS and support for research at the MOP.	• £12.9m over five years to 2010
Kanchanaburi DSS, Thailand Aim: To explore how migration from agricultural households affects patterns of labour force allocation and the allocation of land to different forms of agriculture.	• £2.8m over six and a half years to 2006
Karonga DSS, Malawi Aim: Phenotypic data and DNA collection continuation, focusing on infectious diseases (leprosy, tuberculosis, HIV).	• £4.35m over five years to 2006; renewed for £2.9m over three years to 2009; renewed for £2.2m over two years to 2011
Ouagadougou Urban DSS, Burkina Faso Aim: Household census and phenotypic data collection.	• £1.8m over five years to 2012

Manicaland DSS, Zimbabwe Aim: Analysis of cohort survey data, HIV surveillance.	• £2.6m over five years to 2013
Nairobi Urban DSS, Kenya Aim: To develop longitudinal surveillance data to (a) clarify links between urbanisation, health and socioeconomic processes and conditions, and (b) monitor and evaluate the impact of intervention programs to improve the wellbeing of the urban poor.	• £2.4m over five years to 2010
Kisesa DSS, Tanzania Aim: Analysis of cohort survey data, HIV surveillance.	• £0.8m over 4 years to 2012
Studies no longer funded by the Wellcome Trust	
The Vertical Transmission Study, South Africa Aim: To evaluate the feasibility and acceptability of exclusive breastfeeding and examine the risk of postnatal transmission of HIV through breastfeeding.	• £3.6m over six years to 2007 • No-cost extension agreed to 2008
Mexico City Prospective Study Aim: To gain a clearer understanding of the major determinants of morbidity and premature mortality in Mexico.	• £2.0m over five and a half years to 2006
Urban Health Study, Beirut, Lebanon Aim: A household census and phenotypic data collection of a representative household sample in three Beirut neighbourhoods, to assess family health.	• £1.9m over five years to 2009
Determinants of cardiovascular disease in eastern Europe: a multi-centre cohort study Aim: A multi-country project to determine the reasons behind high levels of cardiovascular disease in Eastern Europe.	• £1.1m over five years to 2007; renewed for £1.2m over five years to 2012
Thai health-risk transition: a national cohort study Aim: To identify multi-level determinants of health and enhance understanding of the mass effects of modernisation.	• £0.46m over five years to 2009
Ibadan Study of Ageing, Nigeria Aim: To investigate the determinants of healthy ageing.	• £0.3m in 2006

Source: Wellcome Trust AS400.

50. A large volume of population and public health-related research has been funded through the Medical Humanities and Engagement funding stream, which has taken an approach based largely in social science (see Annex C and Box 1). Between 1990 and 2011, 259 grants – totalling more than £10m – were made. Examples include:

    - The Centre for the Study of Incentives in Health, funded by a Strategic Award in Biomedical Ethics, which studied whether it is right to use financial incentives to improve health. The Centre ran a pilot study investigating whether women who were incentivised to stop smoking were more likely to use health services than those not incentivised. The Centre is a collaboration between King's College London, Queen Mary (University of London) and the London School of Economics.
    - The Centre for History in Public Health at the London School of Hygiene and Tropical Medicine, currently funded by an Enhancement Award, was established in 2003 and contributes to the historical understanding of population and public health research. The Centre researches the recent history of public health at the local, national and international levels and has run several 'Witness Seminars' on issues of public health importance in recent history.

    Other examples of key population and public health associated research can be seen in Box 1.

Box 1. Key population and public health developments associated with Wellcome Trust funding and their impacts[15]

Abortion

Dr Meimanat Hosseini-Chavoshi (Research Training Fellowship)
In Iran, abortion is only permitted if there are certain fetal abnormalities or if the mother's life is at risk. Dr Hosseini has studied the health consequences and implications of the policy. The work has been published within Iran and discussed at the highest levels within parliamentary and religious institutions. A book coauthored by Dr Hosseini, *The Fertility Transition in Iran: Revolution and reproduction*, won the 2011 World Prize for Book of the Year of the Islamic Republic of Iran.

Child health

Professor Colin Kennedy (Health Services Research Project)
A controlled trial of otoacoustic emission testing, which screens newborn babies for hearing problems, provided evidence of its benefits, and an eight-year follow-up study confirmed that it ensures babies and families receive appropriate support as rapidly as possible. Universal newborn screening has now been introduced across the UK.

Dementia

The 10/66 Dementia Research Group (Project, programme, and symposium grants)
The Group has developed a dementia diagnosis tool that allows data to be compared between countries and social groups. This tool was used during large-scale population surveys in 11 countries. The archive of data of 20 000 adults from three continents is freely available to the wider research community and is being used in many other projects around the world.

Eating disorders

Professor Chris Fairburn (Principal Research Fellowship)
Professor Fairburn pioneered the use of cognitive behaviour therapy for the treatment of bulimia nervosa, which is now recognised by the National Institute for Health and Clinical Excellence (NICE) as the leading treatment for the condition.

Health and demographic surveillance

Professor Steve Tollman (Programme grants, Tropical Health Services, Research Project Grant, Symposium Grant)
Professor Tollman developed a world-class health and demographic surveillance system (HDSS) covering the Agincourt subdistrict in rural South Africa.

HIV

Dr Simon Gregson, Geoffrey Garnett and Catherine Campbell (Programme grant)
Used data from the Manicaland HIV/STD Prevention Project to model the spread of HIV. Results have contributed to policy development, such as the UNAIDS recommendations on rolling out circumcision services, and influenced HIV prevention and treatment interventions in Zimbabwe.

Professor Marie Louise Newell (Africa Centre for Health and Population studies)
Professor Newell showed that exclusive breastfeeding can reduce the risk of HIV transmission from mother to child in infants aged less than six months when compared to those also given solid foods or replacement feed (i.e. formula milk). These findings fed into the revised World Health Organization Consensus Statement on HIV and Infant Feeding in October 2006.

[15] Grants listed are the major grants most recently awarded to the researchers, up to and including those awarded in 2011.

Mental health

Professor Matthew Hotopf (Project Grant)
Conducted a detailed study assessing mental capacity in 350 patients entering acute psychiatric wards. A substantial proportion of psychiatric inpatients are capable of making autonomous decisions about their care, and healthcare providers should ensure they are enabled to do so. The team's analysis of the interaction between the Mental Capacity Act and the Mental Health Act will help inform clinicians about the application of Deprivation of Liberty Safeguards.

Professor Vikram Patel (Senior Clinical Fellowship, Strategic Award)
A study, published in the *British Journal of Psychiatry*, investigated the impact of a community-based rehabilitation programme for people with psychotic disorders in rural India. The study concluded that community-based rehabilitation is a feasible and acceptable intervention with a beneficial impact on disability for the majority of people with psychotic disorders in a low-resource setting.

Obesity

Professor Boyd Swinburn, The Pacific Obesity Prevention in Communities (OPIC) project (International Collaborative Research Grant Australia/New Zealand)
The OPIC project – a four-country study of obesity prevention in Fiji, Tonga, New Zealand and Australia – has helped to increase capacity for obesity prevention research in the Pacific region and generated crucial evidence for public health action on obesity in both low- and high-income countries.

Pandemic influenza

Thomas House and Professor Matt Keeling (Project grant)
Used computer modelling to predict the spread of pandemic influenza and to look at ways of controlling it effectively. Results showed that vaccinating children helps to protect those at greatest risk of virus exposure and offers protection to unvaccinated adults.

Pesticide poisoning

Dr Michael Eddleston (Programme grant)
Dr Eddleston's work informed the WHO, who launched a public initiative in 2005 to reduce the number of suicides from pesticide poisoning. In addition, the Sri Lankan government has used Dr Eddleston's data to introduce national bans on the three remaining pesticides with the highest case fatality rates.

Population cohorts

ALSPAC (see case study; Project and Programme grants)
The Avon Longitudinal Study of Parents and Children (ALSPAC) is one of the most detailed and comprehensive prospective birth cohort studies ever undertaken in the UK. Research using data from the study has shown that women who eat oily fish regularly during pregnancy have children with higher IQ and neurological function. Other work showed that mothers with mutations in the gene *TCF7L2* had babies with increased birth weight.

Professor Alan Emond, ALSPAC (Project grant)
Professor Emond provided evidence that previously agreed 'safe' levels of lead in the environment were impairing intellectual and emotional development of children. The work suggests new lead safety levels and has been acknowledged by the Health Protection Agency as 'significant'.

COHORTS (see case study; Collaborative Projects)
A long-standing collaboration between five large cohort studies in low- or middle-income countries has shown how early life nutrition affects adult health and economic productivity. Results showed that maternal and child undernutrition is associated with poorer long-term health outcomes, and rapid weight gain during the first two years of life is associated with increased height and school performance.

Pneumococcal vaccine/clinical tropical medicine

Professor Anthony Scott (see case study; Senior Research Fellowship)
Professor Scott's work focuses on the evaluation of vaccines in children, particularly those that protect against bacterial pneumococcal diseases – a leading cause of infant death in Africa. He also studies the epidemiology of pneumonia, investigating how its prevalence is linked with that of malaria.

Rabies

Professor Sarah Cleaveland (Project grant)
Research on rabies in the domestic animal population in the Serengeti National Park, Tanzania, has provided evidence supporting a major rabies eradication scheme for domestic animals. This is being coordinated by WHO's Department of Neglected Tropical Diseases with $10m funding from the Bill and Melinda Gates Foundation.

Rapid diagnostics for infectious diseases in resource-limited settings

Dr Helen H Lee (Diagnostics for the Real World/Strategic Translation Award)
Developed testing kits for chlamydia, hepatitis B and HIV. These tests are simple, affordable, rapid and suitable for use in low- and middle- income countries.

Respiratory infections and diarrhoeal diseases

Professor Robert Heyderman, Dr Nigel Cunliffe and Dr Neil French (Malawi-Liverpool-Wellcome Trust Clinical Research Programme)
Scientists at the University of Liverpool are working in partnership with the Malawi Ministry of Health to monitor the effectiveness of new vaccines developed to protect children from pneumonia and diarrhoea. The study will provide a framework for investigating other vaccine-preventable diseases across the country.

Sexual health

The National Survey of Sexual Attitudes and Lifestyles (Programme grant)
The National Survey of Sexual Attitudes and Lifestyles (NATSAL) is a scientific study of sexual behaviour, the largest survey of its kind in the world.

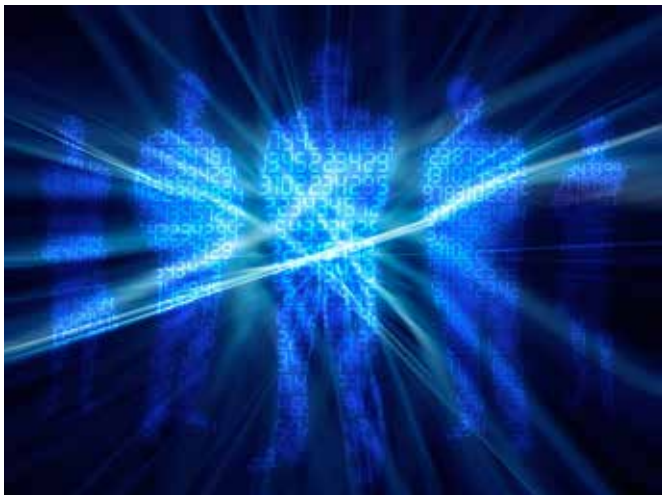
Tuberculosis

Rod Escombe (Training Fellowship In Clinical Tropical Medicine)
Escombe's research shows that opening windows can be more effective than using mechanical ventilation to reduce the risk of transmission of airborne diseases, such as tuberculosis. This supports existing WHO guidelines for preventing tuberculosis transmission in healthcare settings. The spread of tuberculosis could be reduced by up to 70 per cent by using ultraviolet C lights in hospital wards.

Scottish Health Informatics Programme (SHIP)

Impact:

- SHIP is a world leader in the management of electronic patient records, working to provide researchers with access to a wealth of anonymised NHS Scotland data.
- SHIP has published several Scottish public health studies, influencing Scottish Government policy, and is proving a model for the use of electronic patient records in England.



123RF.com

The Scottish Health Informatics Programme (SHIP) is a Scotland-wide collaboration between the NHS and Scottish universities that provides a platform for the management, analysis and linkage of electronic patient records (EPRs).

Scotland is substantially more advanced in this area than England and Wales; all Scottish patients registered with a GP since the 1970s have been allocated a unique patient identification number, maintained in the Community Health Index. During patient care, these numbers allow medical staff to quickly identify an individual's treatment history, but they also provide an opportunity for researchers to assess the effectiveness of health interventions and investigate patterns of disease across Scotland.

SHIP was established in 2008, with funding from the Wellcome Trust, the Medical Research Council, the Economic and Social Research Council, and the Engineering and Physical Sciences Research Council. The Principal Investigator for the project is Professor Andrew Morris, co-Director of the Medical Research Institute at the University of Dundee and Chief Scientist for Scotland.

SHIP has four core programmes, which aim to create secure access to EPRs in addition to investigating the ethical, legal and cultural challenges associated with their use. SHIP has already published a good governance framework for the use of EPRs for research and created a national indexing and linkage service within the NHS. The governance plans, formulated by SHIP's legal team, were informed by extensive engagement with public attitudes to the use of medical records for research.

SHIP also has four research aims: determining whether some clinical trials can be virtualised, by comparing real trial outcomes with information drawn from EPRs; undertaking epidemiological research on a national scale; using EPRs to identify adverse reactions to prescription drugs; and linking EPRs to socioeconomic and environmental data.

Although it is currently a developing resource, data linkage has been used in several health studies in Scotland. SHIP researchers used anonymous linked clinical diabetes and cancer data to show that patients using synthetic insulin were at no greater risk of developing cancer than those using traditional insulin. Linked data were also used to define the higher risk of heart disease and stroke in those with diabetes on a national scale.

