Cancer research spend in the UK 2002–2011

An overview of the research funded by NCRI Partners

Partners in cancer research
NCRI Partners
Cancer research spend in the UK 2002–2011
An overview of the research funded by NCRI Partners
NCRI collects data on the cancer research funded by its 21 cancer research funding Partners annually and records it in the NCRI Cancer Research Database. The data collected includes award title and abstract, principal investigator, host institution and financial information, allowing analysis of spend by, for example NCRI Partner, research category or cancer site. This report provides an analysis of the data relating to cancer research between 2002 and 2011 inclusive.

Up to 2011 the database included just under 11,000 unique awards and £4bn of peer-reviewed cancer research spend. Key findings from the report include:

- A 62% real terms increase in spend on cancer research over the ten year period
- A levelling off in recent years reflecting a more austere financial environment which appears to be affecting government and charity sectors to a similar degree
- Consistent strengths in research in Biology and Treatment
- Consistent relative weaknesses in research in Prevention and Cancer Control, Survivorship and Outcomes Research
- The top nine cities according to spend are unchanged between 2002 and 2011
- Over half of all research spend is in Cambridge, Oxford and London
- An increase from 22.1% to 29.6% over the ten years in the proportion of investment which goes on Resources and Infrastructure, such as, research centres, clinical trial units and biobanks, as opposed to discreet defined research projects
- While funding by government Partners overall comprises only 40% of the total portfolio, they tend to support a higher proportion of research that is directly applicable to cancer patients and to public health
- Sixty percent of the portfolio is consistently non-site specific and potentially applicable to all cancers
- Of the site specific spend, the amount spent on the four commonest cancers (breast, lung, colon and rectal and prostate) has consistently accounted for 41-44% of the portfolio
- Significant increases, above the 62% inflation-adjusted average, have been seen in research on Prevention and in relation to lung, brain, oesophageal and pancreatic cancers.

All started from a low base and remain less well-funded than some other areas. The database has enabled the NCRI and the research community to understand gaps and relative weaknesses in the portfolio. During the decade the NCRI has undertaken initiatives in cancer prevention and lung cancer to address such gaps. These two areas have seen increased spend above the average and out of proportion to the direct effect of NCRI initiatives and it may be that raising awareness of the need has itself had an effect on the research community. The NCRI has more recently developed initiatives to increase the amount of research in surgery and radiotherapy and will continue to monitor the database to identify the impact from these initiatives.

Our analysis identified a significant increase in investment in Resources and Infrastructure over the decade. This increase reflects the growth of clinical research networks and Experimental Cancer Medicine Centres (ECMC) and the investment of NCRI Partners into strategic infrastructural initiatives, for example, the Cancer Research UK Centres and National Institute for Health Research (NIHR) Biomedical Research Centres (BRCs).

Since its inception, the NCRI has been a partner in the International Cancer Research Partnership (ICRP) an international group of cancer research funders who share portfolio data in a similar format to the NCRI Cancer Research Database. NCRI is also promoting portfolio analysis through an EU-funded initiative in translational cancer research (TRANSCAN). It is hoped that this will lead to more European funders joining ICRP and sharing portfolio data thereby giving further information on relative strengths and weaknesses in research internationally and enabling further cross-country comparisons.

The data collected from ICRP members (including individual NCRI partners) is available online and for each award includes details of the award title and abstract, principal investigator, host institution and the research category and cancer site which have been assigned to it. ICRP members are also able to access the associated financial information. In parallel the NCRI publishes a data package containing aggregate financial information across research categories and cancer sites. This can be accessed from the NCRI website.
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1. Introduction

1.1 The National Cancer Research Institute

The National Cancer Research Institute (NCRI) is a UK-wide partnership between government, charity and industry which promotes co-operation in cancer research for the benefit of patients, the public and the scientific community. The government and charity Partners each spend at least £1m per annum on cancer research in the UK and the current membership is shown in Appendix 1.

In fulfilment of its role the NCRI undertakes a number of core activities including organising the annual NCRI Cancer Conference, coordinating and developing clinical research portfolios through the NCRI Clinical Studies Groups and collecting and analysing NCRI Partner cancer research funding data through the NCRI Cancer Research Database. It also runs a number of topic-specific initiatives, details of which can be found on the NCRI website.1

Alongside its national remit, the NCRI represents the UK cancer research funding community on the international stage in various EU initiatives and as a member of the International Cancer Research Partnership (ICRP).2 The ICRP aims to enhance global collaboration and strategic coordination of cancer research, through sharing of best practice and research portfolio data across as many countries as possible.

1.2 The NCRI Cancer Research Database

The NCRI Cancer Research Database provides an annual record of the cancer research funded by NCRI Partner organisations in the government and charity sectors. In 2002 the NCRI undertook the first analysis of cancer research funding to provide the Partners with a greater understanding of the landscape in the UK, leading to the publication: The NCRI Strategic Analysis 2002.3

The earlier report showed research spend by research category, cancer site and geographical area, and highlighted relative strengths and weaknesses within the UK cancer research portfolio. This knowledge enabled NCRI Partners to identify key areas of research which would benefit from a collaborative approach to funding.

Annual collection of NCRI Partner research funding data continues, and up to 2011, the NCRI Cancer Research Database included just under 11,000 unique awards and has recorded over £4bn of UK funded cancer research. The present analysis examines trends over the first ten years of data collected for the years 2002-2011 inclusive.

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1 www.ncri.org.uk (last accessed September 2013).
2 https://www.icrpartnership.org/ (last accessed September 2013).
2. Methodology

2.1 Scope and inclusion criteria

The NCRI Cancer Research Database records the peer-reviewed cancer research funded by NCRI Partner organisations in the government and charity sectors. Every year, Partners submit information for each cancer-relevant grant or other award that is in progress on 1 April of that year: The data includes award title and abstract, name of the principal investigator, host institution, start and end dates, and financial value. In this way we create a ‘snapshot’ of work in progress on the census date of 1 April, and it should be noted that this is not the same as actual expenditure over any given 12-month period. The ability to capture data at the individual project or programme level is a distinctive feature of this approach and is necessary for the analysis that follows.

The database records direct spend on cancer research and spend on resources and infrastructure that directly support or enable specific areas of cancer research. Exclusions include the purchase of land or buildings for the purposes of research, the building or refurbishment of laboratories, the costs of attending or holding scientific meetings, conferences or training courses, and projects focussed on policy or advocacy which do not have a research component. Such exclusions, and the different reporting periods (calendar year or financial year versus snapshot), mean that NCRI figures for research spend may differ from some of those published by Partner organisations themselves.

The database also excludes the underpinning costs provided to universities by the four funding councils of the UK, or in hospitals by the NHS. In general charities do not provide any overhead costs in association with their grants and other awards. Government bodies do provide some overhead costs although this falls short of the full economic cost, and the formula for calculation was changed in 2005. It should therefore be borne in mind that there is an inherent inconsistency in the data in this regard. Nevertheless, the analysis does provide a picture of how Partners spent their available research funds over the ten year period.

Partners are asked to submit data on all awards that have some relevance to cancer. For organisations that only fund research on cancer this will usually be their whole portfolio and the full financial value of each project is included in the database.

More generic funders of research may submit any award they consider to be potentially relevant and the NCRI Secretariat will determine, according the strict criteria set out by the Coding Panel, whether the award should be included in the database. Some projects or programmes have only a partial relevance to cancer, these are included although the value will be calculated at the fraction estimated to be attributable to cancer. For example, for a general project on palliative care, 25% of the cost would be included, since approximately 25% of deaths are due to cancer in the UK. While such conventions may be imprecise, they do enable comparisons to be made between funders, or over time, when consistently applied.

2.2 Coding the awards

Each research award within the NCRI Cancer Research Database is individually coded using two classification systems - the Common Scientific Outline (CSO) to define research category and NCRI Cancer Site codes to define the cancer site(s) of focus.

The CSO was created by the USA National Cancer Institute (NCI) to analyse their cancer research portfolio and is now used by over 60 members of the ICRP. The CSO is organised into seven broad cancer research categories: Biology; Aetiology; Prevention; Early Detection, Diagnosis and Prognosis; Treatment; Cancer Control, Survivorship and Outcomes Research and Scientific Model Systems. Within the seven major codes, there are a total of 38 sub-codes with which to classify the research. The CSO coding system is more fully described in Appendix 2.

The NCRI Cancer Site coding system consists of a list of 48 different primary cancer sites within the body to which research spend can be assigned, and a code for Primary of Unknown Origin. For practical reasons the NCRI code differs slightly from the list used by ICRP, although this does not preclude international analysis. There are two further codes for research which is relevant to ‘all sites’, and that which is ‘fundamental’, jointly referred to as ‘non-site specific’ research in this report. Some awards are relevant to a particular subset of cancer sites. Examples include paediatric cancer or the cancer risk associated with smoking. For these awards a ‘roll-up code’ is devised. When the code is assigned, it acts as an algorithm to apportion costs appropriately across the relevant NCRI Cancer Site codes in each case. Each roll-up code is based on available statistical data, for example, relating to the relative incidence of different cancers in childhood, in the case of paediatric cancer awards. The NCRI Cancer
Site codes and roll-up codes are more fully described in Appendix 3.

