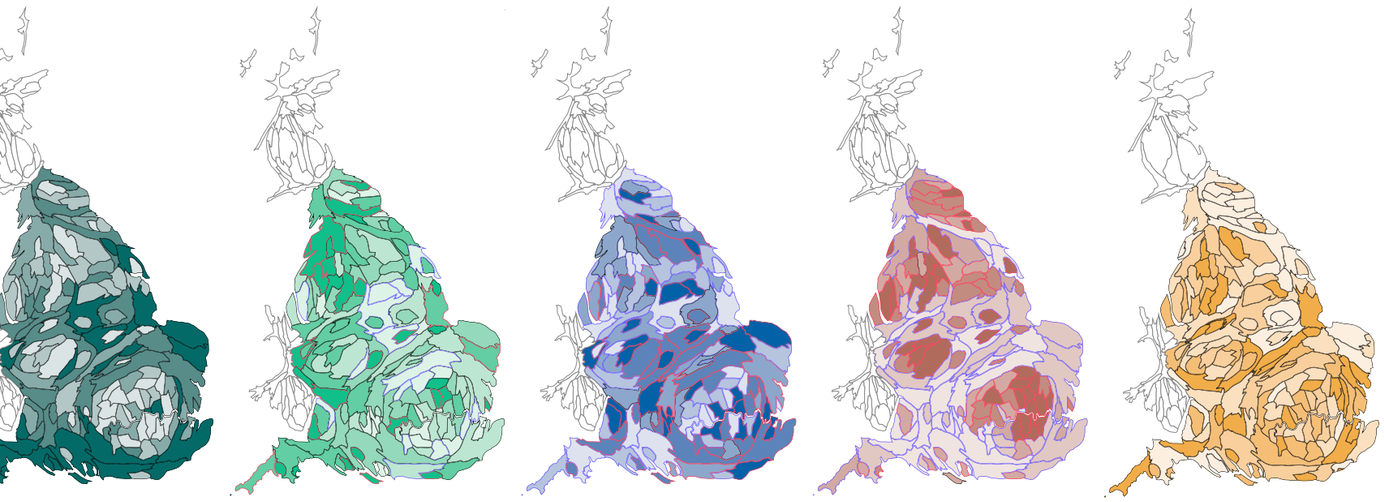
Annual Report of the Chief Medical Officer

Volume One, 2011
On the State of the Public's Health



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http://www.dh.gov.uk/cmo

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Dear Reader

My annual report will be published in two volumes. This, the first volume, focuses on epidemiology and surveillance of the public's health. The second volume will be an indepth review into 'Infections and Infectious Diseases', pulling together expert advice so that I can provide clinical and policy recommendations, along with advice to the public.

This volume develops a picture of the public's health in England throughout the chapters. It contains information that takes a 'broad brush' view of the health of our nation while also considering many aspects in detail. It provides a clear picture of our current health and highlights areas where we are improving health and public health services, and areas where we can do better. In addition, all the data used to produce this report are available in Microsoft Excel files, by local authority (where possible) at data.gov.uk

Yours ever

Sally C

Prof Dame Sally C Davies

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Origins of the Chief Medical Officer's Report

The role of the Chief Medical Officer was first conceived in the mid 19th century and grew out of an ever increasing interest by government in the need for better public health. 1848 saw the establishment of the General Board of Health, a national board with a primary focus on sanitation and the environment. In 1847 and 1848 local Acts were passed in Liverpool and London establishing the first Public Health Departments and appointing the first Medical Officers of Health. It was only in 1855, that the General Board of Health received any medical representation.

Following his appointment as the first Medical Officer of Health for London, Sir John Simon was appointed the first Medical Officer for the General Board of Health. This appointment made him the de facto Chief Medical Officer. Following the dissolution of the General Health Board, the role transferred to the Privy Council in 1858.

In his role of Chief Medical Officer to the Privy Council, Sir John started the tradition of a Chief Medical Officer annual report. The purpose was to provide an independent assessment of the state of the public's health.

Chief Medical Officers have produced their annual reports in different ways, but each with the aim of highlighting a limited number of issues which were, in their opinion, the ones that should be the current focus for policy and action to improve the health of the nation. There has been a natural shift in the content of these annual reports, from the greatest concerns of the mid 19th century, such as industrial health, sanitation and housing conditions, to more recent concerns around obesity, alcohol and tobacco. However, there are also some common themes running through the reports, such as child and occupational health and the training and education of healthcare professionals.

I find that Sir John Simon set an excellent precedent for the position of the role of Chief Medical Officer. He was well known for his use of statistical information to inform policy and the advice he gave to the Government of the time. I also strongly believe that data and scientific evidence should be at the heart of policy making and advice to government and have reflected this in my approach to the Chief Medical Officer annual report. Data should be used to inform our prioritisation of action and to evaluate the effectiveness of such action, scientific evidence should be used to determine what actions should be taken.

Mapping, innovation and public health intelligence

A major emphasis of this, my first annual report volume one, is geographical differences. The default geographical units used, where information was available at that level, is upper tier local authority. This is intended to be of particular value to Directors of Public Health (DsPH). The report is a tool to help examine what local DsPH should prioritise and to help support their Joint Strategic Needs Assessments.

The use of innovative mapping techniques to analyse data and convey messages is far from a new idea in public health. Historically it was perhaps most famously used by John Snow to show the relationship of the 1854 Broad Street cholera outbreak with the sources of the outbreak, including the Broad Street pump. At that time many people, including leading doctors of the day, did not accept germ theory and showing this link was an important step forward in saving lives. In recent years, there has been growing emphasis on the use of geographical data, both in point data analysis and in more ecological analyses, as in this report. As data, access to data and methods to analyse and present data have improved, our understanding of patterns of disease, risk factors for ill health and the social determinants of health have also improved.

This report presents geographical data using 'cartograms'. The cartograms display data in the form of maps of England, in which the size of a particular area has been adjusted to reflect the size of its population. Visualisation in this way means that the data can be interpreted both in terms of the size of the population affected and the geographical distribution. Wherever possible the unit of area used has been upper tier local authority and the data used to produce the maps are available at data.gov.uk for anyone wishing to examine or use the underlying data.

It must be remembered that variability between areas may not necessarily be due to different rates of occurrence of, for example, disease. Causes of variation in health care are generally due to artefacts in the data or differences in supply, demand, or need. Where differences in prevalence or incidence are seen and these have been estimated from routinely collected service data, differences can also be affected by these factors. However, for mortality data, it is only artefacts in the data that is really a potential problem. In most cases, high rates will be an accurate reflection of public health in the area and thus should inform the spending of health and public health resources. Where an area is shown to have a high rate of a particular condition, risk factor or social determinant, I encourage the health professionals responsible for that area to understand the cause of this high rate.

My future annual reports will develop the analysis of data so that they can be used to provide a more detailed picture of public health, especially with regard to co-morbidities and the co-occurrence of risk factors and social determinants.

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This report could not have been produced without the generous input of the following editors and their teams.

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Summary

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Key Findings

Throughout this summary I have included specific recommendations that I would like action to be taken on. I want to draw attention to three key issues which have emerged from this volume, liver disease, access to healthcare and surveillance and intelligence systems.

Liver disease

Liver disease has emerged as a key theme from international comparisons which show that this is the only major cause of mortality and morbidity which is on the increase in England whilst decreasing among our European neighbours.

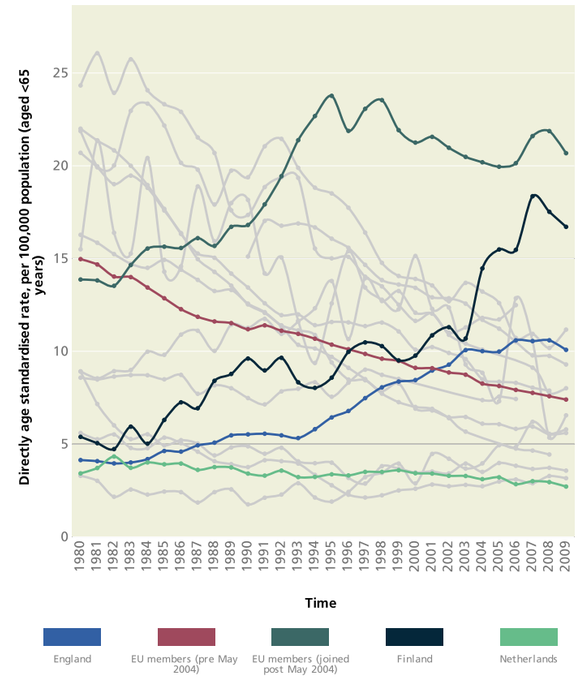
Among the causes of the increasing numbers of people with liver disease are

- obesity,
- undiagnosed hepatitis infection, and increasingly,
- harmful alcohol use.

These causes are all preventable but the individual's role in responding to the threat of liver disease is often undermined by the fact that it progresses unnoticed for many years. Liver disease does not manifest with obvious symptoms or signs until a relatively late stage. Preventative measures should involve a combination of public health policy initiatives (action on obesity and harmful alcohol use) and better awareness amongst the public of their liver health. Equally important, service providers should continue to improve their efforts to detect early signs of liver disease. This will entail appropriate risk assessment strategies in their populations, and use of appropriate tests to identify liver disease that can be reversed or treated. These measures need to be integrated across all aspects of service provision for optimum efficacy but in particular, a proactive approach needs to be adopted so that we reduce presentations at a late stage of disease.

Recommendation **Action on preventing, identifying and treating liver disease is a priority and needs to be included in local health and wellbeing strategies.**

Trend in premature mortality (ages under 65) from chronic liver disease and cirrhosis, England and EU countries, 1980 to 2009



Source: EU: WHO, Health For All data set; England: ONS.

Access to healthcare

Ensuring that local populations are receiving appropriate, cost effective healthcare is an important public health challenge. Access to care emerges as a key issue from the analysis in Chapter five, which reveals that, while there are some notable successes, there are still a number of areas where we find apparently unexplained variation in good quality care and in the numbers of people accessing and receiving care.

Diabetes is an example where we see marked variation in people receiving optimum care. Only 50.1% of registered diabetics are receiving all nine NICE recommended diabetes care processes and, when considering the ranges of the different quintiles into which Primary Care Trusts are grouped for mapping, the bottom quintile (the 5th of PCTs with the lowest rates) alone ranges between 43.8% and 6.4%. It is not always clear whether the variations seen result from different levels of provision or underlying variation in prevalence, but where we see differences it is vital that we understand the reasons in order to address any inequalities in provision of healthcare.

Where there is variation in access or outcome between different population groups, the contributory factors include delayed presentation, delayed diagnosis, and delayed entry into care. Improvement in access to health care services and early detection and diagnosis improves outcomes, reduces unwarranted variations, and reduces costs.