The ability to collate and analyse large amounts of complex data is central to the advancement of medical research. The UK has a wealth of routinely collected, high-quality patient data, which could be a powerful resource to improve healthcare practices and public health, yet much of it remains underused.

In 2011, the Prime Minister announced plans to make it easier for scientists to access NHS data, proposing that all patient data would automatically be included in research and that patients who qualify for clinical trials could be contacted directly. Scotland, through its use of SHIP, has become a world leader in the use of EPRs. Although national health systems are devolved, SHIP, along with the Welsh Secure Anonymised Information Linkage (SAIL) system, are providing model systems that NHS England can learn from as it develops its own linked EPR system.

The Avon Longitudinal Study of Parents and Children (ALSPAC)

Impact:

- Research using data from the ALSPAC study has produced findings of public health and policy importance.
- The study has developed an internationally recognised open-access biomedical data resource used by researchers from around the world working in a variety of disciplines.

Avon Longitudinal Study of Parents and Children

The Avon Longitudinal Study of Parents and Children (ALSPAC), based at the University of Bristol, is one of the most detailed and comprehensive prospective birth cohort studies ever undertaken in the UK. It was the first to have a genetic component, including appropriate consent for DNA analysis, built into the design from the outset. Research arising from the study provides key insights into how genetic and environmental factors influence development, health and disease.

ALSPAC began in 1991 with the recruitment of more than 14 500 pregnant women in the Avon area of England. The study has followed the children of these women, born between April 1991 and December 1992, and will continue to do so for the duration of their lives. ALSPAC was launched to investigate the genetic and environmental determinants of childhood disorders, with later work researching chronic diseases and health-related behaviour. ALSPAC's value is in its large amounts of detailed, routinely collected social and biological data and its evolution as a world-class open-access data resource. The study was founded by Professor Jean Golding, who received an OBE for her work on the study in 2012. In 2006, Professor Golding retired from leading the ALSPAC project and Professor George Davey Smith took over as Scientific Director.

From birth to the age of six, data on the participating children were collected mainly by questionnaire, although a 10 per cent subset – the 'Children in Focus' – had six-monthly examinations. From the age of seven, all children and their parents were asked to participate in more detailed assessments every one to two years. These involved physical examinations (including the collection of urine and blood samples), in-depth questionnaires, and interviews about diet, lifestyle, their thoughts and feelings, family relationships and socioeconomic status.

The Wellcome Trust, the Medical Research Council and the University of Bristol provided core support to ALSPAC in 2001 and again in 2006. The Trust and MRC support was renewed in 2011 for a period of three years.

The large amount of data collected by ALSPAC has generated key findings that have influenced several areas of public health policy. For example, the data verified the safety of the Back to Sleep campaign, which promoted placing babies on their backs to sleep. As a consequence of this campaign, levels of sudden infant death syndrome (SIDS), also known as cot death, have fallen dramatically. Other work has shown that using eczema cream containing peanut oil is associated with children developing peanut allergies later in life. The study has also demonstrated that women who eat oily fish regularly during pregnancy have children with higher IQs and better neurological function.

DNA samples have been taken from more than 10 000 children and their mothers, allowing many genome-wide assessment studies to be undertaken. ALSPAC played a substantial part in the discovery of the first gene linked to obesity, the *FTO* gene. The availability of maternal DNA also allows researchers to investigate how a mother's genetic makeup affects fetal development; for example, mothers with mutations in the gene *TCF7L2* had babies with increased birth weight.

ALSPAC is a world-famous research project and biomedical resource, which has received more than 1300 proposals from scientists worldwide to use its varied dataset. It continues to collect data from the original cohort of mothers and young adults, and the project is currently expanding to include fathers, siblings and the third generation – children of the original cohort.

UK Biobank

Impact:

- UK Biobank has collected samples and health data from 500 000 participants to help understand the causes of diseases that occur in mid- and later life.
- The resource is one of the most detailed collections of health data in the world.

Test tubes at UK Biobank. *Wellcome Library, London*

In 2002, the Wellcome Trust, the Medical Research Council, the Department of Health and the Scottish Government collaborated to create UK Biobank, a resource for researchers investigating how lifestyle, the environment and genetic factors influence the risk of a wide range of diseases that affect people in mid- to later life. The Trust and the MRC provided initial investments of £28 million each, and the other funders committed an extra £5.5 million.

In total, 500 000 men and women aged between 40 and 69 participated in the study. Recruitment took place between 2006 and 2010 in 22 assessment centres across the UK. The age range 40–69 was chosen because, within a reasonable timeframe, many participants will go on to develop diseases such as cancer, heart disease, diabetes and depression. Volunteers completed detailed health and lifestyle questionnaires, had physical measurements, and provided samples of blood and urine. An additional £6 million was provided by the Trust, the MRC, the Department of Health and British Heart Foundation to enable a more detailed study of a subset of participants, including eye measurements from more than 100 000 people in the UK. When recruitment was completed, around one in 50 of the eligible UK population had participated.

The UK Biobank coordinating centre is located in Stockport, where its state-of-the-art automated freezer facility ensures the accurate processing and storage of millions of samples. Its Chief Executive and Principal Investigator is Rory Collins, BHF Professor of Medicine and Epidemiology at the University of Oxford, who received a knighthood in 2011 for his services to science.

After a public consultation in 2011, the procedures that researchers must follow to access UK Biobank were finalised. The resource was launched in March 2012, and its data and samples are available to approved academic and commercial scientists internationally for all areas of health research that are in the public interest. Information provided to researchers will not identify participants, whose data are anonymised – one of the key components of the study. UK Biobank works within an ethics and governance framework, which describes the ethical, legal and sociological standards that the resource must adhere to, monitored by the independent UK Biobank Ethics and Governance Council.

In 2010, a further £25 million of funding was awarded over a period of five years, split between the MRC and the Wellcome Trust. This award was given to maintain the resource, repeat measurements in some of the volunteers and to establish links to participants' medical and other health-related records.

Typically, big cohort studies like UK Biobank collect either a large amount of data on a small number of people (data 'depth') or a small amount of data on a large number of people (data 'breadth'). UK Biobank has achieved both, making it one of the world's most detailed collections of health data.

The Consortium of Health-Orientated Research in Transitioning Societies (COHORTS)

Impact:

- A long-standing collaboration between five large cohort studies in low- or middle-income countries has shown how early life nutrition affects adult health and economic productivity.
- The Wellcome Trust has supported this collaboration from its inception.

A grandmother feeding a child in rural India. *John and Penny Hubley/Wellcome Images*

Birth cohort studies follow large numbers of participants from birth, collecting information on the part that health, environmental and socioeconomic factors play in their long-term health outcomes and human capital achievements. Many such studies have been undertaken in high-income areas, particularly in northern Europe, but their results cannot necessarily be extrapolated to populations in low- or middle-income nations, where few long-term studies have taken place.

In 2005, the *Lancet* commissioned a series of research papers investigating the impact of maternal and infant nutrition in human health. The second of the papers was to be written by Cesar Victora, Professor of Epidemiology at the Federal University of Pelotas, Brazil, who received funding from the Wellcome Trust to pool the data from five long-term cohort studies in low- or middle-income countries, collaborating with their principal investigators.

The studies in Professor Victora's review all began at – or before – birth and had a follow-up period of at least 15 years. These were the 1982 Pelotas Birth Cohort Study (Brazil), the Institute of Central America and Panama Nutrition Trial (Guatemala), the New Delhi Birth Cohort (India), the Cebu Longitudinal Health and Nutrition Survey (the Philippines) and the Birth to Twenty study (South Africa). In total, more than 10 000 people were enrolled, and the Trust provided funds for both the Brazilian and South African studies. This collaboration allowed researchers to verify whether their results were prevalent across a range of countries, socioeconomic circumstances and cultural backgrounds. For most outcomes, there was remarkably similarity between the five studies: maternal and child undernutrition is strongly associated with less schooling, shorter adult height, lower offspring birth weight and reduced economic productivity.

As a result of this work, Professor Victora applied for renewed funding to strengthen the collaborative network between the studies, which became the Consortium of Health-Orientated Research in Transitioning Societies (COHORTS). This second project, which began in 2007, focused on the effects that rapid growth and breastfeeding during childhood have on adolescent and adult health.

Results showed that infants who began eating solid foods in their first six months of life were more likely to become overweight adults. Having a high birth weight or gaining weight rapidly during the first two years of life was associated with increased height and school performance. Rapid weight gain after two years was not associated with increased performance but was strongly associated with an increased risk of several non-communicable diseases. The third phase of the COHORTS project began in 2009 with a Trust project grant awarded to Professor Linda Richter, from the Human Sciences Research Council, South Africa. Whereas the previous two studies primarily investigated the role of nutrition in child development, this series of analyses looked at how environmental and socioeconomic factors in early life affect growth and adult health.

The unique nature of this collaboration between five large cohort studies from different low- and middle-income countries has enabled large quantities of epidemiological data to be pooled, improving the quality of the results gained. COHORTS has already made substantial contributions to public health knowledge by showing the lasting effects of poor nutrition in early life and that rapid weight gain after two years of life increases the risk of chronic disease. This work will inform national programs to emphasise the importance of appropriate nutrition throughout childhood.

HIV and breastfeeding

Cut-away model of the human immunodeficiency virus. *John Wildgoose/ Wellcome Images*

Impact:

- Professor Coovadia's work in South Africa has shown that exclusive breastfeeding reduces the risk of transmitting HIV from mother to child.
- As a result of this work, international guidelines on best feeding practices have been changed.

HIV can be passed from mother to child during pregnancy, delivery or breastfeeding. Although much research had been carried out on HIV transmission during pregnancy and delivery, scientists and policy makers were divided regarding the risks of transmission while breastfeeding.

A study at a Wellcome Trust major overseas programme, the Africa Centre for Health and Population Studies, South Africa, was led by Professor Hoosen "Jerry" Coovadia. The work revealed that exclusive breastfeeding can significantly reduce the risk of HIV transmission from mother to child in infants under six months.

A six-year Wellcome Trust-funded study, which ended in 2007, enrolled 2722 HIV-infected and uninfected pregnant women attending clinics in KwaZulu-Natal. More than 2800 babies were born during the trial and were divided into two groups depending on how their mothers fed them: using breastfeeding exclusively or using a mixture of breast milk and replacement food (formula milk or solids).

The results showed that when the children were fed on breast milk only between the ages of six weeks and six months, there was a 4 per cent risk of postnatal HIV transmission from mother to child. Infants fed on a mixture of formula and breast milk were nearly twice as likely to be infected, and those who also received solid food were almost 11 times as likely to become infected.

The mucous membrane within the intestine is thought to act as a barrier to HIV infection. Breastfeeding strengthens this lining, whereas solid foods might damage it and allow the virus to pass through the intestinal wall. Frequent breastfeeding was also associated with fewer maternal health problems, such as breast abscesses, which can increase the amount of virus in the mother's milk.

In high-income countries, it is recommended that HIV-infected mothers feed their babies exclusively with formula. However, this is not practical in many low-income countries because of the lack of access to clean water, sanitation and sterilising equipment. In addition to increasing HIV risk, diarrhoeal infections from unclean water account for high levels of morbidity and mortality in infants throughout the world. Breastfeeding protects against diarrhoea and other potentially fatal conditions and is thus suggested as the best option.

Professor Coovadia's work has impacted WHO policy, which now states that: "Every effort should be made to accelerate access to antiretrovirals for both maternal health and also prevention of HIV transmission to infants…Even when ARVs are not available mothers should be counseled to exclusively breastfeed in the first six months of life and continue breastfeeding thereafter unless environmental and social circumstances are safe for, and supportive of, replacement feeding."

Kenya major overseas programme

Impact:

- Work from researchers at the KEMRI–Wellcome Trust Research Programme has led to evidence-based policies and practice that can be used to improve public health in Kenya.
- The resulting improvements in clinical practice and epidemiology are applicable to many other African countries.

A mosquito, the vector for malaria, full of blood. *Hugh Sturrock/Wellcome Images*

The KEMRI–Wellcome Trust Research Programme is known internationally for its work tackling malaria and other infectious diseases, particularly bacterial and viral childhood infections. The Programme was formally established in 1989, in partnership with the Kenya Medical Research Institute (KEMRI). It conducts basic and clinical research, and its results feed into local and international health policy. Its aim is to expand the country's capacity to conduct multidisciplinary research that is strong, sustainable and internationally competitive.

Mike English

Professor Mike English is a Wellcome Trust Senior Clinical Fellow who works to improve the delivery of evidence-based care of severely ill children in Kenya. He began working for the KEMRI-Wellcome Trust Research Programme in the Kilifi District of Kenya in 1992 before moving to Nairobi in 2004, where he leads the Child and Newborn Health Group.

In Kenya, 74 in every 1000 children die before their fifth birthday. Diseases such as pneumonia, malaria and diarrhoea are major causes of infant and child mortality. After establishing that rural hospitals were not providing effective care to these populations, Professor English's research has focused on long-term studies initiating and establishing best practices within rural government hospitals. In a 2011 paper, Professor English and colleagues showed that comprehensive implementation strategies are required to improve hospital care for Kenyan children. During this three-year project, eight Kenyan hospitals were assigned to either 'full' or 'control' intervention groups. Those in the full intervention group received clinical guidelines, training, job aides, performance feedback and face-to-face supportive supervision, whereas those in the control group received guidelines, short training, job aides and written performance feedback. Hospitals in the full intervention group completed more admission assessment tasks and incorporated more good clinical practices into their treatments. In addition, a lower proportion of children in these hospitals received inappropriate doses of drugs and managers were more likely to tackle resource and organisational shortcomings.