Each individual award within the NCRI Cancer Research Database is assigned to one or more CSO sub-codes and NCRI Cancer Site codes, as relevant. Codes are determined on the basis of the information provided in the award title and abstract in each case.

### 2.3 Financial information

The following analysis requires that care be taken to avoid double-counting of any costs within the NCRI Cancer Research Database. Where necessary, the cost of each award is split across the number of CSO sub-codes assigned, and additionally across the assigned NCRI Cancer Site codes. Percentages are judged by the coders as best as possible based on information in the award title and abstract. Where an award is jointly funded, costs are apportioned across all funders and any support from non-NCRI Partners is excluded from the database.

This approach means that the database can be searched on any data field (e.g., research category, NCRI Cancer Site code and/or NCRI Partner) to obtain a figure for spend in a given year. Care is needed in interpretation, particularly where the breakdown leads to small numbers, i.e., at a low percentage of the total spend. Figures for site specific funding may also not be fully representative bearing in mind that 60% of the portfolio is potentially applicable to all cancer sites.

Spend in any given year is recorded in line with monetary value in that year. For instance the spend recorded in the 2003 dataset is given in ‘2003 pound sterling’. This spend may be referred to as the ‘cash spend’. In order to look at trends over ten years we have adjusted for inflation using the ‘GDP-deflator’, this being the inflation index used by the government Partners within NCRI. Inflation-adjusted spend is referred to as ‘real-terms spend’. Figures quoted in this report refer to real-terms spend, based on 2011/12 financial year pound sterling equivalent levels, unless otherwise stated. The complete list of cash spend figures along with the inflation adjustment figures are available on the NCRI website.

### 2.4 Quality assurance

Each award within the database is independently coded by two trained coders principally from among the staff of the NCRI Secretariat and NCRI Partner organisations. Where two coders do not apply the same codes to an award it is referred to a third coder for a final decision. Advice may also be sought from the Coding Panel consisting of some of the most experienced coders from the NCRI Secretariat, NCRI Partner organisations and an ICRP representative. The Coding Panel remit is to make a final decision on any coding divergence and to share best practice in coding to ensure consistency across all coders and from year to year.

At the end of the coding process each year, each Partner checks and signs off their organisation’s portfolio after which the dataset is considered complete and closed for that year. No further alterations are permitted even if errors are discovered subsequently. This ensures that the same data for year is always included in analyses, which may be performed over a period of years.

In 2011, the ICRP undertook a statistical analysis of 2,500 awards coded to a single CSO sub-code from 2005-2008 to measure coding consistency. The sample dataset used included awards coded by the NCRI and subsequently uploaded to the ICRP database. The sample was split between six different coders, including two NCRI coders, to blind code. The results from this analysis indicate that there is a high degree of consistency in the codes assigned to awards across the ICRP database.

The ICRP acts as the custodian for the CSO coding system, updating it when necessary to take account of new scientific developments and providing advice and training to new users.

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4 An award may be assigned up to seven different CSO sub-codes and up to 11 different NCRI Cancer Site codes, although more commonly only one or two are assigned in each case.


8 The inter-rater reliability co-efficient, known as Cohen’s Kappa, showed that agreement between coders for major CSO codes was ‘very good’ (0.817) and agreement by CSO sub-code was ‘good’ (0.649).
### 3. Overview of spend

#### 3.1 Total spend by NCRI Partners

The cash spend by NCRI Partners has increased from £257m in 2002, to £521m in 2011. This represents a doubling in cash terms over ten years *(Figure 1)*. Following adjustment for inflation, the increase is 62% in real terms *(Figure 2)*. Figure 2 also shows that growth was steady from 2002 to 2008 and is only partly accounted for by new Partners joining NCRI. Investment has not changed significantly during the four years 2008-2011 inclusive and this may, at least in part, reflect the global financial downturn in 2008.

In looking at the breakdown of spend in specific areas of cancer research it is possible that some trends will be masked by the overall increase of 62%. For this reason, we also present data in terms of the percentage of the portfolio that falls into a given category, such as a CSO code.

#### 3.2 Spend by location

Over the ten year period, over 80% of cancer research funding has been spent in England with smaller portions in Scotland, Wales and Northern Ireland *(Figure 3)*.

Scotland consistently attracts a higher portion of funding per head of population than the other countries while Wales and Northern Ireland attract less than the average for the UK *(Table 1)*. Northern Ireland now attracts more than four times as much investment as in 2002 which in part reflects the setting up and development of the Centre for Cancer Research and Cell Biology at Queen’s University Belfast. Investment per head in Wales has also grown more than the national average while that in England and Scotland has grown by a little lower than the average.

Spend outside the UK has shown a high proportionate increase from £1.8m to £9.1m over the ten years. Most of the overseas funding is awarded by Association for International Cancer Research and there has also been a more recent increase in investment in cancer research outside the UK by The Wellcome Trust. Other NCRI Partners who regularly support research outside the UK are, Breast Cancer Campaign, Cancer Research UK, Children with Cancer UK, Leukaemia & Lymphoma Research, and the Medical Research Council.

Analysis of total spend by city shows that during the decade somewhat over half of the total investment in the UK has been within the ‘Golden Triangle’ of London, Cambridge and Oxford (55.5% in 2002 and 56.4% in 2011). This is very much in line with the figure of 55.7% which the UK Clinical Research Collaboration (UKCRC) found in their analysis of all UK health research in 2009/10.

The top nine cities have remained unchanged although their rank order has changed a little *(Figure 4)*. These cities consistently account for around 85% of UK spend. Leeds has more prominence than might be expected because the whole of the budget for the National Institute for Health Research (NIHR) Cancer Research Network is administered through the University of Leeds, prior to distribution England-wide. Increases in some cities can be linked to known new investments; for example investment in Cambridge, where Cancer Research UK opened a new institute in 2007, has grown from £35.4m to £71.4m which is an increase of 101.5% i.e. somewhat in excess of the average of 62%.

#### Table 1: Spend per head of population, 2002 and 2011, and increase across the decade

<table>
<thead>
<tr>
<th>Country</th>
<th>Spend per head of population 2002</th>
<th>Spend per head of population 2011</th>
<th>Increase in spend per head of population</th>
</tr>
</thead>
<tbody>
<tr>
<td>Northern Ireland</td>
<td>£0.94</td>
<td>£3.73</td>
<td>295.6%</td>
</tr>
<tr>
<td>Wales</td>
<td>£1.58</td>
<td>£3.15</td>
<td>99.6%</td>
</tr>
<tr>
<td>Scotland</td>
<td>£8.26</td>
<td>£12.40</td>
<td>50.1%</td>
</tr>
<tr>
<td>England</td>
<td>£5.52</td>
<td>£8.12</td>
<td>47.0%</td>
</tr>
<tr>
<td>UK</td>
<td>£5.46</td>
<td>£8.25</td>
<td>51.1%</td>
</tr>
</tbody>
</table>


Among the less-generously funded cities, there have been some substantial proportionate increases. For example investment in both Belfast and Liverpool has increased more than 4-fold. Because the figures are small, the impact on the overall picture is not significant although such increases are important achievements for those cities themselves.

Within Scotland over 90% of the total spend occurs in Edinburgh, Glasgow and Dundee. Research within these three cities consistently accounts for 12-14% of total spend by NCRI Partner organisations. The UKCRC spend figure for these three cities is 10.2%.

### 3.3 Spend by government and charity Partners

Charity Partners account for approximately 60% of the total research spend with government Partners accounting for the remaining 40%. This 60:40 ratio has remained stable over the ten years of data collection (Figure 5).

The consistency of this split over time suggests that the factors affecting the early growth and later levelling of the total spend over the ten year period have been experienced similarly in the two sectors, in spite of their very different methods of income generation. These data also suggest that the charity sector in the UK is much stronger in relation to government than in the USA or Canada\(^\text{11}\) while a survey of European countries published in 2006 showed investment from government and charity sectors to about equal.\(^\text{12}\) However, as noted in the Methodology section, some government investment in infrastructure in the universities and NHS is not captured by NCRI. Organisations in other countries may operate to a different funding model making direct comparisons difficult to interpret.