Recommendation **Both Chapter 5 of this report and the NHS Atlas of Variation[1] are key tools in examining variation and I encourage both commissioners and clinicians to use these to improve outcomes.**

Surveillance and intelligence systems

The final theme emerging from the analysis presented in this volume is the need for more robust systematic surveillance of health and disease at the national level, particularly in respect of those diseases which are a major burden on the population in terms of clinical morbidity and diminished wellbeing, but with relatively low mortality. Examples include musculoskeletal diseases, skin diseases, cognitive impairment, incontinence and loss of hearing or sight.

The importance of 'fit for purpose' surveillance systems cannot be overemphasised. If we are to benefit from a quick response to new and emerging health threats, or even important changes in old ones, it is essential to have an adequate national early warning system. This means establishing a limited number of reliable surveillance mechanisms that could alert us to those changes that would require a response, if they were present. As this report demonstrates many of the data required already exist, in which case it is a question of systematically examining them, in other cases certain new data collections are required. Surveillance approaches need to justify their cost on a case by case basis, however the cost of late detection of a threat can be very high indeed, for example when the impact of thalidomide went undetected for much too long. The history of public health suggests that it is not enough to prepare for the health problems we already know about.

In considering how to strengthen surveillance across the board, there is a need to look first at some of our existing information systems, many of which are international exemplars of good practice. One such system is that in place for cancer, through the work of the cancer registries, ONS and the National Cancer Intelligence Network. The Health Protection Agency is also a world leader in surveillance.

With the changing health and social care system, this is the right time for us to comprehensively review our information needs and to seek intelligent, cost effective ways to improve the standard of surveillance nationally. These must revolve around not just the needs of commissioners, but also make data available and usable to health professionals, patients, and the public.

Recommendation **Public Health England needs to develop and implement a set of coherent national surveillance systems for non-communicable diseases, congenital anomalies and important medical, environmental and lifestyle risk factors.**

Chapter summaries

In considering the main findings from each of the chapters, I have the following observations.

Chapter 1 – Demography

In order to better understand our health and social care needs and plan for the future, my report begins with data on the size and characteristics of our population. Projections of population change will help us plan services for the future. It has long been recognised that our population is aging, what is often overlooked is that it is also expanding. For example, it is projected that more people will be born in England in 2020 than 2010 and services will need to plan for changes of this type.

Chapter 2 – Mortality, morbidity and wellbeing

When considering the broader, summary measures of mortality, morbidity and wellbeing, it is clear we have had real successes. Life expectancies at birth and at 65 have increased, all cause mortality rates have decreased, as have infant mortality rates. Much of our success has been due to the reductions in cardiovascular mortality (particularly coronary heart disease and stroke) and cancer, in which reductions in smoking, high blood pressure and cholesterol have all played an important role. There still remain, however, large inequalities in health for almost every disease examined. Geographical differences in rates often reflect patterns of deprivation.

Particularly interesting is the analysis of life expectancy and years lived in disability. This shows that people living in the areas with the greatest life expectancy tend to be those with the least number of years lived with disability or limiting long term illness (difference between life expectancy and disability-free life expectancy). Life expectancy is lower in more deprived areas, so this relationship is likely to be due to deprivation; however, the data shows us that it is possible for people to live long lives without substantial disability.

I find it disappointing that there is a lack of information available at a national level on 'wellbeing' and resilience, which needs to be included at the core of all public health action. The Office for National Statistics (ONS) is working to improve this situation. However action is also needed by the public health community to put wellbeing at the heart of their actions.

Recommendation **Public Health needs to encompass not only physical health but also mental health and wellbeing. All current interventions should be reviewed to consider how improving wellbeing can be incorporated.**

Chapter 3 – Risk factors

Much of the available information on the health behaviours of the population of England focuses on the prevalence of specific individual risk factors. While this provides a useful insight, often these risk factors occur alongside one another. The World Health Organisation (WHO) national burden of disease toolkit[2] estimates the main risk factors for early death and disability in the UK. They can be divided into lifestyle, medical and environmental risk factors and are, in order of impact;

- tobacco use
- harmful alcohol use
- high blood pressure
- high cholesterol
- overweight and obesity
- physical inactivity
- illicit drug use
- low fruit and vegetable intake
- occupational risks
- unsafe sex

Chapter 3 considers each of these in turn, with the exception of occupational risks (addressed in Chapter 4). Replacing this is urban outdoor air pollution, which is estimated by the toolkit to be among the top ten causes of mortality in the UK.

Chapter 3 considers the most important issue related to risk that health professionals should be aware of: the clustering of lifestyle with medical risk factors. The data available allows us to look at smoking, binge drinking, low fruit and vegetable consumption, obesity, diabetes†, high blood pressure and raised cholesterol‡. Approximately 68% of those aged 16 and over report the presence of two or more of these risk factors.

I can think of no stronger reason for the services addressing these issues to move to a more integrated approach, one that takes into account the likely co-occurrence of many major risk factors that we need to address. We need services that treat us as a whole person.

Recommendation **Medical, environmental and lifestyle risk factors should be addressed using a range of evidence based interventions by a variety of community providers e.g. GPs, pharmacies and local authorities. This should be done in an integrated manner, taking into account that many people will present with several risk factors at once.**

† Not included as a risk factor in the national burden of disease tool kit but identified as important for high income countries in the Global Health Risks report[3]

‡ Changes to the way the Health Survey for England measures physical activity levels meant it was not possible to include this risk factor in the analysis.

Chapter 4 – Social determinants of health

The social determinants of health are the conditions of daily life and the fundamental drivers that give rise to them. Social determinants impact on all aspects of health, as shown by the consistent relationships of risk factors and disease with deprivation. This chapter specifically considers five of the six areas of action highlighted in the *Fair Society, Health Lives* review[4] led by Sir Michael Marmot, examining the trends and inequalities in the social determinants of health.

The action areas considered are:

- Early years (child development)
- Cognitive skills (educational attainment)
- Employment and work (unemployment, work related ill health and health risks, working conditions)
- Healthy standard of living (income, poverty, fuel poverty, deprivation)
- Sustainable communities, places and vulnerability (green space and green infrastructure, housing conditions, homelessness, crime and fear of crime, social inclusion)

The importance of creating the right environment to enable healthy behaviours cannot be overstated. The links between good quality green space and the likelihood of people engaging in physical activity is just one example of this. However providing the right environment is only part of the answer. The 2012 Olympics and Paralympics legacy provide a great opportunity to make people aware of, and encourage the use of, many existing high quality facilities and green spaces.

Recommendation **All local authority organisations should maximise the 2012 Olympic and Paralympic legacy by promoting physical activity and the use of green space.**

Many groups present a poor picture across a range of indicators. For example:

- Children who receive free school meals have:
  - » a lower than average percentage assessed as ready for school at age 5
  - » a lower than average percentage achieving required educational attainment levels at each subsequent key stage and
  - » a higher percentage are not in education, employment or training (NEET) at age 19.
- Single adults with children have:
  - » lower than average income levels
  - » a large proportion of children living in poverty
- Single pensioners have
  - » lower than average income levels and
  - » a high percentage are living in fuel poverty.

While this work identifies some particularly vulnerable groups, it is clear to me from the data that it is important to address the social determinants across the whole social gradient. We should not focus solely on the worst off or most deprived areas.

Chapter 5 – Healthcare

Good population health outcomes, including reducing health inequalities, depend not only on preventing communicable disease, and improving health through promoting positive health behaviours and healthy environments, but also on the quality and accessibility of healthcare services provided by the NHS.

The effectiveness of healthcare interventions should not be underestimated. Over the last ten years, the mortality rate for conditions amenable to healthcare has declined faster than both preventable and avoidable mortality. Between 2001 and 2010, mortality considered amenable to healthcare decreased by 35%, preventable mortality by 23%, and avoidable mortality by 25%. This demonstrates the impact that can be had. When considering the cancer survival outcomes it is clear we can do better.

Recommendation **Survival from some cancers, such as lung cancer, is still poor, with even the best English survival rates well below the European average. While mortality rates from many cancers are falling, in some we have had little substantial impact, for example, pancreatic cancer mortality rates. Prevention and early diagnosis are a priority for joined up working between Clinical Commissioning Groups and Directors of Public Health.**

I have already discussed the importance of access to care as one of my key messages. The other area focused upon in this chapter is the provision of effective preventive services such as screening and immunisation. In general these have been great success stories in England. Since 2000, a number of new preventive and screening programmes have been introduced such as NHS smoking cessation services, newborn bloodspot screening, routine HPV immunisation for girls aged 12-13 years, and diabetic retinopathy screening.

The past decade has seen an improvement in coverage of routine childhood (pre-school) immunisations. Coverage of breast and cervical screening programmes has also improved. Other successes include more than 380,000 people in England successfully quitting smoking with NHS Stop Smoking Services in 2010/11. Despite this there still remains marked geographic variation in provision of these services. This can be seen in immunisation uptake of MMR in young children, HPV, and influenza in older people. Access to specialist services such as alcohol treatment, drug treatment services, and operations for morbid obesity vary across England.

Postscript – Public health research funded by the Department of Health

The need for a stronger arsenal of evidence based interventions to address public health challenges is clear. This postscript identifies a number of the initiatives our National Institute for Health Research (NIHR) has funded to help address this issue. I believe this will be of interest to the public health community, but also I hope it will help to improve the dialogue between those delivering public health services, academic public health staff and those funding public health research. There is a long way to go before we really understand and have the evidence to impact on the behavioural and social factors underlying the multiple "risk" behaviours so many adopt, to the detriment of their health and longevity.

The life course model

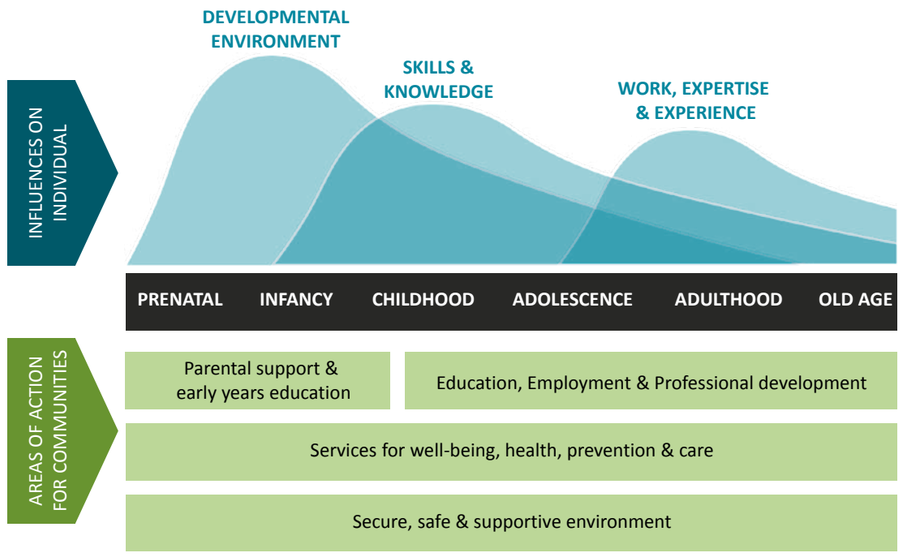
Following the publication of *Fair Society, Healthy Lives*, led by Sir Michael Marmot, public health professionals regularly frame health inequalities using the life course model proposed. This model notes that disadvantages start before birth and accumulate throughout life. Many localities in England have been successfully using the model to frame or structure their health and wellbeing strategies.