In 2005 and 2010, work from the Child and Newborn Health Group was used in the development of national treatment guidelines for Kenya, based on locally conducted systematic reviews. These guidelines and the training they are linked to are now widely disseminated in Kenya and have been adopted in Uganda and Rwanda. Professor English continues to work closely with the Kenyan Ministries of Health, the University of Nairobi and the WHO (for whom he acts as a technical advisor and contributes to the *Pocket Book of Hospital Care for Children*).

Bob Snow

Professor Bob Snow is a Wellcome Trust Principal Research Fellow and head of the Malaria Public Health and Epidemiology Group at the KEMRI-Wellcome Trust Research Programme. He is in the top five authors of highly cited malaria research papers worldwide, 1989–2008, and has written over 300 papers on the subject. He is also an advisor to the Kenyan Government and other international panels.

Professor Snow's work mapping malaria transmission and its impact on health evolved into a global initiative known as the Malaria Atlas Project, which began in 2005. Under his directorship, the project has assembled a spatial database containing medical information and satellite-derived climate data to map the burden of two of the most deadly strains of malaria: *Plasmodium falciparum* and *Plasmodium vivax*. This work, provided free to researchers and public health officers, is the first evidence-based map of malaria prevalence and risk and has already begun to provide international agencies with a framework to prioritise investment worldwide.

Professor Snow's group has used a combination of operational research and detailed statistical models to guide the Kenyan Government's malaria strategies on delivering insecticide-treated bednets and where to target donor-assisted malaria funding. The team is also working with neighbouring countries to provide research evidence to support the best use of limited financial resources in the treatment, control and elimination of malaria in Somalia, Djibouti, Sudan, Uganda, Malawi and Namibia.

Anthony Scott

Professor Anthony Scott, a Wellcome Trust Senior Clinical Fellow, is Head of the Invasive Bacterial Diseases Group at the KEMRI–Wellcome Trust Research Programme. His work focuses on the evaluation of vaccines in children, particularly those that protect against bacterial pneumococcal disease – a leading cause of infant death in Africa. He also studies the epidemiology of the disease, investigating how its prevalence is linked with that of malaria.

In 2011, work by Professor Scott and colleagues showed that immunising babies against pneumococcus within the first three days of life is both safe and effective. The vaccine given at birth, ten weeks and 14 weeks was shown to be as safe as when given at six, ten and 14 weeks, one of the schedules recommended by WHO. Because many deaths occur before babies receive their first dose of vaccine, early immunisation might have a considerable impact on the health of African children. Professor Scott's work on the epidemiology of pneumococcal disease in Kenya was instrumental in developing a successful application to the Global Alliance for Vaccines and Immunization that meant Kenya became the first African country to provide the vaccine as part of its routine immunisation programme.

His research on *Haemophilus influenzae* type b (Hib) has led to a direct policy change in Kenya. Infection by Hib can cause pneumonia or meningitis, but infection is difficult to diagnose and expensive to treat. Despite these difficulties, the Ministry of Health in Kenya introduced Hib vaccine into the routine childhood immunisation programme in 2001. Professor Scott's work showed that this reduced the incidence of Hib by 88 per cent among children under five. As a result, the Kenyan government has decided to sustain the vaccination programme, which was originally funded by the Global Alliance for Vaccines and Immunization.

Public Health Foundation of India (PHFI)

Impact:

- The PHFI was established to address the shortage of highly qualified public health professionals in India.
- Wellcome Trust funding is supporting initiatives to improve public health capacity in India.

Women carrying water pots. *The Leprosy Mission International/Wellcome Images*

With approximately 30 per cent of its population of 1.2 billion people still living below the poverty line, India faces substantial public health challenges. To address these issues, the Prime Minister of India, Dr Manmohan Singh, founded the Public Health Foundation of India (PHFI) in 2006. India has a weak research base for public health, with few specialists trained to further degree level. The PHFI aims to improve health outcomes in Indians by training a new generation of public health workers.

The PHFI is a public–private partnership comprising government agencies, academic institutions and charitable foundations, including the Wellcome Trust. Professor K Srinath Reddy has been President since its inception. The Foundation has established four Indian Institutes of Public Health (IIPH), located in Gujarat, Andhra Pradesh, Orissa and Delhi. Each IIPH offers teaching and research programmes and is developing its faculty. A PHFI Centre of Excellence in chronic diseases has been established, along with three other centres focusing on cardiometabolic risk reduction, disability-inclusive development and social determinants of health.

In 2008, the Trust awarded a £5 million strategic award to fund Master's degrees, PhD studentships and research grants. This grant was split between India and the UK; the London School of Hygiene and Tropical Medicine was placed in charge of managing the UK consortium. Students undertaking these courses split their time between India and one of 16 UK institutions, and the fieldwork aspect of the study occurs in India. After completing their courses, students are expected to stay in India, working in one of the IIPHs. Currently, 19 PhD studentships are being undertaken and 15 Master's projects have been completed or are in progress as part of the capacity building programme.

In addition to further degrees, the PHFI offers seven postgraduate diplomas – four on campus and three via distance learning – and runs several short training courses on crucial public health issues such as health communication and quantitative analysis. Since they began in 2008, more than 5000 people have completed these short courses, including many government employees – some states are making them mandatory for their staff. Although government-run public health institutes exist in India, they generally do not operate to a standardised qualification level. The PHFI is working to establish an independent accreditation body for degrees in public health.

Research is central to the work of the PHFI. The Trust funding provides India- and UK-based research fellowships and includes grants for Indian research staff to undertake collaborative projects with UK partner institutions. Currently, 11 research grants have been awarded, and 11 fellowships are being undertaken.

India has the highest number of people with diabetes in the world – an estimated 50 million people. A Wellcome Trust Strategic Award made to Professor Shah Ebrahim from the London School of Hygiene and Tropical Medicine led to the establishment of the South Asia Network for Chronic Diseases, a collaboration between the PHFI and the Wellcome Trust Bloomsbury Centre for Clinical Tropical Medicine that aims to strengthen chronic disease research capacity. In other work, a translational award has been made to PHFI researchers to investigate the effectiveness of 'mWELLCARE', mobile phone software for community health centres that will be used to assess a patient's health profile and help inform health workers of best treatment practices. In 2012, a $38 million dollar grant from USAID was awarded to the PHFI to help strengthen the national HIV/AIDS control programme. This is the first time that a consortium led by an Indian NGO has been selected for such a grant.

In February 2012, the Indian Prime Minister announced that India should look to increase its healthcare spending from 1.4 per cent to 2.5 per cent of GDP, at a cost of over $40 billion at today's prices. The Trust is working closely with the India–UK CEO Forum, founded by the Indian and UK Prime Ministers, to investigate how India might develop healthcare provision.

4. Current and future challenges for population and public health research

51. As described, this review is intended to be both reflective and prospective, to help identify the current challenges facing the field of population and public health research and to consider what might be done to help address any challenges identified.

52. With the help of experts in the field, through a consultation survey and an in-person group, several current challenges were cited (Table 6). In addition to perceived limited funding for population and public health research, the importance of building capacity was a key focus for experts. There was a view that 'population and public health research', as an inherently multidisciplinary field, lacks the cohesiveness and profile (and funding sources) of other scientific and emerging scientific fields and is failing to attract appropriately qualified practitioners.

53. There was a sense that undergraduates in many biomedical disciplines are not receiving the quantitative and statistical training that is a prerequisite to working in population and public health-related research. Those researchers with appropriate skills are increasingly attracted to other, more fruitful, fields or potentially lucrative professions. Furthermore, there was a view that traditional research funding mechanisms are not ideally structured to support the multidisciplinary nature of most population and public health projects; focus on a Principal Investigator can obscure the importance of other contributors in a population and public health-related project. As a result, the field is experiencing talent drain, which is not easily addressed without increases in funding. This was seen to be an issue in low-, middle- and high-income countries alike.

> "Attracting high-quality people into our discipline is difficult for a number of reasons: there isn't much of a career trajectory, and the smart folks are often attracted to other disciplines rather than public health, which is seen as low priority."
>
> Wellcome Trust Expert Group on Population and Public Health, June 2012

> "[In my country] the biggest challenge we have is not the lack of funding, it's lack of good investigators to actually do rigorous projects. The real challenge is to improve the capacity for research."
>
> Wellcome Trust Expert Group on Population and Public Health, June 2012

Table 6. Key challenges facing researchers in the field of population and public health

Challenge	Frequency
Lack of funding	25
Capacity building and academic support for training	21
Translating research into effective policy and practice	16
Bureaucratic, regulatory, ethical and research governance procedures	8
Role of industry and commercial interests as an influence on public health (e.g. tobacco and food industries)	8

Source: Population and public health consultation survey, Wellcome Trust Evaluation Team, April 2012.

54. A third major challenge for the field was the often-cited need for research to be effectively translated into policy. This is something that was especially pertinent for research that focused on population and public health where there might be the opportunity to rapidly translate findings into practice.

55. The importance of involving public health practitioners and policy makers in research to ensure effective and more rapid translation in practice is well cited (e.g. in the UK House of Lords Science

and Technology Committee report from 2011, *Behaviour Change*); however, this engagement is not always done sufficiently or effectively.[16] There was a general consensus that fostering dialogue and the exchange of research between policy makers, researchers and public health practitioners would assist the uptake of research data into the policy decision-making process.

> "We've got the skills to perform research. What we really don't know is how to translate that into practice, with all the political and social factors that influence policy decisions. It seems to me that what's missing is a cadre of people who can actually study how to get research into practice."
>
> Wellcome Trust Expert Group on Population and Public Health, June 2012

> "Evidence needs to be commissioned by people who are actually going to use it... the most successful examples are where you get the commissioners of evidence involved from the start, and you get them to tell you what their problems are, not getting the research community to tell you what they think the priorities are."
>
> Wellcome Trust Expert Group on Population and Public Health, June 2012

56. In the consultation survey, experts were asked to describe the key factors that could assist in the translation of population and public health research into policy and practice (Table 7). It was suggested that research funders could play an important part in this and do more to support interaction between researchers and those involved in policy making and implementation; innovative strategies that value dialogue and collaboration are required.

Table 7. Key factors to enhance implementation and uptake of population and public health research

Factor	Frequency
Develop innovative strategies and/or funding mechanisms to enable cross-sector learning and collaboration	34
Forge collaborative relationships between policy makers and researchers	21
The need to improve and deliver public awareness campaigns	8
Implementation research	7

Source: Population and public health consultation survey, Wellcome Trust Evaluation Team, April 2012.

57. In terms of future research priorities for the population and public health field, the consultation survey experts highlighted what they perceived as the most important issues that population and public health researchers will face in the future (Table 8). The responses were endorsed by the Expert Group, who described non-communicable diseases, climate change, and ageing and its associated mental health issues as priorities. Together, these further underpin the need for the structural issues surrounding funding and capacity to be addressed.

> "The big things that...will affect health are the global economic crisis and climate change. Climate change will have impacts on health that are to do with whether housing and shelter in different countries is now fit for purpose, and that impacts on where people have to move in order to live [and] whether we then have issues of overcrowding and infectious diseases, and that affects mental health and other outcomes as well."
>
> Wellcome Trust Expert Group on Population and Public Health, June 2012

[16] **www.publications.parliament.uk/pa/ld201012/ldselect/ldsctech/179/179.pdf**

"Very soon we're going to see that actually the majority of the world is urban. That phenomenon will continue and, in terms of health, that actually brings pros and cons. Clearly, the con is the faster spread of new emerging epidemics and all the rest of it, but the pro is it's actually easier to deliver prevention and care to an urban population."

Wellcome Trust Expert Group on Population and Public Health, June 2012

"A key challenge is the obesity epidemic: it's both local and global, and we have an answer to virtually none of the appropriate questions on how to deal with it."

Wellcome Trust Expert Group on Population and Public Health, June 2012

"So there's definitely the ageing population, which in turn leads to incredible issues of migration. When you need to bring young people in to work…you get the health effects of migration going everywhere."

Wellcome Trust Expert Group on Population and Public Health, June 2012

Table 8. Most important issues for population and public health researchers to address

Issue	Frequency
Prevention of non-communicable diseases and their global burden	20
Global climate change	16
Ageing populations (healthy and unhealthy)	16
Prevention and control of infectious disease, including the need for new antibiotics and vaccines to combat increasing levels of microbial drug resistance	14
Research into complex models and interventions	12
Nutrition and obesity	11

Source: Population and public health consultation survey, Wellcome Trust Evaluation Team, April 2012.

58. It can, however, be difficult to predict what future public health issues might be; the Expert Group discussed how the morbidity and mortality associated with the increased prevalence of smoking and motor vehicle use in the mid-20th century was not predicted. In this light, the Group highlighted the importance of research to explore the potential health impact of the massive increase in the use of communication and mobile technologies among populations – impacts that could be both positive and negative.

59. In addition, the Expert Group discussed the need for significant development in the tools and techniques used by population and public health-related researchers. While the randomised controlled trial has been used as the mainstay of investigations to understand the efficacy of an intervention, they are not always feasible or the most appropriate study design to assess population-based issues and behavioural traits for which there is an absence of 'norms'. The expert group argued that considerable investment in research methods is needed to support the rigorous evaluation of public health interventions and programmes, and this rigour will help to build the profile and credibility of the field and potentially speed up the translation and implementation of findings.

"For the next 20 years – and [this] has been mentioned by several people – there is a need for robust science designs that may not be a randomised controlled trial, which can address new interventions for diseases, issues for the social determinants, issues for how you measure policy. And it seems like that is something the Wellcome Trust could play a lead role in driving."

