



# Index of Cancer Survival for Primary Care Trusts in England: Patients diagnosed 1996–2010 and followed up to 2011

Coverage: **England**

Date: **19 December 2012**

Geographical Area: **Other area classification**

Theme: **Health and Social Care**

## Key findings

- Overall, the one-year cancer survival index for England has increased during the period 1996–2010, from 59.7% for patients diagnosed in 1996 to 67.7% in 2010.
- Geographic inequalities in cancer survival are persistent: a clear North-South gradient existed in 1996, although this was less marked in 2010.
- Geographic inequalities in the one-year survival index in London are only slightly narrower than those observed for the whole of England.
- The pattern of a gradual increase in the survival index with persistent geographic inequalities is similar for middle-aged (55–64 years) and elderly (75–99 years) patients.
- In 2010, the index of one-year net survival for all cancers combined remained on average 20% lower in elderly than in middle-aged patients.

## Summary

This bulletin presents updated estimates of a cancer survival index at one year after diagnosis for all cancers combined in each of 151 Primary Care Trusts (PCTs) in England, for patients diagnosed during 1996–2010 and followed up to 31 December 2011. The survival index is adjusted for differences in the profile of cancer patients by age, sex and type of cancer between PCTs.

## Introduction

This report presents an update for the index of cancer survival at one year after diagnosis for all cancers combined, for each of the 151 PCTs in England. This index is designed to serve as a measure of the effectiveness of cancer services at both local and national level. For managerial application, the index needs to reflect the overall outcome (effectiveness) of care for all cancer patients resident in a given PCT, and to relate to patients diagnosed in a single calendar year.

As a national surveillance tool of strategic value for government policy, the index also needs to provide a succinct national overview of changes in the geographic pattern of short-term survival for all cancers. At both local and national level, trends in the index should help assessment of the impact of earlier diagnosis, a key component of the National Awareness and Early Diagnosis Initiative ([Anon. 2008](#); [Richards, 2009a](#); [Richards, 2009b](#)).

## Survival index for all cancers combined by Primary Care Trust

For each of the 151 PCTs in England and for each of the 15 years 1996–2010, an index was constructed of one-year net survival (%) for all cancers combined.

In comparing survival between PCTs and over time, it is crucial to take account of differences between PCTs in the profile of cancer patients by age, sex and cancer type. This is because net survival varies with age and sex, and especially between different cancers, and the profile of cancer patients within a given PCT can change over time. Standardisation for all these factors is essential to minimise bias and improve the interpretability of the results.

This approach is encapsulated in the survival index reported here. A similar approach has been used to examine international variation in five-year survival in Europe in the 1990s ([Verdecchia et al., 2008](#)), and to explore long-term trends since the 1970s in ten-year survival in England and Wales ([Cancer Research UK, 2010a](#); [Cancer Research UK, 2010b](#)). The objective here was different: to produce an index of short-term survival in small geographic areas that could be used consistently from year to year.

## Results

[Table 1](#) shows the mid-2009 estimates of the resident populations in each PCT ([Office for National Statistics, 2010](#)). PCT populations in 2009 covered a more than ten-fold range, from 90,000 to 1,289,000, with a mean of 340,000.

[Table 1](#) also shows the number of patients included in the analyses for each PCT. Of the 3,029,997 patients who were eligible for analysis, 3.9% were excluded because the cancer was only registered from a death certificate (DCO) and the survival time was therefore unknown. A further

0.3% were excluded because their vital status (whether alive, emigrated, dead or not traced) at 31 December 2011 was unknown, or because of duplicate registration, or an invalid sequence of dates, or because the patient could not be attributed to a PCT of residence at diagnosis. Patients with zero survival time (2% of all patients) were included in the analyses, and one day was added to their survival time. In all, 2,650,578 patients were included in the analyses.

The estimates of the one-year survival index for all cancers combined are presented for each of the 151 PCTs in England and for each of the years 1996–2010, for all adults (15–99 years; [Table 2](#)), for patients aged 55–64 years ([Table 3](#)) and for patients aged 75–99 years ([Table 4](#)).