The re-organisation of the public health function in England, in particular the new responsibilities for health improvement in local authorities, provides a prompt to review where current priorities lie. My report, providing an evidence base for local as well as national decision making, will also inform reviews and developments of health and wellbeing strategies.

I believe a focus on the action areas outlined in the life course model is central to implementing effective change. I have developed representation of the life course model further, explicitly emphasising where action on individual experiences and wider social determinants can be most effective during the life course (see model "Influences and actions along the life course").

This new representation seeks to reflect our changing demographic and economic circumstances. It is likely that an increasing proportion of our population will work to a later retirement age. This is likely to result in more people experiencing ill health before retirement, as some age related patterns of illness currently seen in the retired population will be more evident in the working population. Periods of paid employment interspersed with periods of unpaid employment/worklessness (due to illness or choice) are likely to become more common into older age. This is important for how we represent the life course model, as action to improve health in the workplace will become even more necessary and may need to have a wider focus.

Recommendation **Health and Wellbeing Boards should work with local employers to optimize the health outcomes of their employees and, where possible, their families.**



"Influences and actions along the life course"; model inspired by Fair Society, Healthy Lives

'Influences and actions along the life course' demonstrates potential areas of action relating to both the *individual* and the *community*. This model maintains the emphasis on the accumulation of effects on health and wellbeing starting before birth seen in the *Fair Society, Healthy Lives* life course model.

Life course stages are positioned centrally across the diagram and represent the life course stages of an individual from 'prenatal' to 'old age'. Clearly not all individuals will pass through all life course stages. Causes of death that are predominant in different life course stages will require different action.

The top section depicts areas of activity experienced by an individual that influence his or her development along the life course. The curves represent the significance on health and wellbeing of each individual activity, which are large in earlier years and taper off in later life. These influences are:

- **Developmental environment;** the environment into which a child is born, including the nurture they receive, socioeconomic conditions, nutrition pre and post birth, imprinting and epigenetic influences and the psychosocial and developmental support received influence a child's life course.
- **Skills & Knowledge** include all life skills (from social skills and resilience, to vocational skills), and knowledge gained through all forms of direct and indirect education.
- **Work, expertise, and experience** indicate the acquisition of expertise and experience through all forms of paid and unpaid work and work-related activity.

The lower section of the diagram depicts areas of action at the community level, i.e. where action needs to be taken at the group rather than individual level, and often focused towards specific communities. These will (in part) determine the societal influences on individuals and action here is essential for the healthy development of society. These areas of action include:

- **Parental support and early years education** includes family building in a more holistic sense, such as interaction with parents and/or caregivers, as well as targeted education on the importance of parenting, nutritional, and developmental support.
- **Education, employment and professional development** includes the need for policy action in providing opportunities for continuous education and development at work.
- **Services for well-being, health, prevention and care** including basic physical, mental, emotional, and preventative health measures by and for communities, including the need for policy action in providing services for early diagnosis and treatment. 'Care' includes all aspects of health and social care across the life stage from a policy perspective, but equally empowering families and communities to create caregiving environments.
- **Secure, safe and supportive environment** not only alludes to the idea of creating supportive and caregiving environments, but ensuring that policy action is taken to ensure the safety and security of communities as a basic requirement.

1. QIPP Rightcare. The NHS Atlas of Variation in Healthcare: Reducing unwarranted variation to increase value and improve quality. London 2011 http://www.rightcare.nhs.uk/index.php/nhs-atlas/

2. WHO. National Burden of Disease ToolKit . http://www.who.int/healthinfo/global_burden_disease/tools_nbd_toolkit/en/index.html

3. WHO. Global health risks: mortality and burden of disease attributable to selected major risk. 2009.

4. Marmot Review Team (2010) Fair Society, Healthy Lives: Strategic review of health inequalities in England post-2010 (The Marmot Review). London: Marmot Review Team.

Contents

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How to use this report

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1. What is the purpose of this report?

The main purpose of this report is to serve as a compendium providing information and key facts on a very broad range of topics to health and social care professionals, policy makers and elected representatives.

It has been designed to allow people to selectively focus on specific issues.

2. What is the report content?

The summary contains those issues the Chief Medical Officer would particularly like to highlight.

In the body of the report, as a general standard, readers can expect a two page spread including a short summary of the issue examined and relevant charts and maps of data. The report includes a focus on change over time and age, allowing mapping of issues to life stages.

A major innovation in the way this Chief Medical Officer's report has chosen to represent geographical data is the use of cartograms for mapping; as this may be unfamiliar to many, map 'keys' are provided in the following pages to help readers identify specific geographical areas.

The use of cartograms has been pioneered in the UK by Professor Danny Dorling and much of the inspiration for this report comes from his book 'The Grim Reaper's Road Map: An atlas of mortality in Britain'[1]. It adds a unique perspective, showing maps where the area is proportional to the resident population rather than the geographical area, in contrast to conventional maps where urban centres that are represented by small geographical areas contain substantial resident populations.

Like all data focused reports, particularly those using routine data, there are caveats and limitations to the data that should be borne in mind. These are discussed further in 7.1. All of the data that has been mapped is also available in Microsoft Excel format for people who require the specific values (see below).

2.1. How are the topics sequenced?

The report seeks to achieve the following:

- define how the population of England is changing (Chapter 1)
- identify the current patterns of disease (Chapter 2)
- examine the current epidemiology of those specific risk factors with the largest impact on health (Chapter 3)
- describe a number of social determinants of ill health (the causes of causes) that pertain specifically to the action areas identified in *Fair Society, Healthy Lives*[2] (Chapter 4)
- assess the performance of current preventative services in the NHS while also considering issues of access to care (Chapter 5).

Each chapter has an internal rationale for the sequencing of topics. This is particularly evident for the ordering chapters 2 and 3. In chapter 2, more high level measures of health (with the exception of infant mortality) are presented first, such as wellbeing, life expectancy, all cause mortality, international comparisons and winter deaths. Disease topics are presented in the order of the Global Burden of Disease Study[3], which is approximately the order of the International Classification of Diseases.

In Chapter 3, key risk factors are presented in order of importance in terms of their contribution to the overall UK health burden (as assessed by the WHO National Burden of Disease Toolkit). As this uses data from 2004 and new evidence has arisen around the health impact of different risk factors (e.g. the impact of physical inactivity), this should be interpreted with caution. However it remains a useful guide for prioritising action.

2.2. Does this report include official statistics?

Strict rules cover the production of official statistics; information governance is in place is to ensure confidence in the collection, methods of analysis and interpretation of statistics produced and that they are free from political interference. This is a key professional duty of statisticians working within government. As the Chief Medical Officer's report is an independent report by the Chief Medical Officer to Government it is not covered by these governance procedures. However, the production of this report has been in line with the spirit of those regulations. Statisticians have been involved in the conceptual design and production of the report, they have advised on the methods used both for representing and analysis within the report.

3. What does the text in the report tell me?

There is minimal written content as the report focuses on the visual representation of a wide range of data, and making this data available. The short passages of text accompanying images cover the general messages arising from the data shown, but specific charts or maps are not discussed in detail and may not be discussed. Various academic and clinical experts and national policy leads have been asked to contribute to, and comment on, text in the report (see Acknowledgements).

3.1. What do the "Key facts" tell me?

Unless otherwise stated, the 'key facts' boxes in Chapter 2 summarise the number of potential years of life lost (PYLL) and number of hospital bed days due to the broad disease groupings considered on that page.

Using mortality rates alone emphasizes the most common causes of death in older people, because the risk of death increases with age. PYLL gives more weight to deaths among younger individuals. It is an estimate of the number of years a person would have lived if they had not died prematurely. Its use in the key facts gives an indication of the relative important of the disease in terms of premature mortality. Similarly, the number of bed days gives an indication of the importance of the disease in terms of NHS hospital resources. While useful, neither of these measures would reflect the

importance of diseases that are primarily non-fatal or not requiring hospital admission.

The data shown in the key facts boxes are based on the primary diagnosis recorded as cause of death or as reason for admission. The proportion this represents of the total number of deaths and hospital is also given. For the analysis in this report dying prematurely was defined as death before the age of 75 years and calculations of PYLL were based on five year age bands rather than individual years

If appropriate, subcategories of the broad disease grouping are considered. The PYLL and number of hospital bed days are then given for each subcategory accounting for the largest proportion

4. How were the images in the report produced?

Due to the large number of graphs and charts in the report, these were produced in an automated fashion based on standardised data sheets and a limited number of options of chart and map style. For low-level visualisation d3.js[4], a JavaScript library for manipulating documents based on data, was used. The chart and map automation was customised and all visualisations were produced by Iconomical[5].

For the cartograms, Local Authority and Primary Care Trust maps shape files were those made publically available by Professor Dorling and colleagues[6]. Regional and cancer network shape files were specifically created for the report but used the same methodology[7], i.e. using the algorithm developed by Michael Gastner and Mark Newman[8] and transformed using the utility developed by scapetoad[9]. Before transformation all map boundaries were based on boundary lines products available as part of Ordnance Survey Open Data[10].

All line charts have had a smoothing function applied. The function used was a low level Cardinal spline. Splines are mathematical functions to interpolate (constructing new data points) between several values The general approach when applying spline functions is that a curve is constructed that closely follows, or as in this case goes through, the sequence of data point.

4.1. What conventions were used in image titles etc?

Titles, labels and sources have been produced as consistently as possible for ease of use. These are designed to provide enough relevant information to allow readers to understand a broad definition of the indicator and the units in which it is being examined. If necessary, more detailed information regarding the indicator is included in the text and as part of the data sheets made available at data.gov.uk.

In titles and labels the following conventions are used:

- For trend over time data the title will include the full start and end date linked by the word 'to', e.g. 2001 to 2010.
- For data averaged over a time period the title will include the full start date and a partial end data linked by a '-', e.g. 2007-09.
- For financial years the title will include both years covered, separated by a '/', e.g. 2011/12.
- For data grouped by national deprivation quintile (based on IMD), these have been labelled 'Most deprived' 'NQ2, 'NQ3', 'NQ4', 'Least deprived'. A similar convention is used for national deprivation deciles

An abbreviated source of the data is given for all graphics.

- Where data has been directly obtained from a data source, the source alone is referenced.
- Where a third party has provided the data the original source is referenced and the provider is acknowledged. *(Provided by ….)*
- Where data has been specifically analysed for the report, the source of the numerator and the source of the denominator (if appropriate) is referenced and the organisation that has undertaken the analysis is acknowledged. *(Analysis by….)*

A list of abbreviations is also included at the end of the report (see Abbreviations). Abbreviations are generally avoided unless also given in full in nearby text. The exception is abbreviations for organisations when quoted in the source of the data.