Wellcome Trust Expert Group on Population and Public Health, June 2012

> "In many cases, I think we find questions that can be answered by methods we're comfortable with – like randomised controlled trials – rather than finding the real questions."
>
> Wellcome Trust Expert Group on Population and Public Health, June 2012

In summary, this review provides several suggestions for the future of population and public health research that funders could work together to help resolve:

- There is a need to consider whether existing funding mechanisms are appropriately structured to support the valuable multidisciplinary nature of population and public health research, both in the UK and beyond.
- Population and public health research needs to attract high-quality researchers from a range of different backgrounds to build and sustain capacity. The current profile, relative to other disciplines and professions, may be deterring retention of appropriately trained researchers; could we do more?
- One of the key factors that could enhance the profile and impact of population and public health as a field would be an enhanced ability to rigorously assess and evaluate public and population-based interventions and programmes – beyond the randomised controlled trial. Investment in the development of new and novel methodologies is required.
- More could be done to support the translation of research into practice. Can we now develop innovative solutions to speed the translation of research findings into policy and practice?

Annex A: Membership of the Wellcome Trust Expert Group on population and public health research

Dr Jeffrey Koplan (Chair)	Emory University, USA
Professor Nish Chaturvedi	Imperial College London, UK
Professor Cesar Victora	Federal University of Pelotas, Brazil
Dr Shireen Jejeebhoy	Population Council, India
Professor Debbie Lawlor	University of Bristol, UK
Professor Ronan Lyons	College of Medicine, Swansea, UK
Professor Göran Tomson	Karolinska Institutet, Sweden
Professor David Heymann	LSHTM, Chair of Health Protection Agency, UK
Professor Steven Tollman	University of Witwatersrand, South Africa
Professor Anne Johnson	UCL, UK
Professor Peter Smith	LSHTM, UK
Professor Jon Nicholl	University of Sheffield, UK
Professor Ray Fitzpatrick	University of Oxford, UK
Professor Peter Mugyenyi	Joint Clinical Research Centre, Uganda
Dr Alex Mold	LSHTM, UK
Dr Sarah Hawkes	UCL, UK

Annex B: Portfolio review methodology: further detail

Funding analysis using Wellcome Trust's AS400 Grants System

1. A search of the Wellcome Trust's AS400 Grants System was used to identify population and public health-related Trust funding between 1990 and 2011, using specific search terms provided by Trust Science Funding staff. This identified 6263 grants, which were then manually filtered to identify grants with a 'population and public health research' focus. All grant extensions were removed, leaving a final portfolio of 1788 grants.

2. Forty-seven grants were allocated as 'core support and infrastructure grants' for Wellcome Trust Centres and Major Overseas Programmes (MOPs). These were separated in the analysis (unless otherwise stated) because although they were certainly contributory, not all of the core support and infrastructure funding can be said to be in support of population and public health research. No attempt was made to determine a proportion. However, for the Africa Centre for Health and Population Studies, all funding was included as its primary aim is population and public health-related research.

Using the Health Research Classification System

1. The Wellcome Trust's population and public health research portfolio was classified using the Health Research Classification System (HRCS), a two-dimensional framework developed by the UK Clinical Research Collaboration (UKCRC) for the classification and analysis of health research. The HRCS classifies research according to research activity and health category.

2. The Research Activity Codes are modelled on the Common Scientific Outline, developed by the International Cancer Research Partners. The Health Categories are based on the International Classification of Diseases and contain 21 separate groupings which encompass all diseases, conditions and areas of health. Full details of the HRCS can be found on the UKCRC's website, **www.ukcrc.org/researchcoordination/**.

3. Of the 1788 population and public health research grants taken from the Wellcome Trust's AS400 grant system, 1765 grants were classified with both Research Activity Codes and Health Categories. These grants were included in the analysis because:

    - the funded research is of health or biomedical relevance
    - the award was active between the financial years 1989/90 and 2010/11
    - the funding can be directly attributed to a set of clearly defined research objectives and classified by type of research activity or health area.

Consultation survey

4. An online survey was sent to a sample of active population and public health researchers to gather opinions on the future priorities and opportunities for population and public health research. The questions used in the survey are shown in Box 1.

Box 1. Qualitative questions used in the survey

Key developments
- Over the past 20 years, what have been the most significant developments in population and public health research that have advanced the field to its current state and why?
- For the developments identified above, what were the key factors that brought these about?

Field progression
- In your experience, what are the key challenges facing researchers in population and public health research (a) in your local context and (b) globally?

Opinions
- Looking forward, what do you anticipate will be the most important issues for population and public health researchers to address?

Research/policy interface
- Looking forward, what do you anticipate to be the key ethical, legal and social issues facing population and public health researchers?

Policy and practice
- What approaches have you found most effective when trying to influence the uptake and implementation of population and public health research findings into policy and practice?

Future
- Thinking about the future, what are the key factors that could enhance the implementation and uptake of population and public health research into policy and practice?

5. A sample of 235 active population and public health researchers – Wellcome Trust funded (n = 107) and non-Wellcome Trust funded (n = 128) – was identified, comprising three subgroups:
    - Wellcome Trust population and public health research applicants between 2009/10 and 2010/11 (n = 78)
    - prolific publishers of population and public health research (n = 91)
    - 'new generation' researchers, defined as junior public health fellows (n = 35) and National Prevention Research Initiative Phase Four Applicants (n = 31).
6. The researchers were sent an online survey in February 2012. After two reminders, the survey was closed after eight weeks. A total of 60 complete responses were received and an overall response of 26 per cent was achieved.
7. The answers to the open-ended questions were coded using thematic analysis to pick out recurring themes in respondents' answers.

Wellcome Trust Expert Group on population and public health

1. To complement the landscape analyses, survey and case study work, 15 experts (plus a Chair) were invited to debate and discuss the status of population and public health research between 1990 and 2011. Experts were selected to cover the range of interests in population and public health and to ensure maximum relevance to the review's aims. Half of the experts had a working knowledge of the Wellcome Trust over the period in question (i.e. they were in receipt of significant Wellcome funding or involved in a Funding Committee). Instead of consulting experts on an individual basis, we tested whether we could usefully employ a cohort of independent subject experts in a group setting.
2. The Expert Group received a summary of the landscaping and bibliometric analysis in advance of their meeting, which was hosted at the Wellcome Trust in June 2012. Under the Chairmanship of Dr Jeffrey Koplan, the discussion was framed around the following broad question areas (Box 2).

Box 2. Outline agenda, Expert Group on population and public health

Key impacts and influences on the field

- What have been the most significant developments in population and public health research that have advanced the field to its current state?
- And for the developments identified, what were the key factors that brought these about?
- What have been the key impacts and applications within the field and beyond?
- What has been the role of the Wellcome Trust throughout this period?

Where are we now? Current challenges

- What are the current limiting factors in population and public health research (a) in your local context and (b) globally?
- Has the field got as far as and/or gone in the direction you anticipated?
- Who and/or what is driving the agenda?

Looking to the future and exploring new horizons

- What are the next big opportunities and challenges in the field?
- Who are the key players that could address these opportunities and challenges, drive this new agenda and make it happen?

Annex C: Additional Wellcome Trust population and public health funding analysis

Table 1. Funding for population and public health research: Medical, Humanities and Engagement

Grant type	Number of grants	Amount awarded (£m)
Biomedical Ethics		
Dissemination Award	1	0.03
Enhancement Award	1	0.4
Small Projects	3	0.1
Small Projects In Developing Countries	4	0.1
Travel grant	2	0.001
Symposia	38	0.2
Total	49	0.831
History of Medicine		
Research expenses	24	0.06
Research Leave Award	13	1
Symposia	47	0.1
Travel grant	32	0.02
University Award	11	2
Enhancement Award	3	1
Pilot Grant	3	0.2
Public Engagement Grant	4	0.2
Total	137	4.58
Public Engagement		
Broadcast Development Awards	2	0.02
Impact Awards	4	0.2
International Engagement Awards	21	1
MH&E Capital Award	1	1
Pulse Award	2	0.02
Society Activity Award	12	0.5
Society Research Award	3	0.5
People Award	25	0.5
Science Symposia	1	0.002
Rediscover	1	1
Small Arts Awards	1	0.009
Total	73	4.751
Total MHE	259	10.162

Base: 1741 Wellcome Trust grants associated with population and public health research, excluding core support and infrastructure funding for Wellcome Trust Centres and MOPs; see funding analysis methods in Annex B.
Source: Wellcome Trust AS400.

Table 2. Funding for population and public health research: 'other' Science Funding grants

Grant type	Number of grants	Amount awarded (£m)
Sir Henry Wellcome Commemorative Awards	3	0.2
Value in People Awards	1	0.25
Australian/New Zealand Research Initiative Award	1	0.1
Flexible Travel Award – Fellowship	1	0.4
Flexible Travel Award – Sabbaticals	5	0.2
Symposium	124	2
Short-term Travel grants	8	0.08
Miscellaneous	2	0.1
South-east Asia and Pacific – Research Leave Award	1	0.1
Vacation scholarships	3	0.002
Total	149	3

Base: 1741 Wellcome Trust grants associated with population and public health research, excluding core support and infrastructure funding for Wellcome Trust Centres and MOPs; see funding analysis methods in Annex B.
Source: Wellcome Trust AS400.

Table 3. Researchers in receipt of the highest amount of Wellcome Trust population and public health research funding (research and personal support), including infrastructure funding for Wellcome Trust Centres and MOPs, 1990–2011

Researcher	Current host institution	Amount (£m)[a]	Grant type
Professor Sir Rory Collins	UK Biobank Ltd, UK	41	Biobank
Professor Marie-Louise Newell	University of KwaZulu-Natal, South Africa	26	Programme; project (x2); International Engagement Award; African Centre for Health and Population Studies
Professor Kevin Marsh	University of Oxford, UK	23	Programme (x2); Strategic Award; project
Professor George Davey Smith	University of Bristol, UK	17	Strategic Award (x2); Programme; Flexible travel award
Dr Helen H Lee	University of Cambridge, UK	12	Collaborative project; project (x2)
Professor John A Todd	University of Cambridge, UK	12	Programme
Dr Christina Zarowsky	International Development Research Centre, Canada	10	Programme
Dr Rajiv Indravadan Modi	Cadila Pharmaceuticals Limited, India	10	Affordable Healthcare In India
Professor Nick White	University of Oxford, UK	10	Principal Research Fellowship (x2); programme; project; Strategic Translational Award; symposium
Professor Brian Greenwood	LSHTM, UK	10	Strategic Award; project

[a] Data are rounded to the nearest £m.
Base: 1788 Wellcome Trust grants associated with population and public health research, including core support and infrastructure funding for Wellcome Trust Centres and MOPs.
Source: Wellcome Trust AS400.

Table 4. Researchers in receipt of the highest amount of Wellcome Trust population and public health research funding (research and personal support), excluding infrastructure funding for Wellcome Trust Centres and MOPs, 1990–2011

Researcher	Current host institution	Amount (£m)[a]	Grant type
Professor Sir Rory Collins	UK Biobank Ltd, UK	41	Biobank
Professor Marie-Louise Newell	University of KwaZulu-Natal, South Africa	26	Programme; project (x2); International Engagement Award; African Centre for Health and Population Studies
Professor George Davey Smith	University of Bristol, UK	17	Programme (x2); Strategic Award; project
Dr Helen H Lee	University of Cambridge, UK	12	Collaborative project; project (x2)
Dr Rajiv Indravadan Modi	Cadila Pharmaceuticals Limited, India	10	Affordable Healthcare In India
Professor Nick White	University of Oxford, UK	10	Principal Research Fellowship (x2); Programme; project; Strategic Translational Award; symposium
Dr Neil French	LSHTM, UK	9	Programme (x2); Strategic Award
Prof Lionel Tarassenko	University of Oxford, UK	9	Health Innovation Challenge Fund; Strategic Award
Professor Jonathan Weber	Imperial College London, UK	9	Project (x2); Strategic Award
Professor Alex Matter	Novartis Institute for Tropical Disease, Singapore	8	Strategic Translation Award (x2)

[a] Data are rounded to the nearest £m.
Base: 1741 Wellcome Trust grants associated with population and public health research, excluding core support and infrastructure funding for Wellcome Trust Centres and MOPs. One Wellcome Trust MOP, the Africa Centre for Health and Population Studies, is included because all of the core support and infrastructure will have been used to support population and public health research; see funding analysis methods in Annex B.
Source: Wellcome Trust AS400.

Table 5. Institutions in receipt of most Wellcome Trust funding for population and public health research, including infrastructure grants to Wellcome Trust Centres and MOPs, 1990–2011 (top 20)

Institution	Amount (£m)[a]
University of Oxford, UK	192
London School of Hygiene and Tropical Medicine, UK	101
UCL, UK	44
UK Biobank Ltd, UK	41
KEMRI, Kenya	34
Imperial College London, UK	34
University of Bristol, UK	33
University of KwaZulu-Natal, South Africa	33
University of Cambridge, UK	33
Kings College London, UK	22
University of Dundee, UK	18
University of Edinburgh, UK	13
Liverpool School of Tropical Medicine, UK	12
University of Liverpool, UK	10
International Development Research Centre, Canada	10
University of Southampton, UK	10
Cadila Pharmaceuticals Limited, India	10
University of Manchester, UK	10
Diagnostics for the Real World Ltd, California	10
Novartis Institute for Tropical Disease, Singapore	8

[a] Data are rounded to the nearest £m.
Base: 1788 Wellcome Trust grants associated with population and public health research, including core support and infrastructure funding for Wellcome Trust Centres and MOPs; see funding analysis methods in Annex B.
Source: Wellcome Trust AS400.