## Commentary

For patients diagnosed in 2010, the one-year survival index in England for all cancers combined and for all ages was 67.7%. This reflects a steady, continuing increase over the last 15 years, from the value of 59.7% for 1996. For patients aged 55–64 years at diagnosis, the index increased from 66.7% in 1996 to 75.5% for patients diagnosed in 2010. The corresponding change for patients aged 75–99 years, the index rose from 47.3 in 1996 to 54.8 for patients diagnosed in 2010.

For individual primary care trusts, the trends are generally similar to the overall national pattern, but the range of the survival index between PCTs is quite wide, from 51.2% to 64.3% in 1996 to 60.5% to 73.0% in 2010.

The north-south gradient in one-year survival is a persistent feature of these data, although it has reduced somewhat between 1996 and 2010. Among PCTs in London, the one-year survival index is persistently lower in the north east of the city, although again, the differences are less marked than 15 years ago.

Caution is required in interpretation of this overall index of short-term cancer survival for PCTs. The index does not reflect the prospects of one-year survival for any individual cancer patient. It should not be interpreted as if it were the only possible indicator of performance, but in conjunction with other information available to the PCT. It should be seen as a guide, to raise questions about the potential for improvement. The index is designed for use as a tool for public health management of cancer care, both at local and at national level.

The index nevertheless provides a convenient, single number that summarises the overall patterns of cancer survival in each PCT, in each calendar year, for men and women, young and old, and for a wide range of cancers with very disparate survival. Survival for most cancers is either stable or rising steadily from year to year (Rachet et al, 2009).

This trend is reflected in the values of the index in the tables, but the patterns of cancer occurrence by age, sex and type of cancer can shift quite quickly over time, especially in small areas. The survival index is designed to reflect real progress by providing a summary measure of cancer survival that adjusts for any such shifts. In short, the index is intended to change only if cancer survival itself actually changes. It is designed for long-term monitoring of progress in overall cancer survival.

## Notes on methodology

The approach adopted to compute the index can be seen as an extension of conventional standardisation by age to include both sex and the type of cancer.

We have avoided ranking PCTs from the highest to the lowest on the basis of their survival index in any given year, because:

- The goal is to provide local information to support long-term improvements in cancer control.
- If the highest value of the index is (say) 65% and the lowest is 50% (a 15% difference), then with 151 PCTs, a difference of just 1% in the value of the index can mean that the rank of a PCT may change by 10, and by 30 or more in the middle of the range, where differences in the value of the index are very small.
- The lowest values of the index in a ranked bar-chart for a given year are not necessarily significantly different from what might be expected, because a bar-chart does not take account of the precision of individual estimates.
- Some year-to-year fluctuation of the index must be expected due to chance alone: if a low value for 2010 (say) were the only outlying value for a given PCT in 15 years, and there was no trend for the index in that PCT to fall progressively below the national average, then the low value in 2010 might simply represent random fluctuation.
- Trends also matter. A smaller PCT for which the tables show that the survival index is consistently lower than average should be considering why survival in its area might be low.

## Additional Information

Funnel plots and smoothed maps for the cancer survival index by PCT will be released in early 2013. Funnel plots show how the values of the cancer survival index in each PCT differ from the national average. The smoothed maps provide a strategic overview of national geographic patterns in survival and how they change over time.

Further information about cancer survival estimates published by the Office for National Statistics (ONS) can be found in the [Cancer Survival Quality and Methodology Information paper](#). Quality and Methodology Information papers are overview notes which pull together key qualitative information on the various dimensions of the quality of statistics as well as providing a summary of the methods used to compile the output. Information about key users of these statistics is also provided.

The [Scottish Cancer Registry](#) produces statistics on cancer in Scotland.

Statistics on cancer in Wales are produced by the [Welsh Cancer Intelligence and Surveillance Unit](#).

The [Northern Ireland Cancer Registry](#) produces statistics on cancer in Northern Ireland.

PCTs are being replaced in 2013 by Clinical Commissioning Groups (CCGs). Methodological work is currently being undertaken by London School of Hygiene and Tropical Medicine to develop composite survival indicators at CCG level. We anticipate that this work will be completed in time for the publication of survival estimates in December 2013.

## Users and uses

Key users of cancer survival estimates include the Department of Health, academics and researchers, cancer charities, cancer registries, other government organisations, researchers within ONS, the media, and the general public. The Department of Health uses cancer survival figures to brief parliamentary ministers, and as part of the evidence base to inform cancer policy and programmes, for example in drives to improve survival rates.