4.2. What is variation and how do you show it?

There is a growing emphasis on examining variation in health and healthcare. In health, variation can reflect issues of health inequalities, potentially due to differences in behavioural and wider determinants of health. It may also reflect different intrinsic risk (due to genetic predisposition).

As provision of effective healthcare, tailored to the needs of the population, is one of the most effective public health interventions (even for those affected by a genetic predisposition, e.g. there are interventions for familial hypercholesterolaemia and for those at risk of familial breast cancer), differences can also reflect issues of access and provision of care.

It should also be noted that variation is sometimes seen due to normal chance. Throughout the report we have used, where available, methods to help quantify if the variation seen is due to chance.

This is dealt with below in more detail but, for example, where appropriate information exist we not only show the geographical spread, but also if areas are statistically significantly above or below the national average.

4.3. What are confidence intervals and how do you show them?

Wherever available 95% confidence intervals have been provided as part of the data underlying the maps and charts presented. Decisions on displaying confidence intervals have depended on their availability and the impact on the readability of the chart or map. Wherever shown, confidence

intervals are 95% confidence intervals.

A confidence interval is a range of values that is used to quantify the imprecision, due to random error (natural variation), in the estimate of a particular value. If a data point falls outside the range, there is a high chance that this is not just due to random variation, and this is a prompt to look for a reason or cause for this different result.

The wider the confidence interval, the greater the uncertainty in the estimate.

With the exception of the cancer statistics, confidence intervals were calculated as outlined using the methods described in The Network of Public Health Observatory Technical Briefings[11]. More information on confidence intervals is available from the briefings. Confidence intervals for cancer statistics were calculated using ONS standard methods, to ensure consistency with ONS published cancer statistics.

4.4. What is the difference between a rate, incidence and prevalence?

A rate is a measure that relates the number of cases (frequency of a phenomenon) during a certain period of time to the size of a population. It can be defined as the number of cases of interest divided by the number of persons at risk over a specific time period. E.g. it can be used to describe how many people have died from liver disease over one year in the English population. As a general convention in the report where rates are given it is for a year period and is described in terms of a nominal population, i.e. per 1000 population. For the majority of rates reported the populations from which the numbers of persons at risk are taken are open populations (i.e. in any specific year the English population changes due to births, deaths and migration), as such mid year estimates of these population are used.

Rates allow comparisons between groups, e.g. if the rate is higher in one age group compared to another.

Where appropriate rates may be described in terms of:

- incidence, the frequency of new cases of a disease in the population, or
- prevalence, the frequency of existing cases of a disease in a defined population at a notional point in time (point prevalence) or at any time during a specified time period (period prevalence).

This is where the data available allows such inferences and the convention is to describe the rates as such.

4.5. What is age standardisation and how is it used?

Disease and mortality rates may vary widely by age. Such variation complicates any comparisons made between two populations that have different age structures. For example, an area may have less actual deaths because it has a younger population age structure than an area with an older population age structure because the risk of dying increases as people get older. When taking age structure into account the first area may actually have a relatively worse mortality experience

Standardisation allows like to be compared with like, by making sure that observed differences in the number of events (e.g. deaths or infections) in two or more populations are not due to differences in the age and sex profile between the different populations.

The main method of age standardisation used in this report is direct standardisation, where the age-specific rates of the subject population are applied to the age structure of the standard population. This gives the overall rate that would have occurred in the subject population if it had the standard age-profile. It is the preferred method for comparing populations against each other, and over time.

Unless stated otherwise, five year age bands were used to calculated the age specific rate which were then applied to a standard population.

An alternative to age standardising rates is to give a series of age specific rates (i.e. calculating the rate in a series of specific age group rather than adjusting for age to produce one rate). As such an approach makes clear the age profile, this has also been done throughout the report and most often displayed visually with population pyramids (see below).

For further details of approaches to standardisation and the advantages and disadvantages of each see the methods described in The Network of Public Health Observatory Technical Briefings[12].

5. MAPS: how do I read the maps?

5.1. What is a cartogram map?

A major innovation in the way this Chief Medical Officer's report has chosen to represent geographical data is the use of cartograms for mapping, as this may be unfamiliar to many, map 'keys' are provided in the following pages to help readers identify specific geographical areas.

The mapping methods used in this report are different from conventional mapping. Cartograms have been used where the size of each area mapped is approximately proportional to the area's population. As far as possible the cartograms also maintain the original shape of the geographical areas. For this to be possible minor size adjustments for areas with especially high population, high density or low population and small geographical area are also implemented. This approach means that both the proportion of people affected and their geographical location can be surmised at a glance.

5.2. What do the shading and different coloured borders indicate?

Map colours relate to the chapter they appear in and, for consistency, the same shadings have been used throughout.

- Where high rates are of particularly interest (e.g. cancer mortality rates), the shading is ordered from dark=high to

light=low, to draw attention to those areas with higher rates.

- Where areas with low rates are potentially of more interest (e.g. life expectancy), the shading is reversed.
- Where there is no clear consensus on whether a high score or a low score is of greater interest, the ordering is also from dark=high to light=low.

For each map the indicator values of the geographies units (e.g. the Upper Tier Local Authorities) are ordered and split into 5 groups of approximately equal size. This means each quintile group has roughly the same number of data points but the range of covered will depend on the distribution of indicator values.

Quintile ranges are defined by either the mid point between the top and bottom of the indicator values in two adjoining quintiles or the top and bottom value of all the indicator values. The number of decimal places shown in the quintile range is automatically assigned dependent on the overall range of the data. In some maps where the range is small this leads to there being several decimal places. As such the number of decimal places shown should not be taken as reflecting greater accuracy, but rather are a reflection of the distribution of the data.

The map legend is a colour key that allows the identification of which quintile a particular geographical unit belongs to. This key also gives the range covered by each quintile, a smoothed histogram displaying the spread of the individual indicators and the individual data points.

In a number of cases data providers did not feel it appropriate to provide confidence intervals around area estimates. This was for a variety of reasons. Where a statistical analysis has been undertaken to examine which geographical units in a specific map are significantly higher or lower than the national average, these are identified on the map by the boundary of the geographical unit being coloured blue or red. To assess whether an area was significantly different from the national average, local area rates with confidence intervals and the national rate was calculated. Areas were classed as significantly above or below the national average if the confidence intervals did not encompass the national average. Due to the differences in population size, some geographical units with small populations may have high rates and not be significantly different from the national average (i.e. as there is a smaller population there is greater uncertainty around the indicator value). Similarly where a geographical unit has a large population (i.e. which will result in more certainty around the indicator value) it may have a rate that is significantly different from the national average but be closer to it than other geographical units that are not significantly different.

Overall the map and legend indicates how much variability there is, which areas are above or below the national average and what belonging to a particular quintile means. Often outliers can have a large impact on the range of the top and bottom quintile. Rather than remove these, by including them but showing the distribution, this gives a fuller picture of all the data.

5.3. Why do you use different geographical areas in the maps?

Throughout the report there are maps with 4 different sets of geographical boundaries: The geographical units of these different maps are:

- upper tier local authorities;
- primary care trusts (PCTs);
- cancer networks;
- government office regions.

As a standard, upper tier local authorities are the default geography used, however in many cases data is not collected at this level, e.g. currently immunisation coverage rates is only available at the PCT level. The following four map keys identify specific geographical units within the maps and can be used to identify local areas.

5.4. Is any map data missing or suppressed?

Where data is unavailable, this is identified in the maps by the area being filled by a dark gray colour. Data may not be available because it has not been collated for that area, or is considered unreliable for inclusion by the data provider (for statistical or quality assurance reasons). For example, cancer age-standardised rates are calculated over a three year period (2008, 2009 and 2010), rates were not calculated if there were fewer than 10 individuals affected in any particular year as low numbers may be susceptible to inaccurate interpretation. Data may also have been suppressed due to low numbers which may mean individuals could be identified, generally this was where less than five people were affected.

Decisions on suppression or non provision of data were at the data provider's discretion such that it met their local data governance requirements. All information provided for the report that has been mapped has been made available.

6. CHARTS: how do I read the charts?

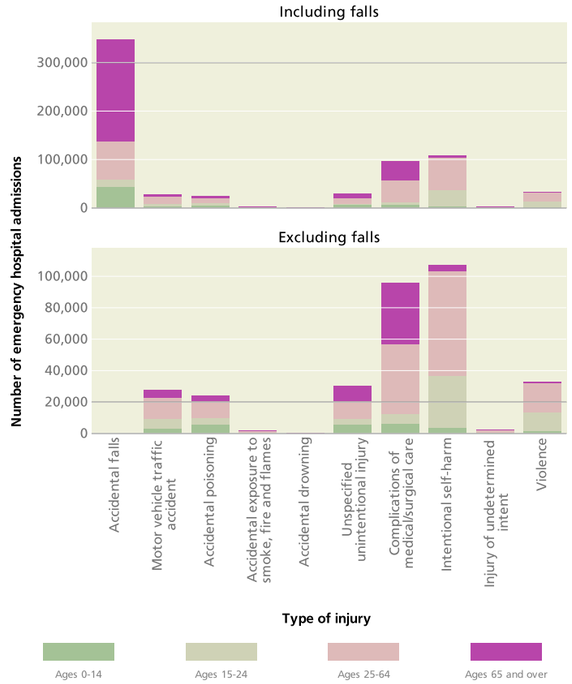
6.1. What types of charts are used?

There are four main types of chart used in the report;

- Population pyramids
- Bar and column charts
- Line charts
- Stacked area charts

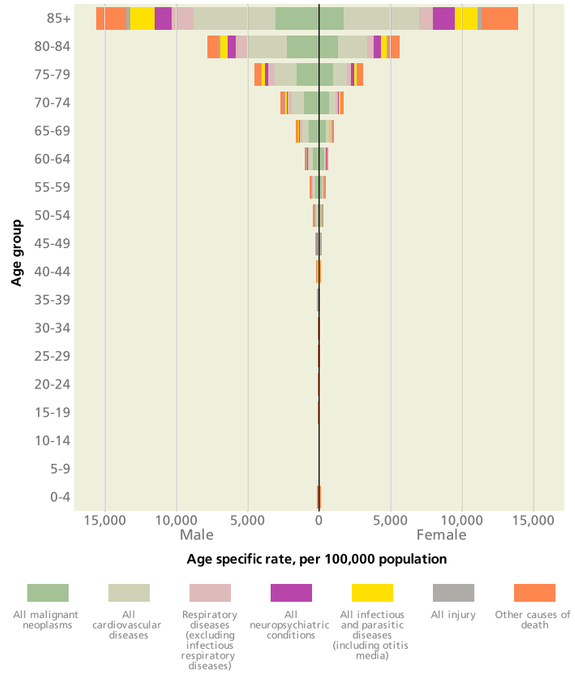
The main additional method used is faceting of graphs, where more than one graph is shown as part of a series. These have a particular function, to aid comparison between different sets of data. An example of this is *Emergency hospital admissions due to injuries by type and age, England, 2010/11*, which is displayed with and without falls. This is to demonstrate the importance of falls as a cause of mortality, while also ensuring the pattern of other accidental causes of mortality is made clear. Where facetted charts have the same x-axis, these are given at the bottom of set of facets.