Table 6. Institutions in receipt of most Wellcome Trust funding for population and public health research excluding infrastructure grants to Wellcome Trust Centres and MOPs, 1990–2011 (top 20)

Institution	Amount (£m)
University of Oxford, UK	92
London School of Hygiene and Tropical Medicine, UK	88
UCL, UK	44
UK Biobank Ltd, UK	41
University of Bristol, UK	34
Imperial College London, UK	34
University of KwaZulu-Natal, South Africa	33
King's College London, UK	22
University of Dundee, UK	18
University of Cambridge, UK	17
Cadila Pharmaceuticals Limited, India	10
University of Liverpool, UK	10
Diagnostics for the Real World Ltd, USA	10
Novartis Institute for Tropical Diseases, Singapore	8
University of Edinburgh, UK	8
St George's University of London, UK	7
University of Witwatersrand, South Africa	6
University of Glasgow, UK	6
Abrasco-Universidade Federal de Pelotas, Brazil	6
University of Southampton, UK	6
Novartis Vaccines Institute for Global Health, Italy	5

[a] Data rounded to nearest £m.
Base: 1741 Wellcome Trust grants associated with population and public health research, excluding core support and infrastructure funding for Wellcome Trust Centres and MOPs; see funding analysis methods in Annex B. One Wellcome Trust MOP, the Africa Centre for Health and Population Studies, is included because all of the core support and infrastructure will have been used to support population and public health research.
Source: Wellcome Trust AS400.

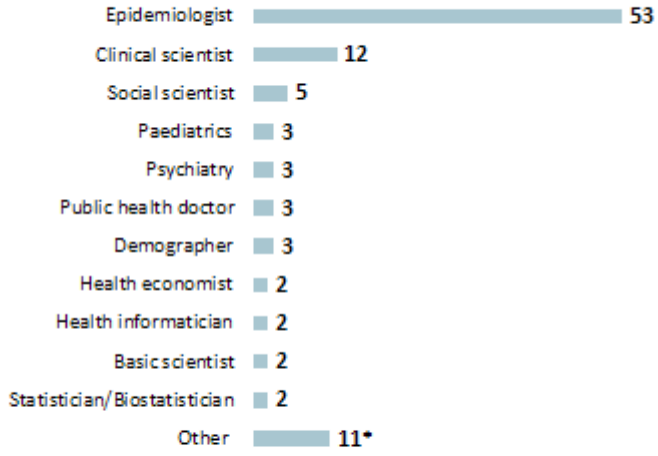
Table 7. Wellcome Trust Senior and Principal Research Fellows focusing on population and public health research funded 1990–2011

Year	Researcher	Institution	Grant type
1990	Professor Jean Golding	University of Bristol, UK	Principal Research Fellow
1990	Professor David Skuse	UCL, UK	Principal Research Fellow
1990	Dr Jenny Shaw	LSHTM, UK	Principal Research Fellow
1991	Professor Nick White	University of Oxford, UK	Principal Research Fellow (renewed 2011)
1992	Professor Bernadette Modell	University of London, UK	Principal Research Fellow (renewed 1996)
1994	Professor Francois Nosten	University of Oxford, UK	Senior Research Fellow, clinical
1995	Professor Alan Fairlamb	University of Dundee, UK	Principal Research Fellow
1995	Professor Robert Snow	University of Oxford, UK	Senior Research Fellow, basic (renewed 2000, 2006)
1998	Professor Dorothy Bishop	University of Oxford, UK	Principal Research Fellow
1999	Professor John Mullins	University of Edinburgh, UK	Principal Research Fellow
2000	Professor William Cookson	University of Oxford, UK	Senior Research Fellow, clinical
2001	Professor Alison Elliott	LSHTM, UK	Senior Research Fellow, clinical (renewed 2006, 2011)
2002	Professor Stephen O'Rahilly	University of Cambridge, UK	Senior Research Fellow, clinical
2003	Professor Maris Laan	University of Tartu, Estonia	Principal Research Fellow
2003	Professor Charles Newton	UCL, UK	Senior Research Fellow, clinical (renewed 2008)
2003	Professor Robert Wilkinson	Imperial College London, UK	Senior Research Fellow, clinical (renewed 2009)
2004	Dr Philip Cooper	St George's University of London, UK	Senior Research Fellow, basic (renewed 2009)
2004	Dr Elizabeth Corbett	LSHTM, UK	Senior Research Fellow, clinical (renewed in 2009)
2005	Professor Heather J Cordell	University of Cambridge, UK	Senior Research Fellow, basic
2005	Dr Helen McShane	University of Oxford, UK	Senior Research Fellow, clinical
2005	Professor Michael English	University of Oxford, UK	Senior Research Fellow, clinical (renewed 2012)
2005	Professor Adrian Hill	University of Oxford, UK	Principal Research Fellow
2005	Professor Vikram H Patel	LSHTM, UK	Senior Research Fellow, clinical (renewed 2010)
2006	Professor Simon Hay	University of Oxford, UK	Senior Research Fellow, basic (renewed 2011)
2007	Professor Anthony Scott	University of Oxford, UK	Senior Research Fellow, clinical
2007	Professor Rowland Kao	University of Glasgow, UK	Senior Research Fellow, basic
2007	Professor Liam Smeeth	LSHTM, UK	Senior Research Fellow, clinical
2008	Professor David Clayton	University of Cambridge, UK	Principal Research Fellow
2008	Professor Brian Spratt	Imperial College London, UK	Principal Research Fellow
2010	Dr David Osrin	UCL, UK	Senior Research Fellow, clinical
2010	Professor Hector Garcia	Universidad Peruana Cayetano Heredia, Peru	Senior Research Fellow, public health and tropical medicine
2010	Professor Richard Price	University of Oxford, UK	Senior Research Fellow, clinical
2010	Professor Thomas Williams	University of Oxford, UK	Senior Research Fellow, clinical
2011	Dr Sandra Telfer	University of Aberdeen, UK	Senior Research Fellow, basic

Base: Senior and Principal Research Fellowships in the cohort of 1788 Wellcome Trust grants associated with population and public health research.
Source: Wellcome Trust AS400.

Annex D: Consultation survey – respondent profile

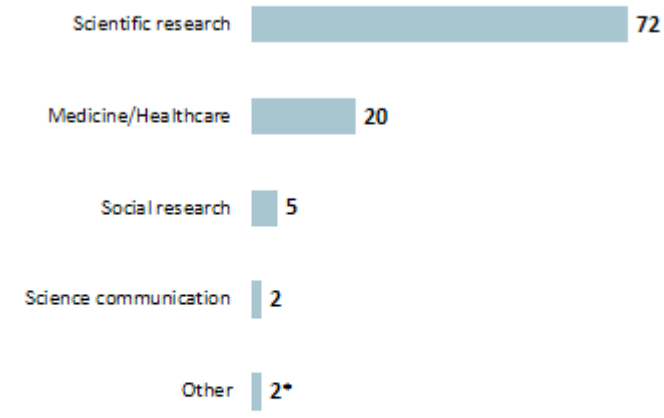
Figure 1: Respondents – disciplinary background (%)



Base: All respondents (n=60)
Q: Which of the following best describes your disciplinary background?

**Other= Education and Psychology, Dietician, Public health, Nutrition, Health policy, and Generalist- drawing on epidemiology, demography, economics and social sciences.*

Figure 2: Respondents – your sector (%)

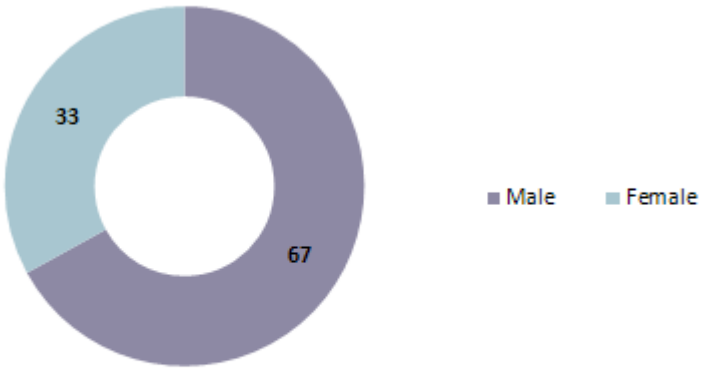


Base: All respondents (n=60)
Q: Which of the following best describes your main area of work?

** Other= Research, Medicine and Health Care.*

Other available options: Education/teaching, Science administration, Government/policymaker, Public relations/press officer, Consulting and Biotechnology/pharmaceutical industry. These options were not selected by any respondents as their main area of work.

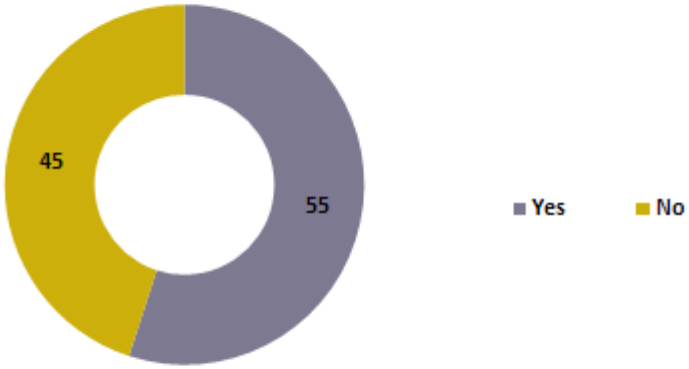
Figure 3: Respondents - gender (%)



Base: All respondents (n=60)
Q: Are you:

Additional option: Prefer not to say

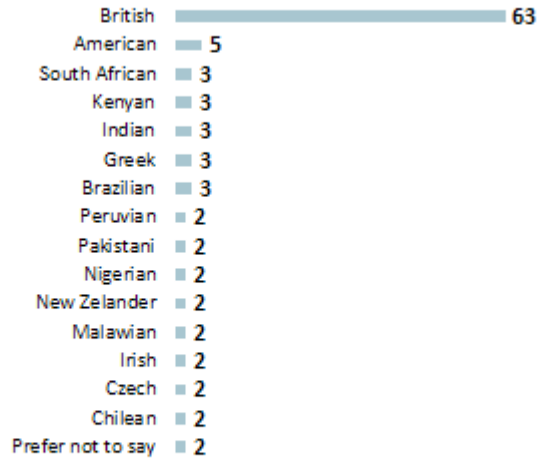
Figure 4: Respondents – medically qualified (%)



Base: All respondents (n=60)

Q: Are you medically qualified?

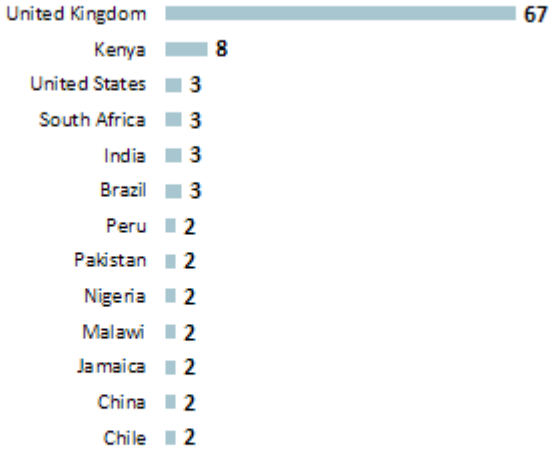
Figure 5: Respondents – your nationality (%)



Base: All respondents (n=60)

Q: What is your nationality?

Figure 6: Respondents – country of residence (%)



Base: All respondents (n=60)

Q: What is your country of residence?

Annex E: Population and public health research timeline

1. The Timeline sets out the key scientific, policy, impact and funding developments that have influenced the field of population and public health research in recent history. In the most recent two decades, the emphasis is on the contribution of the Wellcome Trust – where the Wellcome Trust has played a key part or a contributory role alongside others in the field.

Population and public health research timeline

Date	Key	Summary	Description
1700 BCE	Scientific advance	Code of Hammurabi written	The Code of Hammurabi is the earliest known document that includes laws concerning health practices and the conduct of physicians.
1400 BCE	Scientific advance	Leviticus written	Leviticus contains the first known written health code. It gives guidance on hygiene, food safety and preventing the spread of infectious diseases.
Fifth century BCE	Scientific advance	Hippocrates establishes foundations of modern medicine	Hippocrates wrote a series of works and established a learning system for students of medical practice.
Eighth century BCE	Scientific advance	Earliest known reference to smallpox inoculation written	Madhav, an Indian physician, wrote the Nidana, a medical reference book that recommended using inoculation to protect against smallpox.
180–160 BCE	Scientific advance	Concept of plague developed	Plague was observed as a specific phenomenon of quickly spreading fatal disease in the ancient world. The term 'plague' was coined by the Greek physician and scientist Galen after he treated patients in the Antonine Plague, which is thought to have killed up to 5 million people in ancient Rome.
Tenth to 15th century	Scientific advance	People with leprosy isolated	Documents from the medieval period refer to the isolation of lepers in hospitals and colonies, which was intended to preserve the health of people with leprosy and to prevent the spread of the disease.
1500s	Scientific advance	Syphilis spreads through Europe	Physicians in various European countries recognised the sexual transmission of syphilis, the name of which was coined by Italian physician Girolamo Fracastoro in 1530. Control measures included the physical examination of sex workers and the isolation of victims.
Mid-1500s	Policy development	Regulations to prevent bubonic plague introduced in Europe	In response to the high incidence and mortality rates of bubonic plague, European city authorities (particularly in Italy) introduced measures to limit its spread, such as quarantine for recent arrivals, regulated burial practices for deceased plague victims and waste disposal.
1549	Scientific advance	Early reference to inoculation in China written	Wan Quan, a Ming Dynasty paediatrician, discussed the use of smallpox inoculation, giving few details of the practice. Smallpox inoculation is referred to as widely used in China from the 16th century, and more detailed descriptions of the process appeared from the 17th century onwards.
1564	Scientific advance	Early reference to condom use written	Against the backdrop of the increasing incidence of syphilis, physician Gabriello Fallopio recorded the use of thin, chemically soaked linen sheets held in place by a ribbon to protect against infection during casual sexual encounters. This was nearly four centuries before condoms were used widely in a domestic setting.