Cancer survival estimates will also be used to measure progress against [NHS Outcomes Framework](#) indicators. Academics and researchers use the figures to inform their own research. Similarly cancer registries and other government organisations use the figures to carry out individual and collaborative projects to apply subject knowledge to practice.

Charities use the data so they can provide reliable and accessible information about cancer to a wide range of groups, including patients and health professionals via health awareness campaigns and cancer information leaflets/web pages. Researchers within ONS use the data to support further research and to publish alongside other National Statistics.

## Policy Context

In '[Improving Outcomes: A Strategy for Cancer](#)' (January 2011), the Department of Health stated that although improvements have been made in the quality of cancer services in England, a significant gap remains in survival compared with the European average.

Survival estimates for cervical, colorectal and breast cancer are among some of the lowest among Member States of the Organisation for Economic Co-operation and Development (OECD). The strategy document sets out how the Department of Health aims to improve outcomes for all cancer patients and improve cancer survival, with the aim of saving an additional 5,000 lives every year by 2014/15.

Outcomes strategies set out how the NHS, public health and social care services will contribute to the ambitions for progress agreed with the Secretary of State in each of the high-level outcomes frameworks. The indicators set for the [NHS Outcomes Framework 2013 to 2014 – focus on measuring health outcomes](#) include one- and five-year cancer survival indicators for all cancers combined, and for colorectal, breast and lung cancers combined.

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## Acknowledgement

We are grateful to many persons without whom this work would not have been possible. The continuing efforts of regional cancer registries in England to collect data on all cancer patients to the highest standards of quality and completeness are crucial. The Office for National Statistics collates these data, performs additional quality control and links them to information about each patient's vital status in the National Cancer Registry.

## Background notes

1. Data were obtained from the National Cancer Registry at the Office for National Statistics (ONS), which has collated data from regional cancer registries covering the entire population of England since the 1960s. Each year, more than 200,000 patients are newly diagnosed with cancer in England. The National Health Service Central Register routinely updates these individual cancer records with information on each patient's vital status (alive, emigrated, dead or not traced). Data were extracted from the National Cancer Registry on 18 May 2012 for patients diagnosed during 1996–2010: the vital status at 31 December 2011 was known for 99% of these patients.
2. All adults (15–99 years) who were diagnosed with a first, primary, invasive malignancy were eligible for inclusion. Patients diagnosed with malignancy of the skin other than melanoma were excluded. Cancer of the prostate was also excluded, because the widespread introduction of prostate-specific antigen (PSA) testing since the early 1990s has led to difficulty in the interpretation of survival trends ([Pashayan et al., 2006](#)).
3. Cancers were defined by codes in the International Classification of Diseases, Tenth Revision (ICD-10) and International Classification of Diseases for Oncology, Second Edition (ICD-O-2) (Ashley, 1990; World Health Organisation, 1990).
4. The results presented here are for the PCT boundaries defined in April 2011, when the last changes occurred ([Office for National Statistics, 2011](#)). To achieve consistency over time in the geographic units of analysis, we applied the PCT boundaries for 2011 to data for cancer patients diagnosed over the entire period 1996–2010. Cancer patients were assigned to a Census Enumeration District (ED, up to 2000) or Census Output Area (OA, from 2001) using their postcode of residence at diagnosis and a combined historic postcode directory covering the entire period 1996–2010. Patients were then assigned to a primary care trust on the basis of their ED or OA of residence, using the National Statistics Postcode Directory, available from the Office for National Statistics (Geography).
5. A PCT cannot be responsible for trends in cancer outcomes that pre-date its existence, but we reasoned that it would still be useful for PCTs to have a long time series of outcome measures for patients who were resident within their current boundaries at the time of diagnosis, as an up-to-date guide for policy-making at a local level.
6. Net survival in a population of cancer patients is their survival from the cancer of interest in the absence of other causes of death. It was estimated at one year after diagnosis for each cancer, sex and year or period of diagnosis. Net survival was estimated with an excess hazard model

in which the all-cause mortality is modelled as the sum of the excess (cancer-related) mortality hazard and the expected (or background) mortality. The background mortality is defined by life tables from the general population.