Emergency hospital admissions due to injuries by type and age, England, 2010/11



Source: Hospital Episode Statistics (HES), Health and Social Care Information Centre. © Crown Copyright 2012. 2010 population estimates supplied by ONS. (Analysis by PHOs, led by EMPHO)

Mortality due to all causes (and sub-categories) by age and sex, England, 2008-10



Source: Death registrations and 2008 to 2010 population estimates, ONS. (Analysis by DH)

Population pyramids, in general, give the age and sex specific rate for the indicator considered. For a number of indicators where these can be further subdivided into categories, these are shown as subsections, giving the age specific rates for the subsections. For all population pyramids the time period covered, the geographical area covered and a brief description of the subject area (in conjunction with the legend for charts with subcategories) are included in the title.

By using population pyramids this allows at a glance an understanding of differences between males and females at different life stages. As in *Mortality due to all causes (and sub-categories) by age and sex, England, 2008-10*, this will often emphasise the importance of the disease/issue at older age. Where sub-categories are shown the changing proportional importance of those sub-categories by age, such as the importance of infectious and parasitic diseases as a cause of mortality in older people, is also identified.

The age groupings used are not always uniform as they are constrained by data availability and sometimes it was considered important to include an additional group of children under the age of 1 year. For population pyramids without subcategories, if appropriate and available 95% confidence intervals are displayed. For those with subcategories, this information is available as part of the raw data made available from data.gov.uk.

Bar charts are the main charts used in the report. The length of the bar is proportional to the value being displayed. A number of these charts contain sub-categories (stacked bar charts), grouped bar charts (data is grouped by two or more categories) and faceted bar charts (charts facetted by sex, deprivation quintile, etc). Gridlines are included to help interpretation of differences between bars or columns. In some instances the English average is presented as a line for comparison. In all instances the use of bar charts is to facilitate comparisons between different groups and highlight were differences occur, but also were there are no differences. Similar to population pyramids charts, confidence intervals are provided where appropriate. These cannot be shown for charts with subcategories but are included in the raw data.

Line Charts have been used to show change over time data and in certain instances the change between age groups. In general age standardised rates are shown, however the x or y label (as appropriate) will always identify the units of measurement. In line charts, when included, 95% confidence intervals are displayed as shaded areas around the line.

Similar to bar charts, several of these are presented as facetted charts. Where there are a large number of facetted line charts displaying change over time, rather than the X axis of the time period, the grouping variables are displayed. The purpose of these charts is to aid comparisons of changing patterns in the different groups. As can be seen in *Trends in smoking prevalence by age and sex, England, 1993 to 2010*,

rates are high in younger people (excluding those aged 11-15) and there is a general downward trend in all age groups.

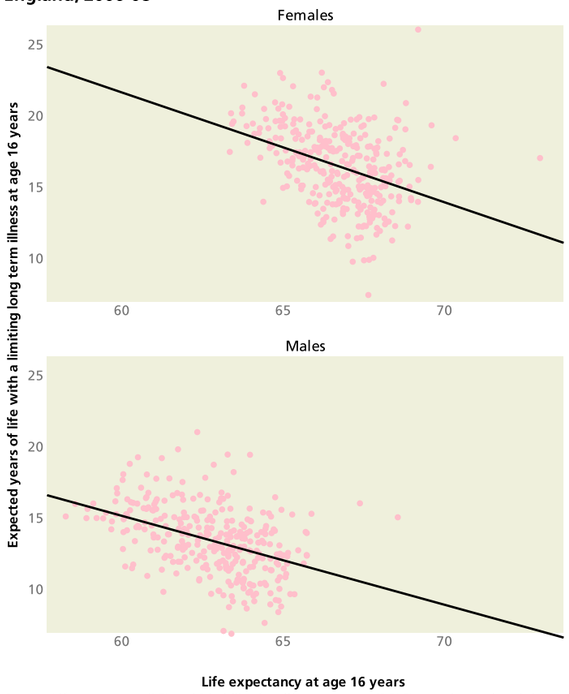
Stacked area charts have been used to show change over time data where there is an overarching variable of interest (e.g. age standardised mortality due to respiratory illness) but this comprises of several sub-categories which are also of interest. *Trend in Mortality due to respiratory diseases (and sub-categories) by deprivation, England, 2001 to 2010* reflects this, in that it shows the relative importance of infectious respiratory diseases, COPD, asthma and other respiratory diseases, the small overall decrease over time and the much higher rates seen in the more deprived areas.

There are also a small number of more specialist charts, these include scatter plots with lines of best fit, a quadrant plot and an infographic (which combines a form bubble chart with a Sankey diagram), as well as several pie charts.

Scatter plots allow an assessment of the relationship between two variables by considering the:

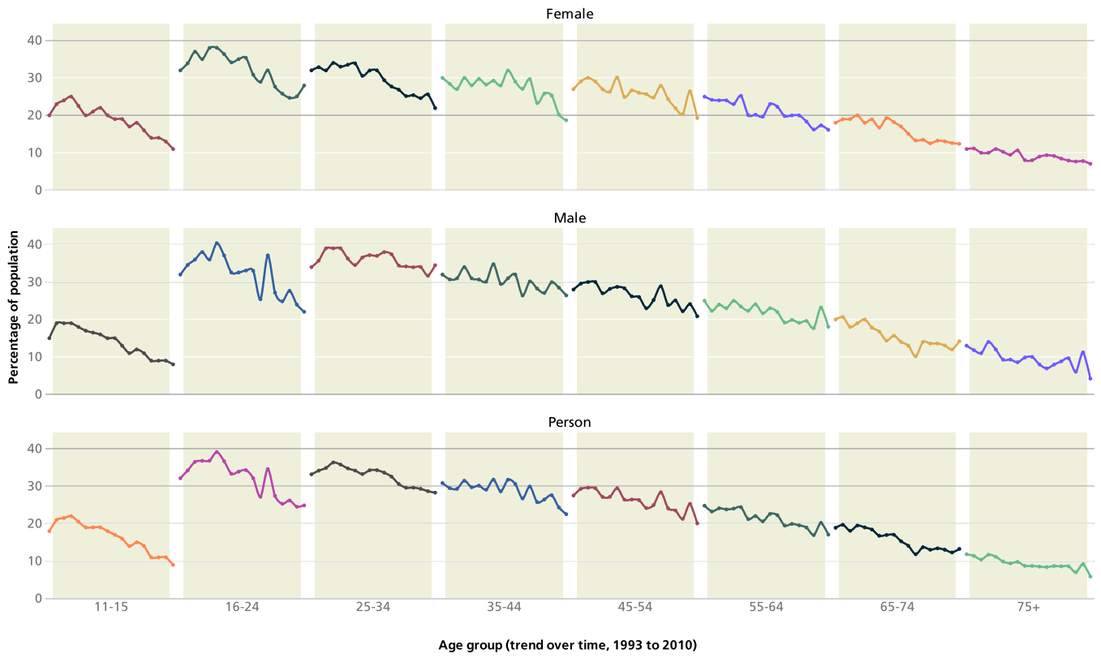
- Direction of the relationship - does one variable increase as the other increases (a positive relationship) or does it decrease (a negative relationship)?
- Form of the relationship - is the relationship best described by a linear/straight line, a curve, etc?
- Strength of the relationship - is the pattern of data clustered around the underlying form or does it seem at random?

Comparison of life expectancy and expected years of life spent with a limiting long-term illness or disability for local authorities, England, 2006-08



Source: Life expectancy (LE) and Disability-free life expectancy (DFLE) experimental statistics, ONS.

Trend in smoking prevalence by age and sex, England, 1993 to 2010

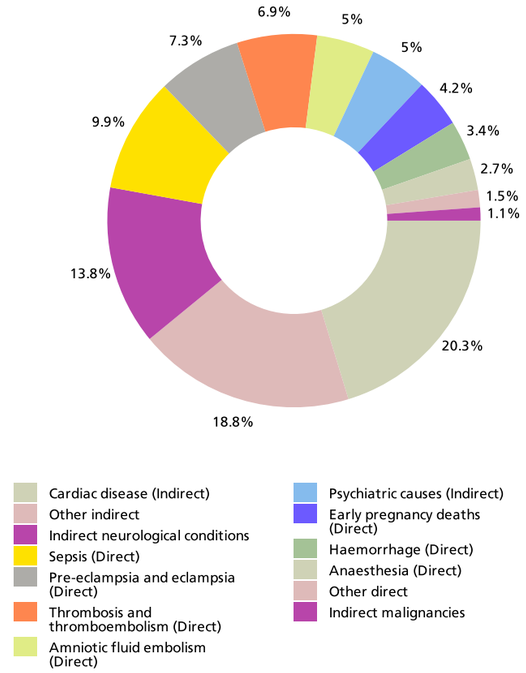


Source: Population aged 11-15: Smoking, drinking and drug use among young people in England in 2010; Population aged 16+: Health Survey for England 2010; Copyright © 2011. Re-used with the permission of The Health and Social Care Information Centre. All rights reserved. Note: Figures for 11-15 age group include 'regular' and 'occasional' smokers

Scatter plots can also identify whether there are important outliers that do not fit the overall pattern of the rest of the data. In this report the scatter plots display the individual data points and a line of best fit (which assumes a linear relationship) to help more clearly show the direction of the relationship and allow an assessment of its strength (by making it easier for readers to examine how clustered data is around the line).

Quadrant plots are essentially scatter plots but can be used to consider and compare the distribution of data within particular categories (i.e. the different quadrants of the plot).

Maternal mortality due to different direct and indirect causes, United Kingdom, 2006-08



Source: CMACE. Saving Mothers' Lives: reviewing maternal deaths to make motherhood safer: 2006-08. The Eighth Report on Confidential Enquiries into Maternal Deaths in the United

Pie charts illustrate the proportion of the whole that each category displayed represents. The area (and arc length and central angle) is proportional to the quantity it represents.

The infographic uses "bubble chart" techniques where numeric quantities are represented by the area of a circle. In this case for each infectious disease the area of the inner circle is proportional to the number of notifications which have a linked travel history and the inner and outer circle areas combined is proportional to all notifications of that disease. This gives an instant impression of the relative number of notifications of different key imported infections and the proportion of those notifications that have a definite linked travel history. Different colours are used to identify the predominant mode of transmission of the key imported infections, giving an overall impression of the mode of transmission that is predominant for these infections. The overlap of non-concentric circles is due to issues of space and has no specific meaning. The second part of the infographic is a Sankey diagram. Sankey diagrams are a specific type of flow diagram in which the width of the arrows are proportional to the flow quantity. Within the infographic they are used to show the travel to and from different geographical areas around the world but are also split by colour to identify the overall proportion of travel to those areas which are considered to be are high, medium or low risk for gastrointestinal illnesses.