Date	Key	Summary	Description
1662	Scientific advance	'Life Table' published as part of the Natural and Political Observations on the Bills of Mortality	John Graunt, an amateur scientist, used a set of population data collected more than a century earlier to analyse death rates at age-based intervals, establishing the foundations for statistical approaches to population analysis.
1667	Scientific advance	First human blood transfusion performed	Jean-Baptiste Denys, a French physician and personal physician to King Louis XIV, transfused the blood of a sheep into a 15-year-old boy, who survived the procedure.
1671	Scientific advance	The Midwives Book published in England	Jane Sharp, a 17th-century midwife, produced a textbook on midwifery that advised both parents and midwives on how to manage each stage of a birth and gave advice on problems in childbirth.
1700	Scientific advance	Diseases of Workers published	Bernardino Ramazzini published Diseases of Workers, a book outlining health hazards associated with specific occupations, including exposure to hazardous materials and unusual postures. His treatise became a seminal work of occupational medicine.
1717	Scientific advance	Malaria linked to exposure to mosquitoes	Italian physician and scientist Giovanni Maria Lancisi published On the Noxious Effluvia of Marshes, in which he hypothesised that malaria is caused by mosquitoes breeding in large numbers in swamps. Lancisi recommended draining swamps as a preventive measure.
1721–22	Scientific advance	Inoculation for smallpox introduced in Britain	After reports to the Royal Society about the effectiveness of smallpox inoculation in Ottoman territories, Sir Hans Sloane undertook a series of experiments that established its credibility among British physicians.
1753	Scientific advance	Treatise on Scurvy published	A series of measures for preventing scurvy in naval personnel – including the consumption of citrus fruit – were recommended, based on research by naval surgeon James Lind.
1796	Scientific advance	Immunisation with matter from cowpox pustules is trialled	Edward Jenner tested his hypothesis that the pus in cowpox pustules protects against smallpox by inoculating a young boy (James Phipps) with matter taken from the cowpox pustules of a milkmaid.
Mid-1800s	Scientific advance	Rubber vulcanisation technology allows mass production of condoms	Condoms became available on a large scale owing to technological changes, although they were still considered uncomfortable. This was accompanied by the advent of the birth control movement in Britain, which gradually began promoting the use of condoms as contraceptives.
1855	Advance in knowledge	Mary Seacole founds the British Hotel	Mary Seacole, a Jamaican nurse, travelled to the Black Sea to set up an institution to care for wounded soldiers. Her nursing services had been refused by the British Army and other nursing professionals in the Crimean War.

Date	Key	Summary	Description
1861	Funding development	Florence Nightingale establishes school of nursing	The first secular nursing school was established at St Thomas' Hospital in London, based – in part – on the principles articulated in Florence Nightingale's book Notes on Nursing, which encouraged the professionalisation of the field. Nightingale's approach was informed by her experience organising wartime services for wounded soldiers during the Crimean War.
1842	Policy development	Chadwick's Report on Sanitary Conditions published	Edwin Chadwick published a report based on his investigations into the living standards and environments of poor populations in England, which highlighted the links between hygiene, sanitation and disease. In the report, he outlined progressive proposals for reform, which later informed the development of the Public Health Act.
1845	Policy development	The Lunacy Act	The UK's Lunacy Act required counties to provide asylums and led to the mass construction of psychiatric hospitals over the next 25 years. The asylums were funded by the county councils rather than parishes, which encouraged local parishes to move poor individuals with perceived mental health issues to the asylums.
1848	Policy development	The Public Health Act	England's first Public Health Act was legislated, establishing a Central Board of Health and assigning responsibility for drainage and water supplies to local boroughs.
1850	Scientific advance	Semmelweis reports on hygiene as a key measure in infection control	The Hungarian physician Dr Ignaz Semmelweis published findings of an association between disinfection procedures and reductions in infant mortality at a hospital in Vienna. His approach was discounted by colleagues until the 1860s, when the work of Dr Joseph Lister and Dr Louis Pasteur on antiseptics became popular.
1854	Scientific advance	Spread of cholera attributed to contaminated water	John Snow, an English physician, mapped the distribution and spread of cholera in Soho in London, convincing the local council that the source was a pump dispensing contaminated water. This was a significant development in the field of epidemiology and has been referred to as 'the birth of modern epidemiology'.
Late 1800s	Scientific advance	Support for eugenics develops in the European scientific community	The concept of eugenics as a scientific discipline gained credence among European researchers as a means of altering population attributes, including health. The popularity of eugenics culminated in the 1920s and 1930s, when some mentally and physically disabled individuals underwent government-sanctioned sterilisation in Europe and the Americas.

Date	Key	Summary	Description
1870	Scientific advance	Pasteurisation process discovered	Louis Pasteur identified harmful bacteria and mould growing in consumable substances such as milk and subsequently invented a process to kill microorganisms growing in liquids using heat. The discovery supported the contemporaneous development of germ theory, while reducing the risk of disease from consuming liquids.
1882	Scientific advance	Cause of tuberculosis identified as Mycobacterium tuberculosis	Robert Koch identified Mycobacterium tuberculosis, the bacterium that causes tuberculosis. Bacterial causes for many diseases, such as cholera and pneumonia, were discovered subsequently by Pasteur, Koch and others.
1898	Scientific advance	Mosquitoes confirmed as malaria vector	British physician Ronald Ross confirmed the mosquito as the carrier of malaria, prompting early attempts at mosquito (vector) control.
1910	Scientific advance	First synthetic antimicrobial agent	Salvarsan, the first antimicrobial agent made and the first effective treatment for syphilis, was developed by Paul Ehrlich in Germany.
1918	Advance in knowledge	Influx of disabled soldiers highlights need for services	World War I resulted in large numbers of disabled soldiers across Europe and the USA, compelling governments to initiate services to meet the needs of the disabled.
1918–19	Advance in knowledge	Pandemic influenza causes more than 50 million fatalities across the world	Pandemic influenza, also known as 'Spanish flu', spread rapidly along trade routes and shipping lines at the close of World War II. Outbreaks swept through North America, Europe, Asia (where the mortality rate reached 50 deaths from flu per 1000 people in India), Africa, Brazil and the South Pacific.
1920s	Scientific advance	Technology to mass produce latex condoms developed	Latex became the primary material for condoms, allowing manufacturers to produce condoms that were both more comfortable and more durable. This development is associated with a dramatic increase in condom production.
1920	Scientific advance	First human trials with the attenuated viable vaccine Bacille Calmette-Guérin (BCG)	BCG, an attenuated version of Mycobacterium bovis, was developed by Albert Calmette and Camille Guérin.
1921	Scientific advance	UK's first family planning clinic founded	Marie Stopes founded the UK's first family planning clinic in north London.
1924	Scientific advance	Iodine first added to salt commercially in the USA	Iodine was first added to salt commercially by the Morton Salt Company at the request of the US government in response to findings that a soil type in certain regions (e.g. around the Pacific Great Lakes and in the Pacific Northwest) was lacking in iodine, causing iodine deficiencies.
1928	Scientific advance	Penicillin discovered	Alexander Fleming observed that a bacterial growth was unable to penetrate a blue-green mould and concluded that the mould was releasing a substance that inhibited bacterial growth. Fleming subsequently grew a pure culture of the mould, naming the bacteria-inhibiting substance penicillin.

Date	Key	Summary	Description
1930	Scientific advance	National Birth Control Council formed in the UK	The National Birth Control Council later became the Family Planning Association.
Early 20th century	Scientific advance	Germ theory developed and penicillin introduced for mass use (World War II)	
1935	Scientific advance	First commercially available antimicrobial developed	The first antimicrobial drug was a sulphonamide with the trade name Prontosil, which was developed at Bayer Laboratories in Germany. Gerhard Johannes Paul Domagk received the Nobel Prize in Physiology or Medicine for his discovery of Prontosil.
1943	Scientific advance	Streptomycin developed	Selman Waksman received the Nobel Prize in Physiology or Medicine for his discovery of streptomycin.
1939–45	Advance in knowledge	World War II prompts global action against malaria	Japan took control of most of the plantations growing cinchona, the primary ingredient for malaria treatment at the time. Frequent and prolonged fighting in malaria-infested areas compelled the Allied Forces to support the development of synthetic antimalarial drugs and the use of an insecticide, DDT (dichlorodiphenyltrichloroethane), to reduce exposure.
1946	Policy development	World Health Organization (WHO) founded	World diplomats adopted a proposal from three physicians (Dr Szeming Sze of China, Dr Geraldo de Paula Souza of Brazil and Dr Karl Evang of Norway) to form a single organisation that would address the health needs of the world's people. The WHO was established as part of the United Nations, and its constitution defined health as "a state of complete physical, mental and social wellbeing and not merely the absence of disease or infirmity".
1940s	Scientific advance	Polio treatment transformed	Until the 1940s, immobilisation and the use of the 'iron lung' had been the primary course of treatment for polio. Radical approaches introduced in the 1940s by figures such as Sister Elizabeth Kenny advocated massage, stretching, exercise and the application of hot packs to keep muscles warm.
1940s	Scientific advance	Large-scale food fortification begins	Britain and the USA began the large-scale fortification of foods such as margarine and flour with essential vitamins and minerals (including vitamins A and D, calcium, and iron).
1945	Advance in knowledge	Penicillin-resistant *Staphylococcus aureus* emerges	
1946	Policy development	UNICEF established	The United Nations International Children's Emergency Fund (UNICEF) was created to provide food, clothing and healthcare for European children after World War II. In 1953, UNICEF became part of the United Nations.

Date	Key	Summary	Description
1946	Funding development	The 1946 National Birth Cohort (MRC National Survey of Health and Development)	The National Birth Cohort (National Survey of Health and Development, or NSHD) was established under director Dr James Douglas. The NSHD is the oldest of the British birth cohort studies and is unique in having data from birth to age 65 years on the health and social circumstances of a representative sample (n = 5362) of men and women born in England, Scotland or Wales in March 1946. • Maternity in Great Britain: a survey of social and economic aspects of pregnancy and childbirth undertaken by a joint committee of The Royal College of Obstetricians and Gynaecologists and the Population Investigation Committee. London: Oxford University Press; 1948.
1948	Policy development	United Nations Universal Declaration of Human Rights	The declaration comprises detailed descriptions of the inherent rights and freedoms all humans are entitled to.
1948	Funding development	Britain's National Health Service (NHS) established	The NHS was established in Britain after World War II as a means of providing health services on a coordinated national level, based on need rather than the ability to pay. The NHS brought together healthcare institutions, medical personnel and administrative services into one organisation, which would become the largest in Europe.
1948	Scientific advance	Randomised controlled trials introduced	The first published randomised controlled trial was in an MRC investigation. • The Streptomycin in Tuberculosis Trials Committee. Streptomycin treatment of pulmonary tuberculosis. BMJ 1948;2(4582):769–82.
1950s	Scientific advance	Chloramphenicol, tetracycline, vancomycin and erythromycin discovered	
1950s	Advance in knowledge	Multidrug-resistant *S. aureus* emerges	
1950s	Scientific advance	DDT spraying used widely for malaria control	Malaria incidence was dramatically reduced in several countries, including the USA, through large-scale interventions involving spraying the chemical compound DDT.
1950s	Scientific advance	Vaccines for polio prevention developed by American medical researchers	An injected vaccine developed by Jonas Salk, an American medical researcher, was introduced in 1952, followed by an oral vaccine developed by Albert Sabin and licensed in 1962. Large-scale programmes to vaccinate children are credited with dramatically reducing polio incidence in subsequent decades.

Date	Key	Summary	Description
1954	Scientific advance	Link between smoking and lung cancer established	Sir Richard Doll, who began researching the rising incidence of lung cancer in the 1940s, established a clear link between smoking and lung cancer based on studies of lung cancer patients in 20 London hospitals. Sir Doll and Sir Austin Bradford Hill published an article in the British Medical Journal warning that smokers are substantially more likely than non-smokers to die of lung cancer.
1950s–1960s	Advance in knowledge	Thalidomide causes malformed limbs in European infants	Thalidomide was licensed for over-the-counter sale as a relaxant therapy in several European countries in 1956. It was taken off the market in 1961 after causing malformed limbs in infants born to women who had used it during pregnancy. It caused impairments in an estimated 10 000 babies.
1953	Policy development	BCG vaccination introduced in secondary schools in the UK	
1955	Scientific advance	Research on the link between seat belt use and injury prevention in automobiles published	Dr C Hunter Shelden published a study on seat belt use in automobiles in the Journal of the American Medical Association, the results of which (along with other studies) were used to support proposals for retractable seat belts and other safety features.
1957	Policy development	The 'Percy Report' published	The Report of the 1954–57 Royal Commission on the law relating to mental illness and mental deficiency, led by Lord Eustace Percy, marked a turning point in official policy from hospital-based to community-based systems of mental health care. Recommendations included limiting restrictions on mental patients' liberty and providing services for most patients on an outpatient, or community, basis.
1958	Funding development	The National Child Development Study (1958 Birth Cohort)	The National Child Development Study took place at the Centre for Longitudinal Studies, the Institute of Child Health and the Department of Epidemiology at St George's Hospital Medical School, University of London. It was carried out by Professor Heather Joshi, Professor Chris Power, Professor David Strachan and Dr Jane Elliott. The goal was initially medical and social science, then genetic association studies.
1959	Policy development	US Congress passes automobile safety legislation	The US Congress passed a law requiring all automobiles to comply with specified safety standards. The global adoption of seat belt use began in the subsequent decade.
1960	Scientific advance	Methicillin developed	
1960	Scientific advance	First oral contraceptive pill approved	A team, led by Professor John Rock from Harvard University and with the support and funding of the birth control movement, developed an oral

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			contraceptive pill (Enovid) that was approved by the US Food and Drug Administration for contraceptive use. Court cases over the next seven years ultimately resulted in the pill being available to unmarried women in all states in the USA.
1961	Advance in knowledge	Methicillin-resistant Staphylococcus aureus (MRSA) emerges in the UK	• Jevons MP.
1962	Policy development	Silent Spring published	Rachel Carson published *Silent Spring*, which documented the damaging effects of pesticides on the environment (particularly bird populations). The book had a substantial effect on the public understanding of the interaction between environmental deterioration and health and affected political and public support for the use of DDT in malaria control.
1964	Scientific advance	Oxford Record Linkage Study published	Acheson, E. and Evans, J. The Oxford Record Linkage Study: A review of the method with some preliminary results. Proc R Soc Med 1964;57:269-74.
1965	Scientific advance	Hill's Criteria for Causation published	Bradford Hill published criteria for the epidemiological assessment of the causes of disease, developing postulates from David Hume, John Stuart Mill, Robert Koch and others.
1967	Funding development	Association for the Study of Obesity (ASO) established	The ASO, which is affiliated to the European and International Associations for the Study of Obesity, organised the 1974 inaugural International Congress on Obesity in London. ASO was also the founding body of the International Journal of Obesity.
1970	Policy development	Victoria, Australia, becomes first state to legislate compulsory seat belt use	The Australian state of Victoria became the first to pass a law requiring both drivers and front seat passengers to wear seat belts.
1970	Advance in knowledge	Haddon Matrix created	A paradigm that is used to form injury intervention and prevention strategies by examining how different personal and environmental risk factors affect the likelihood of an injury or death occurring.
1970s	Funding development	Popularisation of meta-analysis	
1932–72	Scientific advance	Tuskegee Study undertaken in the USA	As part of the 'Tuskegee Study of Untreated Syphilis in the Negro Male', nearly 400 African-American men diagnosed with latent syphilis were monitored for 40 years without being informed of their condition or treated with penicillin. Public outcry in the 1970s led to a significant review of ethical considerations in clinical trials of humans.