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Figure 1: Cash spend on cancer research by NCRI Partners (£m)

Figure 2: Real terms spend on cancer research by NCRI Partners (£m)
Figure 3: Spend, in 2002 and 2011, in the four nations of the UK and internationally

<table>
<thead>
<tr>
<th>Nation</th>
<th>2002</th>
<th>2011</th>
<th>Proportion of total UK spend</th>
</tr>
</thead>
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<tr>
<td>Scotland</td>
<td></td>
<td></td>
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<tr>
<td>Spend</td>
<td>£41,816,270</td>
<td>£65,642,825</td>
<td>13.0%</td>
</tr>
<tr>
<td>Northern Ireland</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Spend</td>
<td>£1,588,556</td>
<td>£6,753,466</td>
<td>0.5%</td>
</tr>
<tr>
<td>England</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Spend</td>
<td>£271,332,848</td>
<td>£430,282,214</td>
<td>84.5%</td>
</tr>
<tr>
<td>Wales</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Spend</td>
<td>£4,581,266</td>
<td>£9,650,849</td>
<td>1.4%</td>
</tr>
<tr>
<td>International</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Spend</td>
<td>£1,842,645</td>
<td>£9,084,393</td>
<td>0.6%</td>
</tr>
</tbody>
</table>
Figure 4: Cities of the UK with the greatest spend in 2002 and 2011

Map showing the nine UK cities with the greatest spend in 2002 and 2011. Together these cities comprise 85.4% and 83.1% of total spend in 2002 and 2011, respectively.

<table>
<thead>
<tr>
<th>City</th>
<th>2002 Spend</th>
<th>2011 Spend</th>
<th>Proportion of total UK spend 2002</th>
<th>Proportion of total UK spend 2011</th>
</tr>
</thead>
<tbody>
<tr>
<td>Glasgow</td>
<td>£15,923,211</td>
<td>£21,843,454</td>
<td>5.0%</td>
<td>4.3%</td>
</tr>
<tr>
<td>Edinburgh</td>
<td>£14,764,917</td>
<td>£25,952,488</td>
<td>11.1%</td>
<td>13.9%</td>
</tr>
<tr>
<td>Dundee</td>
<td>£9,408,394</td>
<td>£13,945,289</td>
<td>2.9%</td>
<td>2.7%</td>
</tr>
<tr>
<td>Manchester</td>
<td>£16,669,480</td>
<td>£28,546,658</td>
<td>5.2%</td>
<td>5.6%</td>
</tr>
<tr>
<td>Oxford</td>
<td>£23,466,441</td>
<td>£43,470,632</td>
<td>7.3%</td>
<td>8.5%</td>
</tr>
<tr>
<td>London</td>
<td>£118,393,419</td>
<td>£174,252,001</td>
<td>37.1%</td>
<td>34.0%</td>
</tr>
<tr>
<td>Birmingham</td>
<td>£9,155,493</td>
<td>£13,573,096</td>
<td>2.9%</td>
<td>2.6%</td>
</tr>
<tr>
<td>Leeds</td>
<td>£29,342,064</td>
<td>£32,754,833</td>
<td>9.2%</td>
<td>6.4%</td>
</tr>
<tr>
<td>Cambridge</td>
<td>£34,439,508</td>
<td>£71,426,299</td>
<td>11.1%</td>
<td>13.9%</td>
</tr>
</tbody>
</table>
Figure 5: Relative spend of government and charity Partners

Cancer research spend in the UK 2002–2011
4. Spend by research category

4.1 Overview

Figures 6 a and b show the trends in the seven research categories over the ten year period. Because the portfolio as a whole has increased by 62%, the shapes of the curves differ depending on whether the plot shows spend in real terms or the percentage of the total portfolio falling within each CSO code. In examining individual codes in more detail below, it is sometimes more informative to look at spend and sometimes more interesting to look at trends in percentages.

4.2 Biology (CSO 1)

Spend in Biology rose from £131.7m in 2002 to a peak of £223.7m in 2008, dropping back a little over the subsequent two years to £204.8m in 2011. In terms of its share of the portfolio Biology was 41.0% in 2002, 43.2% in 2008 and 39.3% in 2011, dropping below 40% for the first time (Figures 6 a, b). The slight downward trend has continued in 2012 (data not shown). The dominant sub-code within Biology has been Normal Functioning (CSO 1.1) throughout. Although this dropped from 60.0% of total Biology to 43.0% between 2002 and 2005, it has remained consistently in the region of 45-50% since (Figures 7 a, b). The next three sub-categories (CSO 1.2, 1.3 and 1.4) which relate to cancer initiation, progression and metastasis make up about a further 40% of total Biology. Figures 7 c and d show a comparison between the ‘normal functioning’ sub-code and aggregated figures for the three cancer-related sub-codes. In 2002, investment in normal functioning was twice that in directly cancer-related biology. By 2005 the two areas had nearly converged and have paralleled each other since. Resources and Infrastructure (CSO 1.5) spend has ranged between 5 and 15% (Figures 7 a-d).

4.3 Aetiology (CSO 2)

Investment in Aetiology, the cause of cancer, has dropped from £52.7m in 2002 to £48.1m in 2011. The drop shows even more strongly in percentage terms where the fall is from 16.4% of the total portfolio to 9.2% (Figures 6 a, b). Breakdown into the four sub-codes provides no clues as to why this might be – in fact these figures show inconsistent spend from year to year, whether expressed in pound sterling or as a percentage of total Aetiology (Figures 8 a, b). Only when the sub-codes are aggregated does the smooth downward trend become apparent.

4.4 Prevention (CSO 3)

Prevention research has increased from £7.8m to £18.7m over the decade, a rise of over 100%, and its share of the portfolio has increased from 2.4% to 3.6% (Figures 6 a, b). Prevention research was highlighted as an area that was receiving relatively low investment in the NCRI Strategic Analysis 2002 report, and this led to the setting up of the National Prevention Research Initiative (NPRI) in 2004.13 Awards funded through the NPRI only account for a small portion of the increase in the Prevention category. This may suggest that the NPRI has helped in raising awareness of the need for prevention research more generally among NCRI Partners. Despite the significant rise in spend in pound sterling, at 3.6% Prevention research remains a minor component of the portfolio, and the drop in research in Aetiology might also mean that less work is being done which could lead to the development of new preventive measures.

Among the sub-codes of the Prevention category, the strongest and most consistent rise is in the one concerned with personal behaviours that affect cancer risk (CSO 3.1), this being the area tackled by the NPRI. The only other area showing a significant percentage increase over the period is Nutritional Science in Cancer Prevention (CSO 3.2) (Figures 9 a, b).

4.5 Early Detection, Diagnosis and Prognosis (CSO 4)

Investment in research in Early Detection, Diagnosis and Prognosis grew from £25.9m in 2002 to £65.9m in 2011. This represents an increase in the share of the portfolio from 8.1% to 12.6% (Figures 6 a, b).

The four sub-codes within the Early Detection, Diagnosis and Prognosis category cover Technology Development and Marker Discovery (CSO 4.1), Technology and Marker Evaluation (CSO 4.2), Technology and Marker Testing in a Clinical Setting (CSO 4.3) and finally Resources and Infrastructure Relating to Early Detection, Diagnosis and Prognosis. More than half of the increase in this research category as a whole is accounted for in terms of Resources and Infrastructure. Analysis at the individual award level shows that this increase in Resources and Infrastructure occurs from 2006 onwards and is largely due to awards relating to the Experimental Cancer Medicine Centres (ECMCs) and NIHR Biomedical Research Centres (BRCs) which in part support Early Detection, Diagnosis and Prognosis research (Figures 10 a, b).

Figure 6: Spend by research category

a: Spend by research category (£m). b: Spend by research category as a proportion of total spend (%).

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b:
Figure 7: Breakdown of spend in Biology (CSO 1)

a: Spend in Biology sub-codes (£m).

b: Spend in Biology sub-codes as a proportion of total spend in Biology (%).
Figure 7: Breakdown of spend in Biology (CSO 1) (contd.)
c: Spend in Normal Functioning (CSO 1.1) compared to sum of the spend in cancer-related Biology (CSO 1.2, 1.3 and 1.4) and Resources and Infrastructure (CSO 1.5) (£m). d: Spend in Normal Functioning (CSO 1.1) compared to sum of the spend in cancer-related Biology (CSO 1.2, 1.3 and 1.4) and Resources and Infrastructure (CSO 1.5) as a proportion of total spend in Biology (%).
Figure 8: Breakdown of spend in Aetiology (CSO 2)

a: Spend in Aetiology sub-codes (£m). b: Spend in Aetiology sub-codes as a proportion of total spend in Aetiology (%).
Figure 9: Breakdown of spend in Prevention (CSO 3)

a: Spend in Prevention sub-codes (£m). b: Spend in Prevention sub-codes as a proportion of total spend in Prevention (%).
Figure 10: Breakdown of spend in Early Detection, Diagnosis and Prognosis (CSO 4)

a: Spend in Early Detection, Diagnosis and Prognosis sub-codes (£m).  
b: Spend in Early Detection, Diagnosis and Prognosis sub-codes as a proportion of total spend in Early Detection, Diagnosis and Prognosis (%).
4.6 Treatment (CSO 5)

At a spend of just under £70m, this research category represented 21.7% of the portfolio in 2002 and has been increasing steadily over the decade up to 26.5% of the total portfolio (£137.9m) (Figures 6 a, b).