7. What data did you use?

7.1. What is the source of the data used in the report?

The source of data is given at the bottom of each image. A list of websites that provide access to additional sources of information are also given at the back of the report. Two major sources of information used in this report are:

- Death registrations based on the details collected when deaths are certified and registered. Most deaths are certified by a medical practitioner though in some cases deaths are referred to a coroner. Cause of death is coded using the Tenth Revision of the International Statistical Classification of Diseases and Related Health Problems. When registered information is also collected from the informant. Further information is available from the Office for National Statistics[13]
- Hospital Episode Statistics (HES) contain details of all admissions to NHS hospitals in England and is used for a wide range of healthcare analysis for the NHS including assessing use of healthcare (in particular secondary care). The Health and Social Care Information Centre liaises closely with NHS trusts and PCTs to encourage submission of complete and valid data and seeks to minimise inaccuracies and the effect of missing and invalid data via HES processes[13].

A variety of other sources of information are also used which includes a mixture of surveillance and routine data.

7.2. Are there limitations on the interpretation of the data?

There are a number of limitations to any data available; although care has been taken to use the data source most likely to be of high quality in this report, some caveats do remain.

As a general rule, where possible, routinely available information has been used throughout the report, such as data from death certificates, GP registers and hospital episode data. A key advantage of routinely available information is its regular collection, allowing assessment of change over time, and that it is often available at the local level, allowing local comparisons to the national situation. However, there are some common limitations that should be taken into consideration when interpreting the data.

- Statistics produced from routinely collected information will be affected by the completeness and accuracy of those recording the data. For example, different coding styles of medical practioners on death certificates or NHS coders for HES data could influence local and national estimates. Clinical coding is also often less accurate in older people with several co-mobidities.
- Changes in the system of collection or coding of data will impact on comparisons over time. For example higher rates of disease could reflect greater completeness of data rather than increasing incidence of a disease.
- Dependent on the source of data used, accuracy and completion of denominator data will impact on the accuracy of statistics produced. For example where data is taken from GP disease registers, even if all people with a disease are identified and correctly diagnosed, if GP list sizes are inaccurate this will bias estimates of prevalence.
- Where data analysis is the secondary use of data collected for other purposes, factors influencing the accuracy and completeness of primary use of the data will impact on any inferences that can be made.
- When using routine data that is primarily recording access to services, high rates could reflect that the system is treating high numbers, that there is a high local prevalence, or both.
- To use routine health data that is primarily recording access to services to estimate prevalence or incidence it must be assumed that people are equally likely to access those services, and that referral pathways are the same. However, it is known that certain groups such as the homeless, migrants and travellers may be less likely to access healthcare.

While the above caveats focus on routine health data, similar issues apply to all routinely available information used in the report.

A particularly important issue is that, unless otherwise stated, mortality and hospital episode data are analysed based on primary cause. While using the primary cause of death/ hospital admission is useful in understanding the overall pattern of mortality and morbidity, it does not address the issue or the causal role that other diseases may have had. As such this data is likely to under represent the total causal impact of chronic diseases.

Although routinely available information has been the default choice, much of the data used in the report is only available from surveys. These are also open to a variety of potential biases that could caveat any interpretation. Two major issues which particularly effect reported behaviour or lifestyle choices are:

- those who respond to the survey may not be typical of the population of interest (e.g. low representation of young people, homeless, ethnic minorities etc) and
- people may report different levels of behaviours (alcohol, smoking, sexual partners etc) than they actually exhibit.

Finally, for a number of maps, modelled estimates are presented for different areas. The accuracy of these estimates depends both on the accuracy of the model used and the accuracy of the local measures which are then used to predict local estimates.

7.3. Where can I find out more about the data used?

Key meta data has been included as part of each chart or map displayed. Taken as a whole, the title, x and y axis labels, legend and source of the data will allow readers to discern the time period, geographical area, a broad definition of the indicator examined and the units the indicator has been measured in.

The original source of the data is also given and where rates have been calculated specifically for the report, the source of the numerator and then the source of the denominator is given.

More detailed information is available as part of the Microsoft Excel files containing the data used in the report, including the specific definition used (as defined by the data providers).

7.4. Specific data caveats?

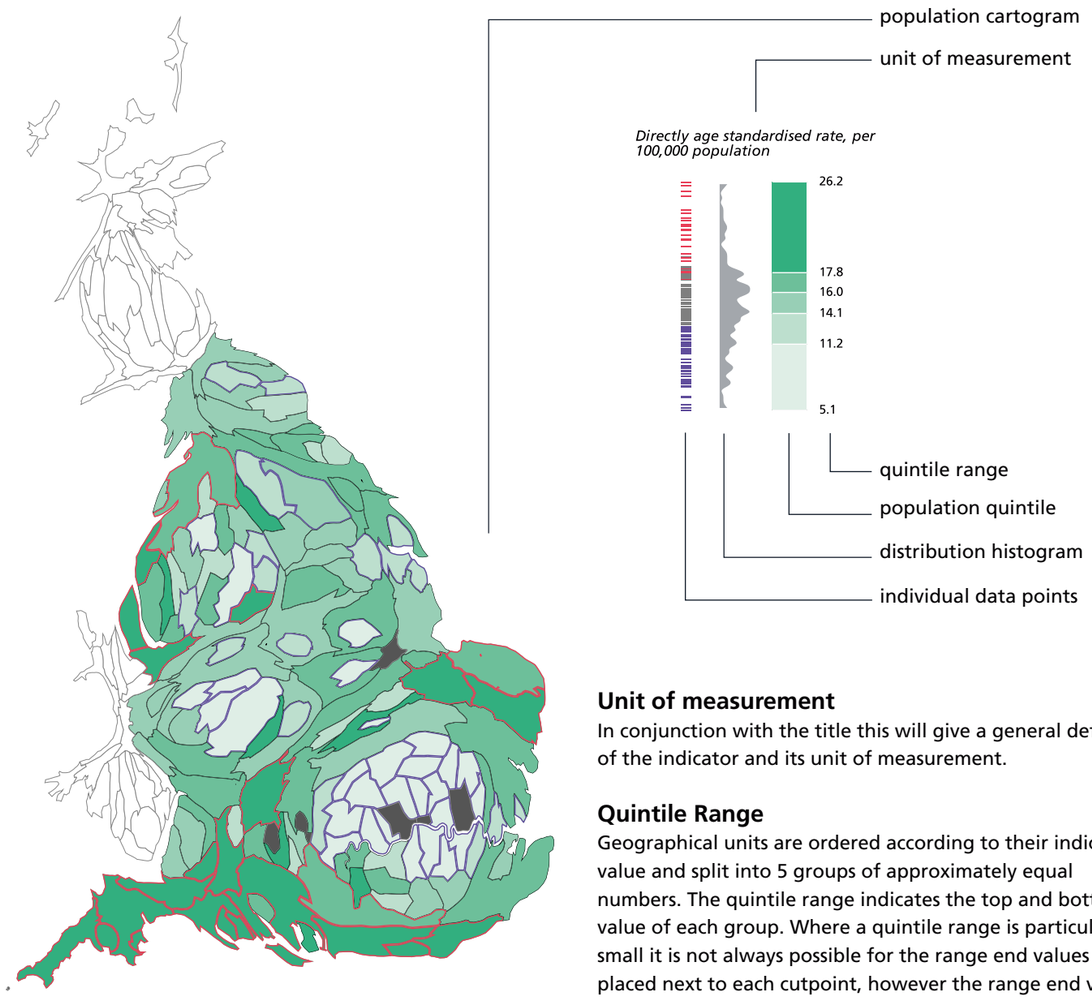
There are several specific caveats that data providers have asked us to make readers of the report aware of. In general, if these are likely to have a large impact on the interpretation of the data, reference has been made to them in the 200 word summary which accompanies each set of images in this report.

- Data presented from infectious disease surveillance underestimates the true prevalence of disease. This is particularly the case for gastrointestinal diseases such as *Campylobacter*, where many people with infection will not present to services.
- Data on key imported infections relies on the recording of a travel history. This is variable in its completeness and figures on foreign travel linked notifications should be considered a minimum of the actual number of travel related infections.
- The age and sex population profile of people with learning disabilities is estimated from case registers covering the City of Sheffield (all ages) and the City and County of Leicestershire (aged 20 and over) as at March 2012. Data from these two areas may not reflect exactly the pattern for England as a whole.
- The estimated average age of death for people with learning disabilities may be affected by the substantial under recording of 'Learning Disabilities' on the death certificate. This probably reflects many certifying doctors view that the learning disability was neither a direct or contributory cause of the death.
- Data on visual impartment is based on the number of people whose vision has fallen to certifiable levels and who have accepted the offer of registration for vision impairment made by a consultant ophthalmologist. It is thus an underestimate the true level of visual disability but is likely to reasonably estimate the level of social service resources needed by the visually impaired.
- Due to data constraints, the age groups used to calculated the age standardised rate in the map 'Certification of visual impairment rates by primary care trust, England, 2010/11' were 0-15, 16-64 and 65+. For the trend over time data for visual impairments, age standardised rates were based on 5 year age groups. Both were applied to was the 2010/11 England population to calculate the age standardised rates.
- For data regarding child dental health, the requirement for positive consent has introduced bias into these data, which means that they cannot be used in backwards comparisons. A summary of caveats and other issues affecting the data is available in the "NHS Dental Epidemiology Programme for England; Oral Health Survey of five year old children 2007 / 2008" report and the "Explanation of caveats for 2007/08 five-year-olds survey data" document[14].

1. Shaw M, Thomas B, Davey Smith G, Dorling D, (2008). *The Grim Reaper's road map: An atlas of mortality in Britain*, Bristol: Policy Press
2. Marmot Review Team (2010) F*air Society, Healthy Lives*: Strategic review of health inequalities in England post-2010 (The Marmot Review). London: Marmot Review Team.
3. WHO *The global burden of disease: 2004 update* (2008), http://www.who.int/healthinfo/global_burden_disease/2004_report_update/en/index.html
4. http://d3js.org/
5. http://www.iconomical.com/
6. http://sasi.group.shef.ac.uk/bankruptbritain/Material.html
7. Thomas B, Dorling D, (2011). *Bankrupt Britain: An atlas of social change*, Bristol: Policy Press
8. Gastner MT, Newman ME, (2004). Diffusion-based method for producing density equalizing maps, Proc Natl Acad Sci USA, vol 101 (20), pp7499-504.
9. http://scapetoad.choros.ch
10. As such all maps contain Ordnance Survey data © Crown copyright and database right 2012.
11. http://www.apho.org.uk/resource/view.aspx?RID=39306
12. IBID
13. Available at: http://www.ons.gov.uk/ons/guide-method/user-guidance/health-and-life-events/mortality-metadata.pdf and http://www.ons.gov.uk/ons/guide-method/method-quality/quality/quality-information/social-statistics/sqr-annual-mortality.pdf
14. Available at: http://www.nwph.net/dentalhealth/caveat.htm

How to use this report continued

How to read the maps



Population Cartograms

All maps in this report are population cartograms. A population cartogram, or *isodemographic map* is where each geographical unit has been scaled so that it is approximately proportional to the size of the resident population in that area, with minor size adjustments for areas with especially high or low population or density. Map keys for the different geographical units used are provided here.