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1973	Scientific advance	Discovery of the first statin	Akira Endo successfully isolated 'mevastatin' from fermentation broths while working at the Sankyo Company in Tokyo. Statins were found to lower LDL (bad cholesterol) but not HDL (good cholesterol) in the bloodstream.
1974	Policy development	A New Perspective on the Health of Canadians published	This report stresses the importance of disease prevention and health promotion for population health, compared to biomedicine alone. • LaLonde M. 1976. A New Perspective on the Health of Canadians. A working document. Ottawa: Government of Canada.
1974	Policy development	WHO launches Expanded Program on Immunization	The WHO launched the Expanded Program on Immunization, which targeted polio, diphtheria, tuberculosis, pertussis, measles and tetanus in children. At the time, fewer than 5 per cent of the world's children were immunised against these diseases in their first year of life.
1976	Policy development	'Prevention and Health – Everybody's business' published	Emphasises the importance of disease prevention for public health. • DHSS. 1976. Prevention and Health: Everybody's business. HMSO.
1977	Policy development	Smallpox eradicated worldwide	The WHO announced the worldwide eradication of smallpox, after targeted campaigns by the Global Smallpox Eradication Campaign made vaccination increasingly available (and, in many countries, compulsory). The last indigenous case was reported in Somalia.
1970s	Advance in knowledge	Asylums to treat mental illness patients gradually replaced by pharmaceutical treatments	
1978	Policy development	Declaration of Alma-Ata	The Declaration from the International Conference on Primary Health Care (Alma-Ata, Afghanistan) articulated worldwide primary healthcare as key to attaining the goal of Health for All, a movement that was launched by the World Health Assembly in 1977. Among its key points was the need for urgent national and international action to protect and promote the health of all. The Declaration highlights the important role of other social and economic sectors (in addition to the health sector) in promoting health as a fundamental human right, with primary healthcare as its foundation.
1979	Scientific advance	Oral rehydration therapy introduced	Oral rehydration therapy was introduced by the WHO to control diarrhoeal diseases.
1980	Policy development	Black Report published	The Black Report was initially suppressed by the Thatcher government but helped draw attention to health inequalities and social determinants of health.
1981	Policy development	WHO Health for All strategy	Global agenda set for health resources and access to services.

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1981	Scientific advance	First documented cases of AIDS reported in the USA	A high prevalence of a rare skin cancer (Kaposi's sarcoma) and pneumonia were reported in gay men in New York and California and subsequently recognised as the first documented cases of AIDS. By the end of 1981, 121 people were known to have died from the disease.
1982 and 1993	Funding development	Pelotas birth cohorts	Two Brazilian birth cohorts (1982 and 1993) examined the impact of socioeconomic, behavioural, healthcare and biological factors on health. The research was based at the Department of Social Medicine, Federal University of Pelotas, Brazil.
1984	Scientific advance	Researchers in France and the USA discover the retrovirus responsible for AIDS	HIV was independently isolated, then cultured, by Luc Montagnier of the Pasteur Institute in Paris and Robert Gallo of the National Cancer Institute in Washington, DC. In the same period, reports of AIDS being passed on through heterosexual intercourse began.
1984	Funding development	Demographic and Health Surveys project launched	The Demographic and Health Surveys Project was initiated by the US Agency for International Development to provide information on the population, health and nutrition of women and children in low- and middle-income countries. The project built on the framework developed by its predecessors, the World Fertility Survey and the Contraceptive Prevalence Survey. Fieldwork began in 1985 in El Salvador.
1986	Advance in knowledge	Emergence of vancomycin-resistant enterococci	The first strains of vancomycin-resistant enterococci appeared in Europe in 1986 and in the USA in 1989.
1986	Policy development	Ottawa Charter frames the 'new public health'	The Charter for Health Promotion (adopted by the WHO at a meeting in Ottawa, Canada) built on the principles established by the Alma-Ata Declaration by reaffirming social justice and equity as prerequisites for health, and advocacy and mediation as the processes for their achievement. The Charter identified five areas of action for health promotion: building healthy public policy, creating supportive environments, developing personal skills, strengthening community action and reorientating health services.
1987	Scientific advance	First commercial statin, 'Mevacor', produced by Merck	Statins are a class of drugs used to inhibit the enzyme HMG-CoA reductase to lower cholesterol.
1987	Scientific advance	First antiretroviral drug introduced	AZT (Zidovudine), the first antiretroviral drug, became available to treat people with HIV after a successful clinical trial. The drug blocks the action of HIV's enzyme reverse transcriptase, which stops the virus replicating in cells. AZT slows down the course of AIDS and delays death.

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1987	Scientific advance	WHO launches Global Programme on AIDS	Estimating that as many as 5 to 10 million people were infected with HIV worldwide, the WHO launched its Global Programme on AIDS.
1988	Funding development	Birth to Twenty (BT20) cohort	The study is currently supported by the Wellcome Trust, the Human Sciences Research Council, the MRC, the University of the Witwatersrand, the South African-Netherlands Research Programme on Alternatives in Development and the Anglo American Chairman's Fund.
1988	Policy development	Widespread breast screening introduced in the UK	Breast screening units were established across the UK to provide mammograms, with the aim of reducing breast cancer deaths in women over 50.
1988	Policy development	Adelaide Recommendations	The second international conference on health promotion in Adelaide, Australia, recommended that health promotion focus on the development of key areas, particularly public policy that promotes health comprehensively. Highlights included greater accountability for health outcomes and related services in public policy (including more robust evaluation of policy impact) and partnerships between public, private and non-governmental stakeholders to encourage a more coordinated approach to health promotion.
1989	Funding development	KEMRI-Wellcome Trust Research Programme	The KEMRI-Wellcome Trust Research Programme – a collaboration between the University of Oxford and the Kenyan Medical Research Institute, Kenya – was formally established in 1989.
1990s	Advance in knowledge	Epidemic of alcohol-related deaths following demise of the Soviet Union	Evidence that the increase in alcohol-related deaths was a major factor contributing to the rapid decrease in life expectancy in the early 1990s, which fell by three years for men between 1992 and 1993. • McKee M. Alcohol in Russia. Alcohol and Alcoholism 1999;34:824–9.
1990s	Policy development	Community case management of childhood illnesses	Community case management aims to accelerate the progress of reducing child mortality by two-thirds between 1990 and 2015 (i.e. Millennium Development Goal 4) by increasing the number of care providers at the community level.
1990	Policy development	The National Surveys of Sexual Attitudes and Lifestyles (NATSAL)	The first study survey (NATSAL I, in 1990) was funded by the Wellcome Trust, and a second study (NATSAL II, in 2000) was carried out with funding from the MRC. NATSAL III began in 2010 with funding from the Wellcome Trust with the MRC, the Economic and Social Research Council, and the Department of Health, and the results are expected in 2013. • Johnson AM et al. UCL, UK.

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1990s	Advance in knowledge	Decline in sudden infant death syndrome (SIDS)	After campaigns to raise awareness of the risks of unsafe sleeping positions for infants, the incidence of SIDS dropped in Europe and the USA.
1990	Policy development	National Health Service and Community Care Act	The UK's National Health Service and Community Care Act of 1990 established the state as an 'enabler', rather than a 'provider', of healthcare and social care provision.
1991	Scientific advance	Mendelian randomisation first described	Gray and Wheatley first described Mendelian randomisation as a method of using measured variation in genes of known function to examine the causal effect of a modifiable exposure on disease in non-experimental studies. • Gray R and Wheatley K. How to avoid bias when comparing bone marrow transplantation with chemotherapy. Bone Marrow Transplantation 1991;7(Suppl 3):9–12.
1991	Funding development	Avon Longitudinal Study of Parents and Children (ALSPAC)	ALSPAC began with the recruitment of 14 000 pregnant women in the Avon area of England. The initial study was co-funded by the Wellcome Trust, the MRC and the University of Bristol and was designed to investigate the genetic and environmental determinants of childhood disorders, with later work researching chronic diseases and health-related behavior. The study was founded by Professor Jean Golding, who received an OBE for her work on the study in 2012. In 2006, Professor Golding retired from leading the ALSPAC project and Professor George Davey Smith took over as Director.
1992	Policy development	Hib vaccine becomes part of the routine childhood immunisation schedule in the UK	The introduction of Haemophilus influenzae type B (Hib) immunisation in the UK caused an immediate decline in the disease. A Hib booster campaign was launched in 2003 to reinforce the importance of immunity in children.
1992	Funding development	Agincourt DSS	Investigating and responding to health, population and social transitions in rural South Africa. University of Witwatersrand, South Africa.
1993	Scientific advance	Cochrane Collaboration launched	The Cochrane Collaboration was formally launched at the first Cochrane Colloquium, in Oxford, UK.
1993	Policy development	WHO declares tuberculosis a global emergency	According to WHO estimates, 2 billion people (one-third of the world's population) were infected with tuberculosis.
1993	Policy development	Investing in Health published	The World Bank's annual World Development Report focuses on health as an issue that is crucial to countries reaching economic development goals (while noting that good health is also a goal in itself). The 1993 report was an early and important multilateral use of standardised indicators of health, such as quality-adjusted life years, that can be used to measure and compare the effectiveness of health interventions.

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1994	Funding development	Gates Foundation formed	The foundation was initially formed by Bill Gates with $94m. It aims to improve healthcare worldwide and combat extreme poverty, as well as increasing educational opportunities and access to IT in America.
1994	Policy development	International Conference on Population and Development	The conference developed a 'Program of Action', which became the directing document for the United Nations Population Fund and, for the first time, stressed the importance of reproductive health and wellbeing.
1994	Scientific advance	Polio eliminated from the Americas	The Global Polio Eradication Initiative, led by WHO, successfully eliminated polio from the Americas.
1995	Funding development	Multiple Indicator Cluster Surveys conducted	International household survey initiative used to collect data on women and children worldwide.
1995	Advance in knowledge	First recorded outbreak of multidrug-resistant tuberculosis at a London hospital HIV unit	• Breathnach AS et al, St Thomas' Hospital, London, UK.
1995	Policy development	Directly observed treatment, short-course (DOTS) strategy for controlling tuberculosis launched	The DOTS strategy has five components: 1. sustained political and financial commitment 2. diagnosis by quality-assured sputum smear microscopy 3. standardised short-course anti-tuberculosis treatment given under direct and supportive observation 4. a regular, uninterrupted supply of high-quality anti-tuberculosis drugs 5. standardised recording and reporting.
1995	Scientific advance	The Barker Hypothesis developed	'The Barker Hypothesis' was named by the *British Medical Journal* after David Barker showed for the first time that people who have a low birth weight are at greater risk of developing coronary heart disease later in life.
1996	Policy development	World Health Assembly passes a resolution on violence as a public health issue	Violence became part of the international public health agenda when the World Health Assembly adopted Resolution WHA49.25, which stated that violence is a major and growing worldwide public health problem. The resolution called for public health activities to characterise the burden of violence, assess the effectiveness of prevention initiatives, and promote activities to tackle the problem at an international and country level.
1996	Funding development	International AIDS Vaccine Initiative established	The International AIDS Vaccine Initiative, a non-profit organisation based in New York, was set up to accelerate research into an HIV vaccine. At the time, it was estimated that 90 per cent of all people infected with HIV lived in low- and middle-income countries.