The breakdown into sub-codes shows two things in particular, the first of which is the predominance of research on systemic therapies (i.e. drug treatments) over research on more localised ones such as radiotherapy and surgery, this being evident over the whole ten year period (CSO 5.3 [in particular] and 5.4 versus CSO 5.1 and 5.2 respectively). The most obvious trend has been in spend on Resources and Infrastructure (CSO 5.7) which reflects the setting up and growth of cancer research networks and Cancer Research UK centres. More recently there has been investment in ECMCs throughout the UK and NIHR BRCs in England. The graph showing spend as a percentage of the total spend on Treatment shows that the increase in Resources and Infrastructure coincides with a reduction in direct funding for systemic therapies research (Figures 11 a, b).

4.7 Cancer Control, Survivorship and Outcomes Research (CSO 6)

The Cancer Control, Survivorship and Outcomes Research (CSO 6) category covers a broad range of topics including patient care, survivorship issues and end of life, tracking cancer cases through the population, beliefs and attitudes which affect behaviour, ethics, education and communication of patients and healthcare professionals and healthcare delivery. This research activity has shown an increase from £18.1m to £32.7m over the ten year period and the proportion of the portfolio has risen from 5.5% to 6.1%. Like prevention research, this area was highlighted as one needing further investment. While there has been an initiative in Supportive and Palliative Care and the National Cancer Intelligence Network is doing more work on outcomes, the positioning of this work in the portfolio has not improved to a great extent (Figures 6 a, b).

The Cancer Control, Survivorship and Outcomes Research category has no less than nine sub-codes – more than any of the other major codes and because of the low expenditure in total, it is not surprising that no significant trends are discernible in spend by sub-code (Figures 12 a, b).

4.8 Scientific Model Systems (CSO 7)

Research coded to this category has reduced from £15.2m in 2002 to £14.4m in 2011, and from 4.8% of the portfolio to 2.8%. This category differs from the other six in being focussed on the development and use of research tools or ‘scientific model systems’ as opposed to a distinct research type and thus analysis at the sub-code level is not informative. It has also come to be realised that projects currently coded to Scientific Model Systems could be accommodated among the other six research categories. Consideration is therefore being given for the future withdrawal of the Scientific Model Systems research category as part of an ICRP CSO review currently underway.

4.9 Resources and Infrastructure

Each of the seven major CSO categories has a sub-code for Resources and Infrastructure which includes, for example, core funding for research centres, clinical trial networks and biobanks.

Analysis of the total Resource and Infrastructure spend across the seven research categories shows that there has been an increase from £57m in 2002 to £154m in 2011. Resources and Infrastructure represented 22.1% of the total 2002 portfolio, rising to 29.6% in 2011 (Figures 13 a, b). For reasons mentioned in section 4.6 above, the largest area of increase is in relation to Resources and Infrastructure for Treatment research (Figure 13 c).

4.10 Government and charity Partner spend by research category

While 40% of the total portfolio is consistently attributable to government Partners, there are differences at the research category level. For example in 2002, overall government funding accounted for 61.8% of the investment in Prevention, and this increased to 73.1% in 2011. Government Partners also accounted for approximately 50% of the total spend in Cancer Control, Survivorship and Outcomes Research in 2002, rising to just over 55% in 2011 (Figures 14 a-h).

In contrast, the charity Partners consistently account for slightly greater than their average of 60% of the total spend in the areas of Biology, Aetiology and Treatment research (Figures 14 a-h).
**Figure 11: Breakdown of spend in Treatment (CSO 5)**

a: Spend in Treatment sub-codes (£m). b: Spend in Treatment sub-codes as a proportion of total spend in Treatment (%).
**Figure 12: Spend in Cancer Control, Survivorship, and Outcomes Research (CSO 6)**

a: Spend in Cancer Control, Survivorship, and Outcomes Research sub-codes (£m).  
b: Spend in Cancer Control, Survivorship, and Outcomes Research sub-codes as a proportion of total spend in Cancer Control, Survivorship, and Outcomes Research (%).

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Figure 13: Spend in Resources and Infrastructure

a: Total spend in Resources and Infrastructure sub-codes (£m). b: Total spend in Resources and Infrastructure sub-codes as a proportion of total spend (%). c: Spend in Resources and Infrastructure sub-codes (£m).
Figure 14: Relative spend of government and charity Partners by research category

The relative spend of government and charity Partners overall is shown in a. The relative amounts for each individual CSO category then follow in b-h. In b-h, the dashed line shows the comparison with the overall proportion in a.
The consistent pattern suggests that overall government Partners may feel a stronger impetus, in terms of the public good, to address areas of research more immediately applicable to patient care and public health. The trend over time may indicate that government Partners feel a duty to provide more support for areas that have been identified as relatively less well funded.

### 4.11 NCRI Partner spend by research category

Figure 15 highlights the different research funding profiles of NCRI Partners with respect to the balance between funding in different research categories. Some changes in the strategic direction of specific partners are evident from these profiles however the majority of funders fund in a similar manner to when they first joined NCRI. The government Partners are each focussed on specific parts of the research spectrum as can be seen when comparing the profile of the Biological and Biosciences Research Council versus that of the Medical Research Council (MRC), Economic and Social Research Council and the Health Departments of the four UK nations. In the case of charity Partners, a spectrum of research funding profiles can be seen reflecting the different strategic priorities of the organisations and the communities they serve.

### 4.12 Comparison of international spend by research category

A recent analysis of research spend by members of the ICRP, highlights the differences and similarities in the funding of cancer research within Canada (represented by members of the Canadian Cancer Research Alliance [CCRA]) and the National Institutes of Health (NIH), the major funder of cancer research in the USA.14

Like the NCRI portfolio, that of the CCRA shows strengths in funding research in Biology and Treatment, with relative weaknesses in Prevention and Cancer Control, Survivorship and Outcomes Research. The NIH, in contrast, has a strong emphasis on Treatment research, with lower levels of funding targeted to Biology research and higher levels to Prevention and Cancer Control, Survivorship and Outcomes Research (Figure 16).

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Figure 15: Spend by NCRI Partners in different research categories

The data are displayed as ‘kite diagrams’. In a kite diagram the sum of the areas above and below the line of origin represent the proportion of total spend of that Partner in that research category. For each NCRI Partner the 2011 kite diagram is shown in colour while the kite displayed as a line graph represents the earliest year in which the Partner’s data was included in the NCRI Cancer Research Database (see Appendix 1 for further details).

Proportion of total spend in 2011

- > 30%
- 8–30%
- 3–7%
- 1–2%
- <1%

- Association for International Cancer Research
- Biotechnology and Biological Sciences Research Council
- Breakthrough Breast Cancer
- Breast Cancer Campaign
- Cancer Research UK
- Chief Scientist Office - Scottish Executive
- Children with Cancer UK
- Department of Health
- Economic and Social Research Council
Cancer research spend in the UK 2002–2011
The data are displayed as ‘kite diagrams’. In a kite diagram the sum of the areas above and below the line of origin represent the proportion of total spend of that organisation in that research category. Data are recorded by calendar year in the ICRP database. The data in this figure represent spend in 2008. As the NCRI Cancer Research Database calculates spend by the 1 April snapshot model the spend associated with NCRI Partner awards is converted to calendar spend for inclusion in the ICRP database. This conversion means there are some small differences in the relative spend in different research categories for the NCRI Partnership as represented in the ICRP database versus the NCRI Cancer Research Database.
5. Spend by cancer site

5.1 Overview

Figure 17 shows that approximately 40% of all research within the NCRI Cancer Research Database can be ascribed to a particular cancer site, whilst the remaining 60% is non-site specific. These proportions have remained very steady over the ten year period. The fact that there are 49 site specific codes inevitably means that some codes have quite small sums of money associated with them. It is important in these cases to remember that 60% of the portfolio is generally applicable, covering areas ranging from basic biology to survivorship and end of life care, and likely to be of benefit to patients diagnosed with less common cancers.

5.2 Trends in spend on different cancer sites

The four major cancers in terms of incidence and mortality are breast, colon and rectal, lung and prostate.15,16 These four cancer sites have consistently represented approximately 41-44% of the total site specific spend recorded in the database over the decade (Figure 18).

Investment in all these cancers has shown an increase and in three cases this has been close to the overall growth in the portfolio of 62%. Breast cancer grew by slightly more (81.1%) while Colon and Rectal and Prostate cancer spend grew by slightly less (53.8% and 56.1% respectively) (Figures 19 a, b). However investment in Lung cancer grew 2.5-fold over the decade from £4.4m to £11.6m. Although there was a slight dip between 2010 and 2011, there has been a further significant rise to £14.6m in 2012 making the increase 3-fold over 11 years (data not shown). At the same time Lung cancer remains less well funded than the other three major cancers as Figures 19 a and b show.