Where analysis has been undertaken to determine which geographical units are significantly ($p<0.05$) greater or less than the national average, significantly different indicator values are identified by the boundary of the geographical unit being coloured red or blue.

Where no data is available, or data has been suppressed due to small numbers, geographical units are coloured dark grey.

Unit of measurement

In conjunction with the title this will give a general definition of the indicator and its unit of measurement.

Quintile Range

Geographical units are ordered according to their indicator value and split into 5 groups of approximately equal numbers. The quintile range indicates the top and bottom value of each group. Where a quintile range is particularly small it is not always possible for the range end values to be placed next to each cutpoint, however the range end values given and the order in which they appear is correct.

Population Quintile

This is the key to the map. It identifies which quintile a geographical unit is part of and illustrates the range of each quintile.

Distribution Histogram

This is a smoothed histogram displaying the distribution of the underlying indicator values for the different geographical units.

Individual data points

This is a plot of the indicator value for each of the geographical units. Where analysis has been undertaken to determine which geographical units are significantly ($p>0.05$) greater or less than the national average, significantly different indicator values are identified by being coloured red or blue.

1. North East
2. North West
3. Yorkshire and The Humber
4. East Midlands
5. West Midlands
6. East of England
7. London
8. South East
9. South West

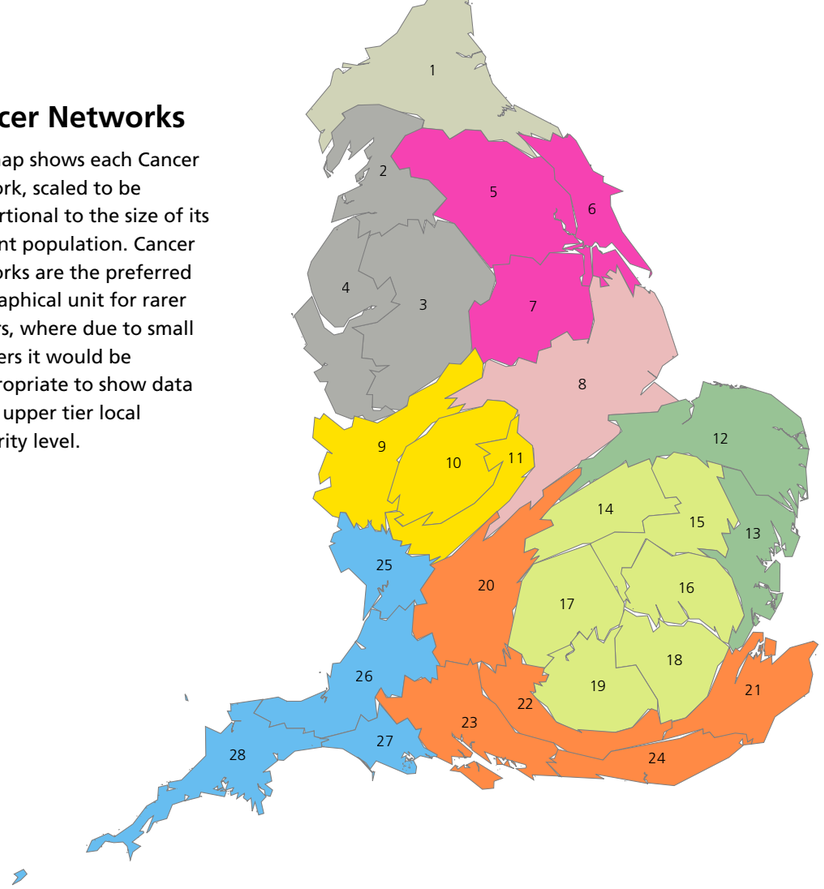
Regions

This map shows each Region, scaled to be proportional to the size of its resident population. 'Regions' are the highest tier of sub-national division in England.

1. North of England
2. Lancashire and South Cumb
3. Greater Manchester & Ches
4. Merseyside & Cheshire
5. Yorkshire
6. Humber & Yorkshire Coast
7. North Trent
8. East Midlands
9. Greater Midlands
10. Pan Birmingham
11. Arden
12. Anglia
13. Essex
14. Mount Vernon
15. North London
16. North East London
17. West London
18. South East London
19. South West London
20. Thames Valley
21. Kent & Medway
22. Surrey, West Sussex & Ham
23. Central South Coast
24. Sussex
25. 3 Counties
26. Avon, Somerset & Wiltshir
27. Dorset
28. Peninsula

Cancer Networks

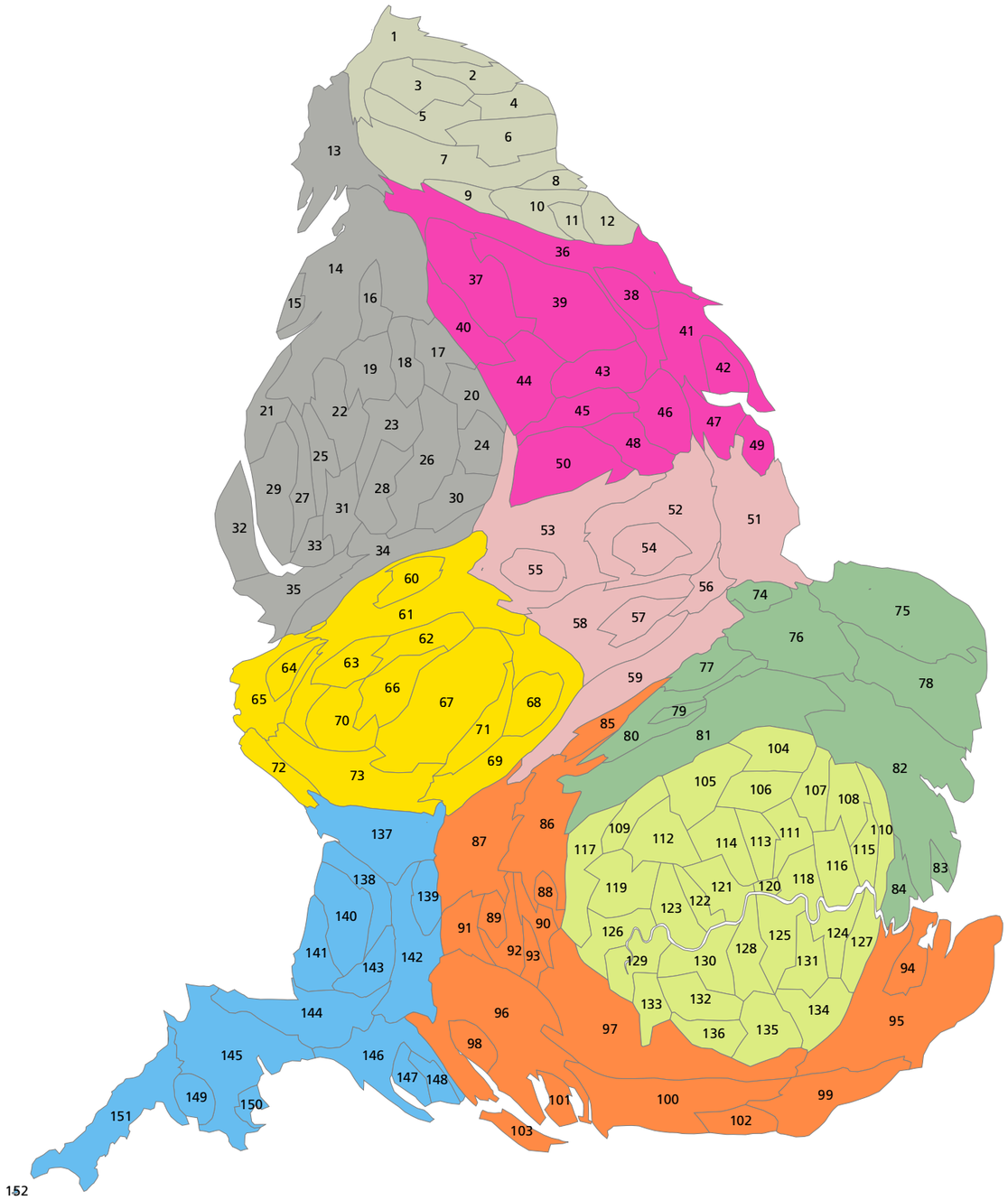
This map shows each Cancer Network, scaled to be proportional to the size of its resident population. Cancer Networks are the preferred geographical unit for rarer cancers, where due to small numbers it would be inappropriate to show data at the upper tier local authority level.



Upper Tier Local Authorities

UA = Unitary Authority
MD = Metropolitan District
CC = County Council
LB = London Borough

This map shows each Upper Tier Local Authority, scaled to be proportional to the size of its resident population. This is the default geographical unit used in the report.



1. Northumberland UA
2. North Tyneside MD
3. Newcastle upon Tyne MD
4. South Tyneside MD
5. Gateshead MD
6. Sunderland MD
7. County Durham UA
8. Hartlepool UA
9. Darlington UA
10. Stockton-on-Tees UA
11. Middlesbrough UA
12. Redcar and Cleveland UA

13. Cumbria CC
14. Lancashire CC
15. Blackpool UA
16. Blackburn with Darwen UA
17. Rochdale MD
18. Bury MD
19. Bolton MD
20. Oldham MD
21. Sefton MD
22. Wigan MD
23. Salford MD
24. Tameside MD
25. St Helens MD
26. Manchester MD
27. Knowsley MD
28. Trafford MD
29. Liverpool MD
30. Stockport MD
31. Warrington UA
32. Wirral MD
33. Halton UA
34. Cheshire East UA
35. Cheshire West and Chester UA

36. North Yorkshire CC
37. Bradford MD
38. York UA
39. Leeds MD
40. Calderdale MD
41. East Riding of Yorkshire UA
42. Kingston upon Hull UA
43. Wakefield MD
44. Kirklees MD
45. Barnsley MD
46. Doncaster MD
47. North Lincolnshire UA
48. Rotherham MD
49. North East Lincolnshire UA
50. Sheffield MD

51. Lincolnshire CC
52. Nottinghamshire CC
53. Derbyshire CC
54. Nottingham UA
55. Derby UA
56. Rutland UA
57. Leicester UA
58. Leicestershire CC
59. Northamptonshire CC

60. Stoke-on-Trent UA
61. Staffordshire CC
62. Walsall MD
63. Wolverhampton MD
64. Telford and Wrekin UA
65. Shropshire UA
66. Sandwell MD
67. Birmingham MD
68. Coventry MD
69. Warwickshire CC
70. Dudley MD
71. Solihull MD
72. Herefordshire County UA
73. Worcestershire CC