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1998	Policy development	Acheson Report published	The report re-examines health inequalities and proposed future policy developments.
1998	Scientific advance	Lancet Series launched	The Lancet Series highlights clinically important areas of health and medicine that do not usually feature in mainstream research programmes and medical publications.
1998	Funding development	Mexico City Prospective Study	This prospective study of cause-specific mortality in 160 000 adults was previously called 'Proyecto Coyoacán' and was originally intended to recruit 200 000 adults (Clinical Trial Service Unit, Nuffield Department of Medicine, University of Oxford).
1998	Policy development	Jakarta Declaration reaffirms principles and practice of health promotion	The World Health Assembly passed its first resolution on health promotion following the Jakarta Declaration, laying out strategies to support healthy public policy, create supportive environments, reorientate health services, strengthen community abilities to promote health and develop individual skills for healthy lifestyles.
1998	Scientific advance	Link between MMR vaccine and risk of autism suggested in the Lancet, causing major public health scare	The *Lancet* published a study, from a team led by Andrew Wakefield (then at the Royal Free Hospital), that suggested an association between the measles–mumps–rubella (MMR) vaccine and an increased risk of autism and bowel disorders. The study caused a major health scare, which has resulted in low vaccination rates and a significant rise in measles cases in the UK. The study's findings were called into question by other leading researchers, and most of the original authors ultimately repudiated the link. The *Lancet* subsequently withdrew the article and Wakefield was struck off the medical register.
1998	Funding development	WHO launches the Roll Back Malaria Campaign	The WHO pledged to halve global cases of malaria by 2010 by employing drug therapies, insecticide-treated bednets and indoor spraying, in partnership with non-governmental organisations worldwide.
1998	Funding development	Public Human Genome Project effort accelerated with additional Wellcome Trust funding	In response to the formation of Celera, the Wellcome Trust substantially raised funding for human genome sequencing work at the Sanger Centre, enabling it to sequence one-third of the genome.
1999	Funding development	Medicines for Malaria Venture (MMV) launched	MMV was launched with support from the Government of Switzerland, the UK Department for International Development, the Government of the Netherlands, the World Bank and the Rockefeller Foundation. Its mission is to reduce the burden of malaria in disease-endemic countries by discovering, developing and facilitating the delivery of new, effective and affordable antimalarial drugs.

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1999	Funding development	TB Alert, the UK's national tuberculosis charity, founded	TB Alert is the only British charity working solely on fighting tuberculosis in the UK and overseas.
2000	Policy development	Millennium Development Goals launched	Eight goals were adopted by the 189 member nations of the United Nations in 2000 to provide a framework for the international community to combat poverty by 2015.
2000	Policy development	Global Alliance for Vaccines and Immunisation (GAVI) launched	The main players in immunisation pulled together to form GAVI, a specialist decision-making body. GAVI aims to improve access to immunisation in 70 of the world's poorest countries.
2000	Funding development	Africa Centre for Health and Population Studies established	The Africa Centre for Health and Population Studies was established to describe the demographic, socioeconomic and health impact of a rapidly spreading HIV epidemic in individuals and households in a rural area in South Africa and to assess the effect of intervention studies (University of KwaZulu-Natal, South Africa).
2000	Advance in knowledge	Polio eliminated from the Western Pacific region	After a targeted campaign initiated by the WHO and supported by national and regional programmes, the WHO announced the elimination of polio from the Western Pacific.
2000	Policy development	WHO creates a Department of Injuries and Violence Prevention	The Department of Injuries and Violence Prevention was established to increase the global visibility of unintentional injury and violence and to facilitate action on a public health basis. The *World Report on Violence and Health* was published by the department in 2002.
2000s	Scientific advance	Recognition of the health consequences of climate change	The Intergovernmental Panel on Climate Change published the final part of its Fourth Assessment Report in November 2007, drawing together the latest evidence of the impacts of climate change.
2001	Funding development	The Vertical Transmission Study	The Vertical Transmission Study was a cohort study to assess the impact of exclusive breastfeeding on postnatal HIV transmission in a rural area of South Africa. The results of the study contributed to revisions in the WHO guidelines on HIV and infant feeding, made after a consultation in October 2006. The study was led by Professor Hoosen Coovadia at the Africa Centre for Health and Population Studies at the University of KwaZulu-Natal, South Africa.
2001	Scientific advance	First HIV testing in the Demographic and Health Surveys	The Demographic and Health Surveys in Mali and Zambia tested for HIV for the first time.
2001	Policy development	First Global Plan to Stop TB launched	A five-year consensus-based Global Plan to Stop TB was launched at the First Global Partners' Forum.

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2001	Policy development	United Nations holds special General Assembly session on HIV/AIDS	This session was the first disease-specific special session to be convened by the United Nations General Assembly.
2002	Funding development	Karonga DSS	A component of a programme of research entitled 'Epidemiology of Mycobacterial and HIV Infections in Northern Malawi'. The Department of Infectious and Tropical Diseases, London School of Hygiene and Tropical Medicine.
2002	Scientific advance	Genome sequence of *Plasmodium falciparum* completed	The £18.5m *Plasmodium falciparum* project was funded in the UK by the Wellcome Trust (£8m) and in the USA by the Burroughs-Wellcome Fund (£4.9m), the National Institute of Allergy and Infectious Disease (£2.2m) and the US Department of Defense (£3.4m). • Gardner MJ et al. Genome sequence of the human malaria parasite Plasmodium falciparum. Nature 2002;419:498–511.
2002	Funding development	UK Biobank project approved	The UK Biobank project was launched by the MRC, the Wellcome Trust and the Department of Health to establish a resource collating medical samples, medical history and lifestyle information for 500 000 UK citizens. The initial investment in the project was £94m, of which the Trust provided approximately £43m. The UK Biobank is located in Stockport, and its Chief Executive and Principal Investigator is Rory Collins, Professor of Medicine and Epidemiology at the University of Oxford, who received a knighthood in 2011 for his services to science.
2002	Policy development	Global Fund to Fight HIV/AIDS, Malaria and Tuberculosis launched	
2003	Funding development	Drugs for Neglected Diseases initiative (DNDi) was founded	Seven organisations joined forces to form the DNDi: five public sector institutions, one humanitarian organisation and one international research organisation. Its mission is to improve the quality of life of those suffering from neglected diseases through the development of new drugs.
2003	Scientific advance	WHO launches their 3 by 5 Initiative	The initiative aimed to provide 3 million people in resource-poor countries with antiretroviral therapy by 2005 in to fight HIV infection. While the initiative was not initially met, by 2007 nearly 3 million people had access to antiretroviral therapy. The sub-Saharan Africa population displayed the largest increase in access.
2003	Scientific advance	'Gold standard' human genome sequence is completed	The human genome sequence was completed and was published in *Nature* in 2004.

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2003	Advance in knowledge	Global outbreak of SARS	More than 8500 probable cases of severe acute respiratory syndrome (SARS, initially called 'atypical pneumonia'), including 810 deaths, were reported in an outbreak that originated in China and spread rapidly through other east Asian countries and Canada.
2003	Policy development	WHO establishes collaborative multi-centre research project on SARS diagnosis	The WHO, aiming to facilitate the identification of the SARS causative agent and the development of a diagnostic test, brought together 11 laboratories in nine countries to work collaboratively on the rapid detection and reporting of disease. The submitted results were shared and assessed daily so investigative strategies could be refined and laboratory findings validated immediately.
2003	Advance in knowledge	WHO organises virtual meeting conference with clinicians on managing SARS patients	Eighty clinicians from 30 countries discussed the features of SARS, including presentation, treatment and progression of the disease, in addition to prognostic indicators and discharge criteria.
2003	Advance in knowledge	WHO issues 35-page report on the epidemiology of the SARS outbreak	The report concluded that there was no evidence to suggest SARS was an airborne disease or was transmitted ten days after the fever had resolved. Evidence further suggested that health workers are at special risk, the risk of transmission is greatest around day 10 of illness and that children are rarely affected by SARS.
2004	Advance in knowledge	Changing burden of *Clostridium difficile* infection	An increasing number of cases of *Clostridium difficile* infection reported by the Health Protection Agency.
2005	Policy development	Framework Convention on Tobacco Control established	In its first multilateral treaty, the WHO established the Framework Convention on Tobacco Control as a means to generate commitment to tobacco control among governments and civil society, and support for international and intersectoral cooperation.
2005	Policy development	BCG vaccination withdrawn in the UK	
2006	Funding development	UNITAID launched	Created by Brazil, Chile, France, Norway and the UK and financed by a tax on airline tickets, UNITAID aims to increase access to treatments for HIV/AIDS, tuberculosis and malaria, primarily for low-income countries.
2006	Policy development	Stop TB Strategy launched	The Stop TB Strategy was a six-point strategy, building on DOTS, that was developed by the WHO.
2006	Policy development	WHO reports evidence of human-to-human transmission of H5N1	During a period of increased incidence of H5N1 (avian flu, most cases of which result from poultry-to-human transmission), the WHO confirmed cases of human-to-human transmission. The proportion of this type of transmission remained low, but the situation was monitored closely by influenza experts.

Date	Key	Summary	Description
2006	Policy development	Second Global Plan to stop TB launched	• The second Global Plan to Stop TB, 2006–2015: actions for life towards a world free of tuberculosis. Geneva. WHO, Geneva, Switzerland and Stop TB Partnership.
2006	Funding development	International Finance Facility for Immunisation launched	The International Finance Facility for Immunisation intends to increase the availability and predictability of funds for GAVI's immunisation programme through long-term pledges from donor governments to sell 'vaccine bonds' in the capital market.
2006	Policy development	European Commission launches 'E-health ERA Project' to help establish a European E-health research agenda	This project emphasised the importance of e-Health among the members of the European Union.
2006	Policy development	ACTs (artemisinin-based combination therapies) developed and recommended by WHO as first-line malaria treatment	ACTS were recommended by the WHO as the first line of treatment for falciparum malaria. The minimum clinical efficacy threshold was raised from 75 per cent at 14 days to 90 per cent at 28 days. • Nicholas White and colleagues.
2007	Policy development	International Health Regulations (IHRs) put into force	The IHRs require the 194 countries bound by them to report certain disease outbreaks and public health events to WHO, as well as improving their existing capacities for public health surveillance and response. The IHRs are intended to help prevent and improve responses to acute public health risks that could potentially cross borders and become worldwide threats.
2007	Policy development	WHO International Clinical Trial Registry Platform (WHO ICTRP) was launched	The WHO ICTRP aims to ensure that the registration for all clinical trials conforms to WHO standards and that they are scientific, ethical and moral.
2007	Policy development	Health Act prohibits smoking in most enclosed spaces in the UK	The Health Act was introduced as a comprehensive strategy to address smoking and its effects on health. In July 2007, the Act came into effect, making it illegal to smoke in most enclosed public places and workplaces.
2007	Scientific advance	Use of PDAs in Demographic and Health Surveys	Demographic and Health Survey fieldworkers first used PDAs to collect information.
2007	Policy development	The WHO and UNAIDS announce recommendations on male circumcision for HIV prevention	
2008	Advance in knowledge	Carbapenem-resistant strains of Gram-negative Enterobacteriaceae and New Delhi metallo-ß-lactamase (NDM-1) emerge in India, Pakistan and the UK	• Health Protection Agency. Health Protection Report 2009;3(26):3–4.

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2008	Advance in knowledge	Increase in measles cases in England	Nearly 1400 confirmed cases of measles were reported in England in 2008, compared to 56 cases in 1998 (before widespread media coverage of the suggested, and now discredited, link between MMR and autism).
2008	Policy development	GAIN-UNICEF Universal Salt Iodization Partnership Project established	UNICEF and the Global Alliance for Improved Nutrition (GAIN) launched the universal salt iodisation programme. In subsequent years, the programme facilitated access to fortified salt among 70 per cent of households in low- and middle-income countries with the aim of preventing childhood morbidity, including mental impairment.
2008	Policy development	Commission on the Social Determinants of Health publishes final report	The Commission on the Social Determinants of Health, which was established by the WHO in 2005 with the remit of investigating health inequities, published its final report. The report recommended improving daily living conditions, tackling the inequitable distribution of power, money and resources, and placing a greater emphasis on the measurement and analysis of relevant issues as means of reducing health-related inequities.
2008	Policy development	HPV vaccination for girls aged 12–13 provided in schools in the UK	The vaccination is designed to stop cervical cancer and comes in two forms available in the UK, Cervarix® and Gardasil®.
2008	Policy development	Research conducted into risk factors and reducing heart disease mortality in the USA	Implementing evidence-based policies would improve the control of tobacco use and achieve a healthier diet across the population, which could potentially halve coronary heart disease deaths in the USA. • Capewell S et al. Cardiovascular risk factor trends and potential for reducing coronary heart disease mortality in the United States of America. Bull World Health Organ 2010;88:120–30.
2008	Scientific advance	National Institutes of Health (NIH) genome-wide association study (GWAS) policy implemented	The GWAS policy was intended to facilitate broad and consistent access to NIH-supported GWAS data to speed the translation of basic genetic research into therapies, products and procedures that benefit the public health.
2009	Policy development	WHO declares H1N1 pandemic	In response to rapid transmission rates and accelerating incidence, the WHO declared the 2009 outbreak of H1N1 influenza virus to be a pandemic. Worldwide, the virus was confirmed in 214 countries and is estimated to have caused more than 18 000 deaths.
2010	Scientific advance	Effects of alcohol pricing on morbidity reviewed	• Wagenaar AC et al. Effects of alcohol tax and price policies on morbidity and mortality: a systematic review. Am J Public Health 2010;100(11):2270–8.
2011	Advance in knowledge	Pandemic Influenza Preparedness Framework became effective	The framework aims to increase the sharing of influenza viruses with pandemic potential in order to improve access to vaccines and medicines for countries during future pandemics.

Date	Key	Summary	Description
2011	Policy development	United Nations High-Level Meeting on Non-Communicable Diseases	
2011	Policy development	United Nations High-Level Meeting on AIDS	The United Nations HIV/AIDS Summit in New York adopted ambitious new targets to address HIV/AIDS. The objectives set for 2015 include halving the sexual transmission of HIV, reducing HIV transmission among injecting drug users by 50 per cent, eliminating vertical transmission during pregnancy and getting 15 million people onto antiretroviral treatment.
2011	Policy development	Increased awareness of mental health issues in the UK	No Health Without Mental Health: A cross-government mental health outcomes strategy for people of all ages, funded by the UK Government, outlined a six-step strategy to address issues surrounding mental health.
2011	Scientific advance	Phase III trial of RTS,S/AS01 malaria vaccine yields first results	The phase III trial of the RTS,S malaria vaccine in African children shows that it reduces the risk of malaria by half in African children aged 5 to 17 months.
2011	Policy development	UK Government calls for action on obesity in England	England has one of the highest rates of obesity in Europe and one of the highest of any high-income country. • Department of Health (2011), Healthy Lives, Healthy People: A call to action on obesity in England.

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