Some other cancers which started the decade with a very low level of investment have also shown a large proportionate increase, albeit that actual investment is still relatively low. Thus Brain cancer has increased from £0.9 to £7.1m (although this dropped back to £4.9m in 2012), Oesophageal cancer from £1.5m to £6.5m and Pancreatic cancer from £1.5m to £5.1m. These cancers, together with Lung cancer, have poor outcomes compared to many other cancers and have been regarded as difficult to study for a variety of reasons. The publication of NCRI data on spend on these cancer sites has encouraged funders to think about how to boost high quality research in these areas, and while care is needed in the interpretation of small numbers, the trend is the right direction.

The cancer to show the largest decrease in investment is Cervical cancer, where spend has fallen from £4.7m to £3.8m over the decade. Amongst the better funded cancers, Leukaemia has grown by 42.9% from £22.7m in 2002 to £32.4m in 2011, well under the 62% rise seen in the database overall.

5.3 Patterns of spend within different cancer sites

The pattern of investment across the seven research categories varies considerably from one cancer site to another. We have shown data for the six most heavily funded cancer sites as numbers are too small in respect of the others. These are displayed as kite diagrams with figures for 2002 and 2011 superimposed to show shifts of emphasis over time (Figures 20 a-f).

One striking difference is that while there is almost no investment in Prevention research in respect of Prostate and Ovarian cancers and Leukaemia, it is significant in respect of Lung cancer and Colon and Rectal cancer. In these latter cases we have some strong clues as to how to prevent them, through smoking cessation and chemoprevention respectively. In the absence of such clues in respect of the other cancers, it is difficult to promote research. The modest amount of investment in preventing Breast cancer was mainly focussed on chemoprevention (especially with tamoxifen) in 2002, while in 2011 alongside chemoprevention studies a number of awards focussed on diet and alcohol consumption appear in the database.

Analysis suggests many cancer sites show a drop in Aetiology research over the decade, reflecting the portfolio as a whole and providing no further explanation for this observation. Colon and Rectal, Prostate and Lung cancer all reflect the overall increase in research on Early Detection, Diagnosis and Prognosis research while the relative level of support in this category was reduced in Breast and Ovarian

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Figure 17: Spend on site specific and non-site specific research as a proportion of total spend

Figure 18: Spend on the four most common cancers and on rare and less common cancers as a proportion of total site specific spend
Figure 19: Spend in the four most common cancers

a: Spend in the four most common cancers (£m). b: Spend in the four most common cancers as a proportion of site specific spend (%).
Figure 20: Relative spend by disease site in different research categories.

The data are displayed as ‘kite diagrams’. In a kite diagram the sum of the areas above and below the line of origin represent the proportion of total spend for that cancer site in that research category. For each Cancer Site (Breast, Lung, Colon and Rectal, Prostate, Leukaemia, Ovarian) the 2011 data are shown in colour while the 2002 data are shown as dashed lines.
cancer and saw no significant change in the case of Leukaemia. The relative increase in investment seen in this category in Prostate reflects the investment in Resources and Infrastructure. This was also seen in Lung cancer which also saw investment in a large screening trial. With the development of a national screening programme the strength in this research category in Colon and Rectal cancer reflects the influx of a number of screening-related awards in recent years.

5.4 Government and charity Partner spend by cancer site

The 60:40 split between charity and government funding in the portfolio as a whole has already been noted. When looking just at the 40% of funding which is cancer site specific, a similar ratio emerges although there is some variation within the range of 60-70% for charity funding. Looking at individual cancer sites, greater differences can be seen. For Breast cancer, 70-80% has been charity funded over the years, reflecting the existence of specific breast cancer charities which fund research and perhaps a more established patient lobby. Prostate and Colon and Rectal cancers are more heavily funded by government Partners than the average, while the pattern for Lung cancer is less consistent, although it looks like more of the increase referred to earlier has come from the government side (Figures 21 a-e).
Figure 21: Relative government and charity Partner spend as a proportion of site specific spend

The relative site specific spend of government and charity overall is shown in a. The relative amounts for individual Cancer Site codes then follow in b-e. In b-e, the dashed line shows the comparison with the overall proportion in a.
6. Discussion

6.1 Summary of observations

The NCRI Cancer Research Database provides valuable insight into how cancer research has developed in the UK over the first decade or so of the twenty-first century. It is likely that the bulk of non-commercial research which has been competitively awarded through peer review has been captured. Notwithstanding some limitations in the methodology described earlier, some clear observations have emerged. These include:

- A 62% real terms increase in spend on cancer research over the ten year period
- A levelling off in recent years reflecting a more austere financial environment which appears to be affecting government and charity sectors to a similar degree
- Consistent strengths in research in Biology and Treatment
- Consistent relative weaknesses in research in Prevention and Cancer Control, Survivorship and Outcomes Research
- The top nine cities according to spend are unchanged between 2002 and 2011
- Over half of all research spend is in Cambridge, Oxford and London
- An increase from 22.1% to 29.6% in the proportion of investment which goes on Resources and Infrastructure, such as, research centres, clinical trial units and biobanks, as opposed to discreet defined research projects
- While funding by government Partners overall comprises only 40% of the total portfolio, they tend to support a higher proportion of research that is directly applicable to cancer patients and to public health
- Sixty percent of the portfolio is consistently non-site specific and potentially applicable to all cancers
- Of the site specific spend, the amount spent on the four commonest cancers (breast, lung, colon and rectal and prostate) has consistently accounted for 41-44% of the portfolio
- Significant increases above the 62% average have been seen in research on Prevention and in relation to lung, brain, oesophageal and pancreatic cancers. All started from a low base and remain less well-funded than some other areas.

6.2 Understanding the trends

The 62% real terms increase in spend seen in the NCRI Cancer Research Database over the decade is encouraging and in line with that seen across medical research as a whole. An earlier UKCRC health research analysis report\(^ {17}\) showed an inflation adjusted increase in research spend of 50.0% between financial years 2004/05 and 2009/10 while the NCRI database showed a 42.3% increase over the same period.

Apart from the overall growth in the portfolio, such trends as are discernible are mostly small in comparison to the overall pattern of spend. This is not surprising as many lines of investigation require long-term investment, and grant-funding is usually committed for a number of years, with either three or five year allocations being typical. Since 2002 the NCRI Cancer Research Database has enabled the research community to understand gaps and relative weaknesses in the portfolio, and while initiatives have been set up in some of these areas, it frequently takes time to build up research in a field which is less well developed or below critical mass. It is not enough to have money available: there is also a need for relevant expertise, motivation in the research community, a perception that research questions are tractable and sometimes infrastructural needs such as biosamples or new methods. These factors add up to what is sometimes referred to as research capacity. Areas that need to be further developed are often those requiring a multidisciplinary approach and/or complex interventions: prevention and palliative care being two examples. This type of research tends to fare less well in fully open competition with other topics.\(^ {18}\) Now that there is a greater understanding of the need for an evidence base in such areas, more strategic funding initiatives are being undertaken. At the other end of the spectrum basic science thrives on open competition, and historically UK funders have focussed on supporting excellence defined in this way, with the result that we have a very strong basic science base in this country.

Investment in Resources and Infrastructure has grown from 22.1% of the portfolio to 29.6%. The largest single growth area within infrastructure has been in...
that relating to Treatment research, reflecting the growth of clinical research networks and ECMCs. Also some partners are putting more of their investment into strategic infrastructural initiatives, for example, the Cancer Research UK Centres and NIHR BRCs, both of which were started part way through the decade of our study.

Some trends are not so easy to interpret. For example, an examination of the Aetiology sub-codes does not identify any specific factor(s) responsible for reduction in investment in this area. The ICRP analysis shows that the portfolio in the USA also experienced a reduction in Aetiology research between 2005 and 2008, so this is not specific to the UK and may warrant some further analysis.\footnote{Cancer Research Funding from an International Perspective: Report from the International Cancer Research Partnership. 2012. Available from \url{https://www.icrpartnership.org/publications.cfm} (last accessed August 2013).}

6.3 Research on specific cancer sites

We find that 60% of the portfolio is consistently in the category of being potentially applicable to all cancers, and all analysis of cancer site specific work needs to be seen against this background. The 40% that is cancer site specific is further divided into 49 categories relating to different sites in the body and a category for cancers of unknown primary. This inevitably means that some categories contain very small numbers. Breast cancer and Leukaemia have long been particular strengths in the portfolio and this relates in part to issues of capacity mentioned earlier: cancer samples are relatively easy to obtain and biology and genetic studies are well-advanced in these areas. Such an established body of work paves the way for developing targeted therapies. There are also strong patient lobbies associated with these cancers, which has led to the formation of specialist charities with significant resources to spend on research.