This approach enables population-level cancer survival to be estimated in the absence of detailed data on the cause of death. To obtain an unbiased estimation of net survival, age needs to be carefully modelled to account for the informative censoring associated with age (Danieli et al., 2011). We used flexible parametric models (Royston & Parmar, 2002; Lambert & Royston, 2009) with age and year of diagnosis as main effects and an interaction between age and year of diagnosis.

We also examined interactions between year and follow-up time and between age and follow-up time to deal with potential non-proportionality of the excess hazards over time since diagnosis. The Akaike Information Criterion (AIC) (Akaike, 1974) was used to select the best-fitting statistical model using the relative goodness of fit.

7. The publicly available program, *stpm2*, was used to estimate net survival (Lambert & Royston, 2009). Analyses were performed in Stata 12 (StataCorp, 2006).
8. Life tables were constructed for the years 1996, 2001, and 2009 using the mid-year population estimates and the mean annual number of deaths in the three years centred on those index years ([Cancer Research UK Cancer Survival Group, 2004](#)). Life tables for each year from 1996 to 2009 were created by linear interpolation.

The life table for 2009 was used for 2010–11. Background mortality changes with time and varies by sex, age, socio-economic status and region, so life tables were created by single year of age, sex, region and deprivation quintile for each calendar year of death. National life tables were used for the very small number of patients with missing region, and regional life tables for those with missing deprivation category.

9. Net survival was initially estimated at one year after diagnosis for cancers of the breast (women), colon and rectum combined and lung. There were 1,296,483 patients diagnosed with these cancers, constituting 51% of all patients included in analyses. Survival for all other cancers combined was estimated as a single category. For each PCT and sex, net survival was estimated for each of five age groups at diagnosis (15–44, 45–54, 55–64, 65–74 and 75–99 years) and each calendar year, using a model that included age and year of diagnosis. The survival index was then constructed as a weighted average of the net survival estimates for each type of cancer, each sex and each age group (see Background Note 10).
10. To make figures from the past comparable with those for today and in the future, it is necessary to adjust an all-cancers survival index for changes over time in the profile of cancer patients by age, sex and the type of cancer within each PCT. This is because survival varies widely with all three factors. Overall cancer survival in a given PCT can change simply because the profile of its cancer patients changes, even if survival at each age, for each cancer and in each sex has not changed.



For each PCT, this adjustment was made by using a weighted average of all the cancer survival estimates for each age, sex and cancer, using the proportions of cancer patients diagnosed in England and Wales during 1996–99 in each age group, sex and type of cancer as the standard weights. All values of the cancer survival index in that PCT, past and future, are adjusted using the same standard weights. This means that the cancer survival index is not affected by changes over time in the proportion of cancers of different lethality in either sex – for example a reduction of lung cancer or an increase in breast cancer. Similarly, the index will be unaffected by ageing of the cancer patient population, or a shift in the proportion of a given type of cancer between men and women.

11. Age-sex-cancer-standardisation relies on having an estimate of survival for each combination of age, sex and cancer. It is not always possible to obtain net survival estimates for each of these combinations for each calendar year of diagnosis in geographic units with small populations, because of the limited number of cases. In this situation, which affected 4% of estimates, the missing value was replaced the estimate for the subsequent age group for a particular cancer-sex combination or by the equivalent value for England.
12. PCTs are being replaced in 2013 by Clinical Commissioning Groups (CCGs). Methodological work is currently being undertaken by London School of Hygiene and Tropical Medicine to develop composite survival indicators at CCG level. We anticipate that this work will be completed in time for the publication of survival estimates in December 2013.
13. A list of the names of those given pre-publication access to the statistics and written commentary is available in [Pre-release Access List: Index of Cancer Survival by Primary Care Trusts in England: Patients diagnosed 1996-2010 and followed up to 2011 \(33.6 Kb Pdf\)](#). The rules and principles which govern pre-release access are featured within the [Pre-release Access to Official Statistics Order 2008](#).
14. Special extracts and tabulations of cancer data for England are available to order for a charge (subject to legal frameworks, disclosure control, resources and agreement of costs, where appropriate). Such enquiries should be made to:

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The [ONS Charging Policy](#) is available on the ONS website.

15. We welcome feedback from users on the content, format and relevance of this release. [The Health and Life Events User Engagement Strategy and Plan](#) is available to download from the ONS website.
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### 21. Issued by:

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