74. Peterborough UA
75. Norfolk CC
76. Cambridgeshire CC
77. Bedford UA
78. Suffolk CC
79. Luton UA
80. Central Bedfordshire UA
81. Hertfordshire CC
82. Essex CC
83. Southend-on-Sea UA
84. Thurrock UA

85. Milton Keynes UA
86. Buckinghamshire CC
87. Oxfordshire CC
88. Slough UA
89. Reading UA
90. Windsor and Maidenhead UA
91. West Berkshire UA
92. Wokingham UA
93. Bracknell Forest UA
94. Medway UA
95. Kent CC
96. Hampshire CC
97. Surrey CC
98. Southampton UA
99. East Sussex CC
100. West Sussex CC

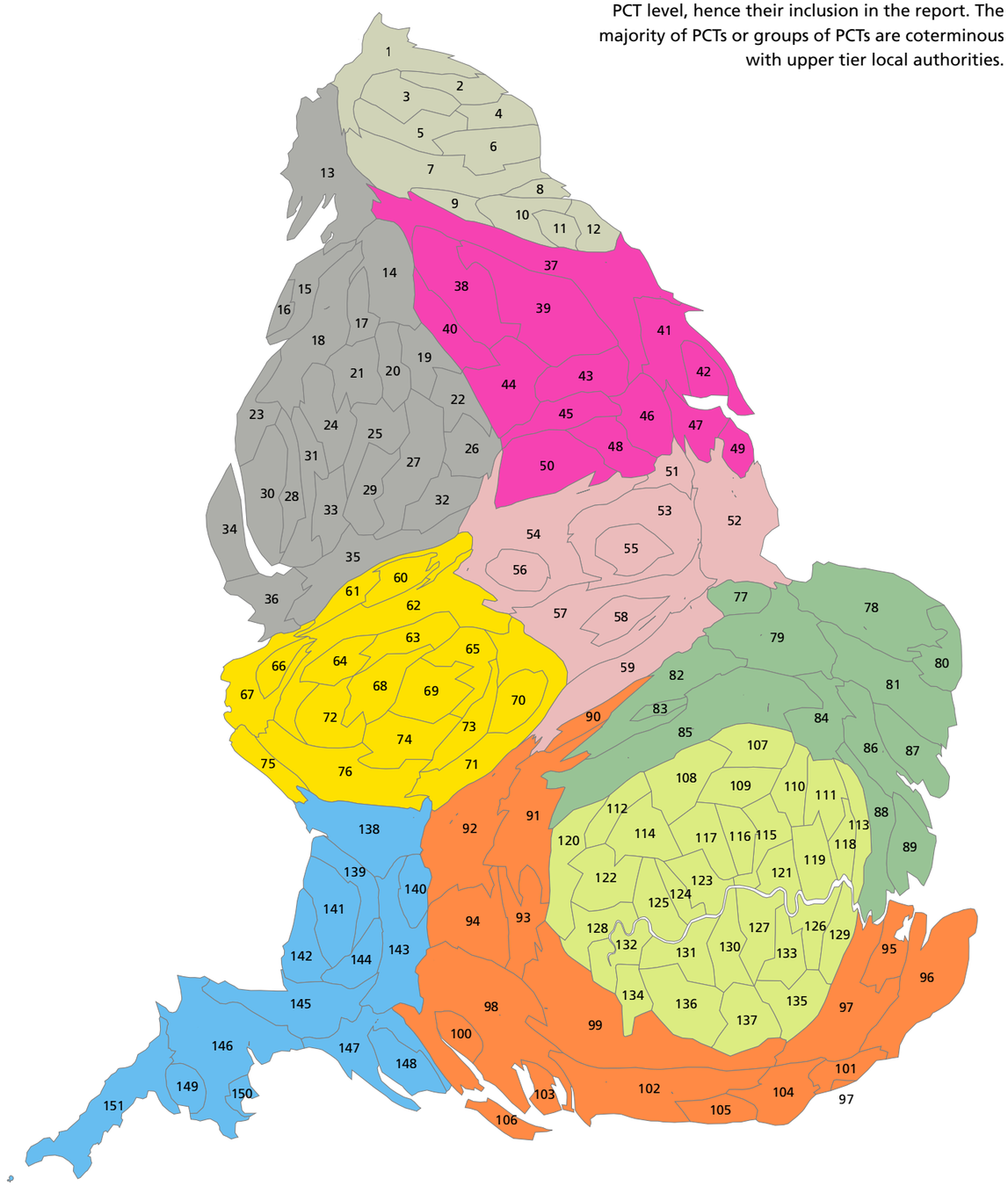
101. Portsmouth UA
102. Brighton and Hove UA
103. Isle of Wight UA

104. Enfield LB
105. Barnet LB
106. Haringey LB
107. Waltham Forest LB
108. Redbridge LB
109. Harrow LB
110. Havering LB
111. Hackney LB
112. Brent LB
113. Islington LB
114. Camden LB
115. Barking and Dagenham LB
116. Newham LB
117. Hillingdon LB
118. Tower Hamlets LB
119. Ealing LB
120. City of London LB
121. Westminster LB
122. Kensington and Chelsea LB
123. Hammersmith and Fulham LB
124. Greenwich LB
125. Southwark LB
126. Hounslow LB
127. Bexley LB
128. Lambeth LB
129. Richmond upon Thames LB
130. Wandsworth LB
131. Lewisham LB
132. Merton LB
133. Kingston upon Thames LB
134. Bromley LB
135. Croydon LB
136. Sutton LB

137. Gloucestershire CC
138. South Gloucestershire UA
139. Swindon UA
140. Bristol UA
141. North Somerset UA
142. Wiltshire UA
143. Bath and North East Somerset UA
144. Somerset CC
145. Devon CC
146. Dorset CC
147. Poole UA
148. Bournemouth UA
149. Plymouth UA
150. Torbay UA
151. Cornwall UA
152. Isles of Scilly UA

Primary Care Trusts

This map shows each Primary Care Trust (PCT), scaled to be proportional to the size of its resident population. PCTs are the unit of organisation of provision of primary care (GPs, Dentists, pharmacy services etc). These will be superseded by Clinical Commissioning Groups (CCGs). Currently a large proportion of health service data is collected at the PCT level, hence their inclusion in the report. The majority of PCTs or groups of PCTs are coterminous with upper tier local authorities.



1. Northumberland Care Trust
2. North Tyneside PCT
3. Newcastle PCT
4. South Tyneside PCT
5. Gateshead PCT
6. Sunderland Teaching PCT
7. County Durham PCT
8. Hartlepool PCT
9. Darlington PCT
10. Stockton-on-Tees Teaching PCT
11. Middlesbrough PCT
12. Redcar and Cleveland PCT

13. Cumbria Teaching PCT
14. East Lancashire Teaching PCT
15. North Lancashire Teaching PCT
16. Blackpool PCT
17. Blackburn with Darwen
18. Central Lancashire PCT
19. Heywood, Middleton and Rochdale PCT
20. Bury PCT
21. Bolton Teaching PCT
22. Oldham PCT
23. Sefton PCT
24. Ashton, Leigh and Wigan PCT
25. Salford PCT
26. Tameside and Glossop PCT
27. Manchester Teaching PCT
28. Knowsley PCT
29. Trafford PCT
30. Liverpool PCT
31. Halton and St Helens PCT
32. Stockport PCT
33. Warrington PCT
34. Wirral PCT
35. Central and Eastern Cheshire PCT
36. Western Cheshire PCT

37. North Yorkshire and York PCT
38. Bradford and Airedale Teaching PCT
39. Leeds PCT
40. Calderdale PCT
41. East Riding Of Yorkshire PCT
42. Hull Teaching PCT
43. Wakefield District PCT
44. Kirklees PCT
45. Barnsley PCT
46. Doncaster PCT
47. North Lincolnshire PCT
48. Rotherham PCT
49. North East Lincolnshire Care Trust Plus
50. Sheffield PCT

51. Bassetlaw PCT
52. Lincolnshire Teaching PCT
53. Nottinghamshire County Teaching PCT
54. Derbyshire County PCT
55. Nottingham City PCT
56. Derby City PCT
57. Leicestershire County and Rutland PCT
58. Leicester City PCT
59. Northamptonshire Teaching PCT

60. Stoke On Trent PCT
61. North Staffordshire PCT
62. South Staffordshire PCT
63. Walsall Teaching PCT
64. Wolverhampton City PCT
65. Birmingham East and North PCT
66. Telford and Wrekin PCT
67. Shropshire County PCT
68. Sandwell PCT
69. Heart Of Birmingham Teaching PCT
70. Coventry Teaching PCT
71. Warwickshire PCT
72. Dudley PCT
73. Solihull
74. South Birmingham PCT
75. Herefordshire PCT
76. Worcestershire PCT

77. Peterborough PCT
78. Norfolk PCT
79. Cambridgeshire PCT
80. Great Yarmouth and Waveney PCT
81. Suffolk PCT
82. Bedfordshire PCT
83. Luton PCT
84. West Essex PCT
85. Hertfordshire PCT
86. Mid Essex PCT
87. North East Essex PCT
88. South West Essex PCT
89. South East Essex PCT

90. Milton Keynes PCT
91. Buckinghamshire PCT
92. Oxfordshire PCT
93. Berkshire East PCT
94. Berkshire West PCT
95. Medway PCT
96. Eastern and Coastal Kent PCT
97. West Kent PCT
98. Hampshire PCT
99. Surrey PCT
100. Southampton City PCT

101. Hastings and Rother PCT
102. West Sussex PCT
103. Portsmouth City Teaching PCT
104. East Sussex Downs and Weald PCT
105. Brighton and Hove City PCT
106. Isle Of Wight NHS PCT

107. Enfield PCT
108. Barnet PCT
109. Haringey Teaching PCT
110. Waltham Forest PCT
111. Redbridge PCT
112. Harrow PCT
113. Havering PCT
114. Brent Teaching PCT
115. City and Hackney Teaching PCT
116. Islington PCT
117. Camden PCT
118. Barking and Dagenham PCT
119. Newham PCT
120. Hillingdon PCT
121. Tower Hamlets PCT
122. Ealing PCT
123. Westminster PCT
124. Kensington and Chelsea PCT
125. Hammersmith and Fulham PCT
126. Greenwich Teaching PCT
127. Southwark PCT
128. Hounslow PCT
129. Bexley Care Trust
130. Lambeth PCT
131. Wandsworth PCT
132. Richmond and Twickenham PCT
133. Lewisham PCT
134. Kingston PCT
135. Bromley PCT
136. Sutton and Merton PCT
137. Croydon PCT

138. Gloucestershire PCT
139. South Gloucestershire PCT
140. Swindon PCT
141. Bristol PCT
142. North Somerset PCT
143. Wiltshire PCT
144. Bath and North East Somerset PCT
145. Somerset PCT
146. Devon PCT
147. Dorset PCT
148. Bournemouth and Poole Teaching PCT
149. Plymouth Teaching PCT
150. Torbay Care Trust
151. Cornwall and Isles Of Scilly PCT

How to use this report continued