6.4 Impact of initiatives

The point has already been made that it is not easy to expand a given research area quickly, especially if it starts from a low ebb. Over the last decade, NCRI has set up research initiatives on a range of topics, for example in prevention and lung cancer. These two areas have seen portfolio growth in excess of the average of 62%. Research in these areas has increased out of proportion to the direct effect of NCRI initiatives and it may be that raising awareness of the need has itself had an effect on the research community. Some other cancer types have also significantly increased their share of the portfolio, in particular cancers of the brain, pancreas and oesophagus, without there having been any special initiatives. Awareness-raising, by NCRI, individual partners, and charities outside of the NCRI Partnership could also be a factor here as could new research opportunities enabling old problems to be tackled.

Looking for an increase in investment is only one aspect of evaluating the success of research initiatives and ultimately there is a need to consider the impact of research on outcomes for patients. Such impacts may not be immediate and in the meantime other measures can be looked at, such as feed through to clinical guidelines or other changes in clinical practice. For example, the NCRI Supportive and Palliative Care (SuPaC) Collaboratives, which were aimed at capacity building, have recently been the subject of such analysis. This identified a number of levels at which the research undertaken by members of the Collaboratives has had an influence on the care of patients, the NHS, health policy and research methodology. Developments in research capacity were also identified with new researchers coming in to the field, development of skills in consumer involvement and career progression of researchers at all levels. A research award, and its potential to have a broader impact, is influenced by numerous factors. An evaluation such as the one on the SuPaC Collaboratives, to be published in late 2013, enables a broader look at the impact of research funding than an analysis of research spend and publication levels alone permits.

NCRI will continue to combine portfolio analysis with the use of other evaluation tools in assessing the impact of initiatives such as those designed to increase the amount of research in radiotherapy and surgery.
6.5 Other uses for the NCRI Cancer Research Database

Individual NCRI Partners have full access to their own data for analysis and following a data sharing agreement introduced in 2010 may also have access to the full data set for their own analyses, on the understanding that appropriate permissions are sought before any publication. The NCRI Secretariat also undertakes some bespoke analyses in response to requests, in so far as resources permit. As all awards within the database are coded by research category and NCRI Cancer Site, analyses based on these codes are relatively straightforward to perform. Some bespoke analyses require the use of key words and these are much more labour-intensive because of the need to individually review the relevance of each abstract that is identified.

Since the inception of the NCRI Cancer Research Database, NCRI has been a partner in the ICRP. Initially comprising only US and UK funders; this has grown over the years to include funders in Canada, France, Netherlands, Japan and Australia. The first ICRP data analysis enabling comparison between the UK and other countries was published in 2012, and more will follow. Over 50 funders have signed a data sharing agreement and have online access to full portfolio information. Some ICRP members use the database in other ways, for example, asking grant applicants to check that their work will not duplicate other research already underway or to identify experts for peer-review in a particular field. NCRI is also promoting portfolio analysis across 13 European countries using the CSO code through an EU-funded initiative in translational cancer research (TRANSCAN) and it is hoped that this will lead to more European funders joining ICRP and sharing portfolio data.

The general public has access to UK portfolio data in two complementary forms. The ICRP database is available online in a version that does not include financial information. It does nevertheless show the title, abstract, principal investigator, host institution and the research category and NCRI Cancer Site codes which have been assigned to each award. In contrast the NCRI Data Package contains only aggregate financial information across research categories (CSO codes and sub-codes) and across cancer sites.

6.6 Looking ahead

NCRI partners have agreed to continue collecting data annually for the foreseeable future although this will be reviewed from time to time. Currently, portfolio analysis is an important tool for promoting contact and communication amongst cancer research funders at national and international level. The depth of UK experience in use of the CSO code means that NCRI has a leadership role to play, along with other major partners in the ICRP. This manifests, for example, in publications such as this one and provision of training in use of the CSO code, especially to other European funders.

CSO coding is quite labour-intensive, even for experienced coders, especially as quality assurance requires dual coding and a third coder being involved if the first two give discordant codes. Automated text-mining software is being explored by some partners in the UK and overseas and may complement, or overtake, manual coding in due course. There is also an ambition to link research award data, as captured in the databases managed by NCRI and ICRP, to outputs and outcomes, such as academic publications, citations, and career trajectories of researchers, and this would certainly enhance their utility.

20 Database available at https://www.icrpartnership.org/database.cfm (last accessed September 2013).
### Abbreviations

<table>
<thead>
<tr>
<th>Abbreviation</th>
<th>Description</th>
</tr>
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<tbody>
<tr>
<td>ABPI</td>
<td>Association of the British Pharmaceutical Industry</td>
</tr>
<tr>
<td>BRC</td>
<td>Biomedical Research Centre</td>
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<td>CCRA</td>
<td>Canadian Cancer Research Alliance</td>
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<tr>
<td>CEA</td>
<td>Carcino-embryonic Antigen</td>
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<td>CSO</td>
<td>Common Scientific Outline</td>
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<td>ECMC</td>
<td>Experimental Cancer Medicine Centre</td>
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<tr>
<td>EU</td>
<td>European Union</td>
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<tr>
<td>GDP</td>
<td>Gross Domestic Product</td>
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<tr>
<td>ICRP</td>
<td>International Cancer Research Partnership</td>
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<td>MRC</td>
<td>Medical Research Council</td>
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<tr>
<td>NCI</td>
<td>National Cancer Institute</td>
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<tr>
<td>NCRI</td>
<td>National Cancer Research Institute</td>
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<tr>
<td>NIH</td>
<td>National Institutes of Health</td>
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<tr>
<td>NIHR</td>
<td>National Institute for Health Research</td>
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<tr>
<td>NPRI</td>
<td>National Prevention Research Initiative</td>
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<tr>
<td>SuPaC</td>
<td>Supportive and Palliative Care</td>
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<tr>
<td>TRANSCAN</td>
<td>ERA-NET on Translational Cancer Research</td>
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<tr>
<td>UK</td>
<td>United Kingdom</td>
</tr>
<tr>
<td>UKCRC</td>
<td>UK Clinical Research Collaboration</td>
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<tr>
<td>USA</td>
<td>United States of America</td>
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</tbody>
</table>
Appendix 1: NCRI Partner organisations

NCRI Partner organisations and the year their data was first included in the NCRI Cancer Research Database. All NCRI Partners are also members of the International Cancer Research Partnership, except for the Ludwig Institute for Cancer Research.

- Association of the British Pharmaceutical Industry (ABPI) (N/A)\(^\text{23}\)
- Association for International Cancer Research (2002)
- Biotechnology and Biological Sciences Research Council (2002)
- Breakthrough Breast Cancer (2002)
- Children with Cancer UK (2007)
- Economic and Social Research Council (2004)
- Leukaemia & Lymphoma Research (2002)
- Marie Curie Cancer Care (2002)
- Medical Research Council (2002)
- Northern Ireland Health and Social Care Research and Development (2002)
- Prostate Cancer UK (2010)
- Roy Castle Lung Cancer Foundation (2004)
- Scottish Chief Scientist Office (2002)
- Tenovus (2002)
- The Wellcome Trust (2004)

\(^{23}\) The ABPI is an umbrella organisation representing the British pharmaceutical industry. The ABPI does not directly fund research and thus does not submit data for inclusion in the NCRI Cancer Research Database.
Appendix 2: Common Scientific Outline coding system

The Common Scientific Outline (CSO) coding system, which is overseen and maintained by the ICRP, can be accessed from the ICRP website. The version currently in use dates from January 2006.

**CSO 1: Biology**
Research included in this category looks at the biology of how cancer starts and progresses as well as normal biology relevant to these processes.

**CSO 1.1: Normal Functioning**
Examples of science that would fit:
- Developmental biology (from conception to adulthood) and the biology of ageing
- Normal functioning of genes, including their identification and expression, and the normal function of gene products, such as hormones and growth factors
- Normal formation of the extracellular matrix
- Normal cell-to-cell interactions
- Normal functioning of apoptotic pathways

**CSO 1.2: Cancer Initiation: Alterations in Chromosomes**
Examples of science that would fit:
- Abnormal chromosome number
- Aberration in chromosomes and genes (e.g., in chronic myelogenous leukaemia)
- Damage to chromosomes and mutation in genes
- Failures in DNA repair
- Epigenetics
- Genes and proteins involved in aberrant cell cycles

**CSO 1.3: Cancer Initiation: Oncogenes and Tumour Suppressor Genes**
Examples of science that would fit:
- Genes and signals involved in growth stimulation or repression, including oncogenes (Ras, etc.), and tumour suppressor genes (p53, etc.)
- Effects of hormones and growth factors and their receptors such as oestrogens, androgens, TGF-beta, GM-CSF, etc.

**CSO 1.4: Cancer Progression and Metastasis**
Examples of science that would fit:
- Latency, promotion, and regression
- Expansion of malignant cells
- Interaction of malignant cells with the immune system or extracellular matrix
- Cell mobility, including detachment, motility, and migration in the circulation
- Invasion
- Malignant cells in the circulation, including penetration of the vascular system and extrasavation
- Systemic and cellular effects of malignancy
- Tumour angiogenesis and growth of metastases
- Role of hormone or growth factor dependence/independence in cancer progression

**CSO 1.5: Resources and Infrastructure Related to Biology**
Examples of science that would fit:
- Informatics and informatics networks
- Specimen resources
- Epidemiological resources pertaining to biology
- Reagents, chemical standards
- Education and training of investigators at all levels (including clinicians), such as participation in training workshops, advanced research technique courses, and Master’s course attendance. This does not include longer term research-based training, such as Ph.D. or post-doctoral fellowships

**CSO 2: Aetiology**
Research included in this category aims to identify the causes or origins of cancer - genetic, environmental, and lifestyle, and the interactions between these factors.

**CSO 2.1: Exogenous Factors in the Origin and Cause of Cancer**
Examples of science that would fit:
- Lifestyle factors such as smoking, chewing tobacco, alcohol consumption, parity, diet, sunbathing, and exercise

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• Environmental and occupational exposures such as radiation, second-hand smoke, radon, asbestos, organic vapours, pesticides, and other chemical or physical agents
• Infectious agents associated with cancer aetiology, including viruses (Human Papilloma Virus, etc.) and bacteria (Helicobacter pylori, etc.)
• Viral oncogenes and viral regulatory genes associated with cancer causation
• Statistical methodology or biostatistical methods
• Centres, consortia, and/or networks
• Education and training of investigators at all levels (including clinicians), such as participation in training workshops, advanced research technique courses, and Master’s course attendance. This does not include longer term research based training, such as Ph.D. or post-doctoral fellowships

CSO 2.2: Endogenous Factors in the Origin and Cause of Cancer
Examples of science that would fit:
• Free radicals such as superoxide and hydroxide radicals
• Genes known to be involved or suspected of being mechanistically involved in familial cancer syndromes; for example, BRCA1, Ataxia Telangiectasia, and APC
• Genes suspected or known to be involved in ‘sporadic’ cancer events; for example, polymorphisms and/or mutations that may affect carcinogen metabolism (e.g., CYP, NAT, glutathione transferase, etc.)

CSO 2.3: Interactions of Genes and/or Genetic Polymorphisms with Exogenous and/or Endogenous Factors
Examples of science that would fit:
• Gene-environment interactions
• Interactions of genes with lifestyle factors, environmental, and/or occupational exposures such as variations in carcinogen metabolism associated with genetic polymorphisms
• Interactions of genes and endogenous factors such as DNA repair deficiencies and endogenous DNA damaging agents such as oxygen radicals or exogenous radiation exposure

CSO 2.4: Resources and Infrastructure Related to Aetiology
Examples of science that would fit:
• Informatics and informatics networks; for example, patient databanks
• Specimen resources (serum, tissue, etc.)
• Reagents and chemical standards
• Epidemiological resources pertaining to aetiology

CSO 3: Prevention
Research included in this category looks at identifying interventions which reduce cancer risk by reducing exposure to cancer risks and increasing protective factors. Interventions may target lifestyle or may involve drugs or vaccines.

CSO 3.1: Interventions to Prevent Cancer: Personal Behaviours That Affect Cancer Risk
Examples of science that would fit:
• Research on determinants of personal behaviours, such as, diet, physical activity, sun exposure, and tobacco use, that affect cancer risk
• Interventions to change personal behaviours that affect cancer risk

CSO 3.2: Nutritional Science in Cancer Prevention
Examples of science that would fit:
• Quantification of nutrients and micronutrients
• Studies on the effect(s) of nutrients or nutritional status on cancer incidence
• Dietary assessment efforts, including dietary questionnaires and surveys
• Development, characterisation, and validation of dietary/nutritional assessment instruments

CSO 3.3: Chemoprevention
Examples of science that would fit:
• Chemopreventive agents and their discovery, mechanism of action, development, testing in model systems, and clinical testing

CSO 3.4: Vaccines
Examples of science that would fit:
• Vaccines for prevention, their discovery, mechanism of action, development, testing in model systems, and clinical testing
CSO 3.5: Complementary and Alternative Prevention Approaches

Examples of science that would fit:

- Discovery, development, and testing of complementary/alternative prevention approaches such as, diet, herbs, supplements, or other interventions that are not widely used in conventional medicine or are being applied in different ways as compared to conventional medical uses
- Hypnotherapy, relaxation, transcendental meditation, imagery, spiritual healing, massage, biofeedback, etc., used as a preventive measure

CSO 3.6: Resources and Infrastructure Related to Prevention

Examples of science that would fit:

- Informatics and informatics networks; for example, patient databanks
- Specimen resources (serum, tissue, etc.)
- Epidemiological resources pertaining to prevention
- Clinical trials infrastructure
- Statistical methodology or biostatistical methods
- Centres, consortia, and/or networks
- Education and training of investigators at all levels (including clinicians), such as participation in training workshops, advanced research technique courses, and Master’s course attendance. This does not include longer term research based training, such as Ph.D. or post-doctoral fellowships

CSO 4: Early Detection, Diagnosis, and Prognosis

Research included in this category focuses on identifying and testing cancer markers and imaging methods that are helpful in detecting and/or diagnosing cancer as well as predicting the outcome or chance of recurrence.

CSO 4.1: Technology Development and/or Marker Discovery

Examples of science that would fit:

- Discovery of markers (e.g., proteins, genes), and/or technologies (such as fluorescence, nanotechnology, etc.) that are potential candidates for use in cancer detection, staging, diagnosis, and/or prognosis
- Use of proteomics, genomics, expression assays, or other technologies in the discovery of markers

CSO 4.2: Technology and/or Marker Evaluation With Respect to Fundamental Parameters of Method

Examples of science that would fit:

- Development, refinement, and preliminary evaluation (e.g., animal trials and Phase I human trials)
- Preliminary evaluation with respect to laboratory sensitivity, laboratory specificity, reproducibility, and accuracy
- Research into mechanisms assessing tumour response to therapy at a molecular or cellular level

CSO 4.3: Technology and/or Marker Testing in a Clinical Setting

Examples of science that would fit:

- Evaluation of clinical sensitivity, clinical specificity, and predictive value (Phase II or III clinical trials)
- Quality assurance and quality control
- Inter- and intra-laboratory reproducibility
- Testing of the method with respect to effects on morbidity and/or mortality
- Study of screening methods, including compliance, acceptability to potential screenees, and receiver-operator characteristics
- Research into improvements in techniques to assess clinical response to therapy

CSO 4.4: Resources and Infrastructure Related to Detection, Diagnosis, or Prognosis

Examples of science that would fit:

- Informatics and informatics networks; for example, patient databanks
- Specimen resources (serum, tissue, images, etc.)
- Clinical trials infrastructure
- Epidemiological resources pertaining to risk assessment, detection, diagnosis, or prognosis
- Statistical methodology or biostatistical methods
- Centres, consortia, and/or networks
- Education and training of investigators at all levels (including clinicians), such as participation in training workshops, advanced research technique courses, and Master’s course attendance. This does not include longer term research based training, such as Ph.D. or post-doctoral fellowships
**CSO 5: Treatment**

Research included in this category focuses on identifying and testing treatments administered locally (such as, radiotherapy and surgery) and systemically (treatments like chemotherapy which are administered throughout the body) as well as non-traditional (complementary/alternative) treatments (such as, supplements, herbs). Research into the prevention of recurrence is also included here.

**CSO 5.1: Localised Therapies - Discovery and Development**

Examples of science that would fit:

- Discovery and development of treatments administered locally that target the organ and/or neighbouring tissue directly, including but not limited to surgical interventions and radiotherapy
- Therapies with a component administered systemically but that act locally (e.g., photodynamic therapy, radioimmunotherapy and radiosensitisers)
- Development of methods of drug delivery
- Research into the development of localised therapies to prevent recurrence

**CSO 5.2: Localised Therapies - Clinical Applications**

Examples of science that would fit:

- Clinical testing and application of treatments administered locally that target the organ and/or neighbouring tissue directly, including but not limited to surgical interventions and radiotherapy
- Clinical testing and application of therapies with a component administered systemically but that act locally (e.g., photodynamic therapy and radiosensitisers)
- Phase I, II, or III clinical trials of promising therapies that are administered locally
- Side effects, toxicity, and pharmacodynamics
- Clinical testing of localised therapies to prevent recurrence

**CSO 5.3: Systemic Therapies - Discovery and Development**

Examples of science that would fit:

- Discovery and development of treatments administered systemically such as cytotoxic or hormonal agents, novel systemic therapies such as immunologically directed therapies (vaccines, antibodies), gene therapy, angiogenesis inhibitors, apoptosis inhibitors, and differentiating agents
- Defining molecular signatures of cancer cells
- Identifying molecular targets for drug discovery. Includes mechanistic studies of cellular metabolism, combinatorial chemical synthesis, drug screening, development of high-throughput assays, and testing in model systems
- Investigating the molecular mechanisms of drug resistance and pre-clinical evaluation of therapies to circumvent resistance
- Development of methods of drug delivery
- Research into the development of systemic therapies to prevent recurrence

**CSO 5.4: Systemic Therapies - Clinical Applications**

Examples of science that would fit:

- Clinical testing and application of treatments administered systemically such as cytotoxic or hormonal agents, novel systemic therapies such as immunologically directed therapies (vaccines, antibodies), gene therapy, angiogenesis inhibitors, apoptosis inhibitors, and differentiating agents
- Phase I, II, or III clinical trials of promising therapies administered systemically
- Side effects, toxicity, and pharmacodynamics
- Clinical testing of systemic therapies to prevent recurrence

**CSO 5.5: Combinations of Localised and Systemic Therapies**

Examples of science that would fit:

- Development and testing of combined approaches to treatment
- Clinical application of combined approaches to treatment such as, systemic cytotoxic therapy and radiation therapy
- Development and clinical application of combined localised and systemic therapies to prevent recurrence

**CSO 5.6: Complementary and Alternative Treatment Approaches**

Examples of science that would fit:

- Discovery, development, and clinical application of complementary/alternative treatment approaches such as, diet, herbs, supplements, natural substances, or other interventions that are not widely used in conventional medicine or are being applied in different ways as compared to conventional medical uses
• Complementary/alternative approaches to the prevention of recurrence (please note that primary prevention using complementary or alternative approaches should be coded under CSO 3.5)

CSO 5.7: Resources and Infrastructure Related to Treatment and the Prevention of Recurrence
Examples of science that would fit:
• Informatics and informatics networks; for example, clinical trials networks and databanks
• Mathematical and computer simulations
• Specimen resources (serum, tissue, etc.)
• Clinical trial groups
• Epidemiological resources pertaining to treatment
• Statistical methodology or biostatistical methods
• Drugs and reagents for distribution and drug screening infrastructures
• Centres, consortia, and/or networks
• Education and training of investigators at all levels (including clinicians), such as participation in training workshops, advanced research technique courses, and Master’s course attendance. This does not include longer term research-based training, such as Ph.D. or post-doctoral fellowships

CSO 6: Cancer Control, Survivorship, and Outcomes Research
Research included in this category includes a broad range of areas: patient care and pain management; tracking cancer cases in the population; beliefs and attitudes that affect behaviour regarding cancer control; ethics, education and communication approaches for patients and health care professionals; supportive and end of life care; and health care delivery in terms of quality and cost effectiveness.

CSO 6.1: Patient Care and Survivorship Issues
Examples of science that would fit:
• Quality of life
• Pain management
• Psychological impacts of cancer survivorship
• Rehabilitation
• Reproductive issues
• Long-term morbidity

• Symptom management, including nausea, vomiting, lymphoedema, neuropathies, etc.
• Prevention of treatment-related toxicities and sequelae, including symptom management, prevention of mucosities, prevention of cardiotoxicities, etc.

CSO 6.2: Surveillance
Examples of science that would fit:
• Epidemiology and end results reporting (e.g. SEER)\(^\text{25}\)
• Surveillance of cancer risk factors such as diet, body weight, physical activity, sun exposure, and tobacco use
• Analysis of variations in risk factor exposure by demographic or other factors
• Registries that track incidence, morbidity, and/or mortality related to cancer
• Trends in use of interventional strategies
• Method development for risk factor surveillance

CSO 6.3: Behaviour
Examples of science that would fit:
• Behavioural medicine research and interventions
• Influence of social factors such as community, policy, education, and legislation, on behaviours related to cancer control
• Attitudes and belief systems and their influence on psychological health and on behaviours related to cancer control. For example, how beliefs can alter attempts to seek screening, detection, and treatment
• Interventions to change attitudes and beliefs that affect behaviour related to cancer control and cancer outcomes
• Influences of attitudes and beliefs on compliance with treatment and prevention protocols
• Psychological or educational interventions to promote behaviours that lessen treatment-related morbidity and promote psychological adjustment to the diagnosis of cancer and to treatment effects
• Burdens of cancer on family members/caregivers and psychological/behaviour issues

CSO 6.4: Cost Analyses and Health Care Delivery
Examples of science that would fit:
- Analyses of the cost effectiveness of methods used in cancer prevention, detection, diagnosis, prognosis, treatment, and survivor care/support
- Development and testing of health service delivery methods
- Interventions to increase the quality of health care delivery
- Impact of organisational, social, and cultural factors on access and quality of care
- Studies of providers such as geographical or care-setting variations in outcomes
- Effect of reimbursement and/or insurance on cancer control, outcomes, and survivorship support
- Access to care issues
- Health services research, including health policy and practice
- Analysis of health service provision, including the interaction of primary and secondary care; cost-effectiveness of treatments

CSO 6.5: Education and Communication
Examples of science that would fit:
- Development of communication tools and methods
- Education of patients, health care providers, at-risk populations, and the general population about cancer
- Communication to patients regarding therapeutic options
- Educational interventions to promote self-care and symptom management
- Communicating cancer risk to underserved populations, at-risk populations, and the general public
- Alternative teaching methods to communicate therapeutic options and risk-reduction behaviour to patients and the general public
- Communication of lifestyle models that reduce cancer risk, such as communication of nutritional interventions
- Communicating smoking and tobacco cessation interventions
- Special approaches and considerations for underserved and at-risk populations
- Education, information, and prevention/ screening/assessment systems for the general public, primary care professionals, or policy makers
- Training, predictive cancer models, pain management, and surveillance systems for primary care professionals, telehealth/ telemedicine applications
- Communication regarding cancer genetics, managed oncology care, and communicating with survivors
- Barriers to successful health communication

CSO 6.6: End of Life Care
Examples of science that would fit:
- End of life care issues, including palliative care, psychological interventions with families at end of life, hospice care, and pain management for terminally ill patients

CSO 6.7: Ethics and Confidentiality in Cancer Research
Examples of science that would fit:
- Informed consent modelling and development
- Quality of Institutional Review Boards (IRBs)
- Protecting patient confidentiality and privacy
- Research ethics

CSO 6.8: Complementary and Alternative Approaches for Supportive Care of Patients and Survivors
Examples of science that would fit:
- Hypnotherapy, relaxation, transcendental meditation, imagery, spiritual healing, massage, biofeedback, etc., as used for the supportive care of patients and survivors
- Discovery, development, and testing of complementary/alternative approaches such as diet, herbs, supplements, or other interventions that are not widely used in conventional medicine or are being applied in different ways as compared to conventional medical uses

CSO 6.9: Resources and Infrastructure Related to Cancer Control, Survivorship, and Outcomes Research
Examples of science that would fit:
- Informatics and informatics networks
- Clinical trial groups related to cancer control, survivorship, and outcomes research
CSO 7: Scientific Model Systems
Research included in this category looks at the development of new animal models, cell cultures and computer simulations and their application to other studies across the spectrum of cancer research

CSO 7.1: Development and Characterisation of Model Systems
Examples of science that would fit:
- Development and characterisation of model systems, including but not limited to:
  - Computer-simulation model systems and computer software development
  - In vitro model systems
  - Cell culture model systems
  - Organ and tissue model systems
  - Animal model systems such as Drosophila and C. elegans, zebrafish, mouse, etc.

CSO 7.2: Development and Characterisation of Model Systems
Examples of science that would fit:
- Research into new ways of applying model systems, including but not limited to:
  - Computer simulation model systems and computer software development
  - In vitro model systems
  - Cell culture model systems
  - Organ and tissue model systems
  - Animal model systems such as Drosophila and C. elegans, zebrafish, mouse, etc.

CSO 7.3: Resources and Infrastructure Related to Scientific Model Systems
Examples of science that would fit:
- Models made available for distribution to the scientific community
- Centres, consortia, and/or networks
- Education and training of investigators at all levels (including clinicians), such as participation in training workshops, advanced research technique courses, and Master’s course attendance. This does not include longer term research-based training, such as Ph.D. or post-doctoral fellowships
Appendix 3: NCRI Cancer Site coding system

Non-site specific

Fundamental Research (including fluids, secretions, milk, lymph, blood components, cells, cell fractions, tissues, strains, and experimental tumours)

All Sites

Site specific

Adrenocortical
Anal
Bladder
Bone (including Osteosarcoma, Malignant Fibrous Histiocytoma and Ewing’s Sarcoma)
Brain Tumour (including Chordoma)
Breast
Cervical
Colon and Rectal
Ear
Endometrial
Eye (not including Retinoblastoma)
Gallbladder (including Extra-hepatic Biliary Tract)
Heart
Hodgkin’s Disease
Kaposi’s Sarcoma
Kidney (not including Wilm’s Tumour)
Laryngeal
Leukaemia (including Acute Lymphocytic Leukaemia, Acute Myeloid Leukaemia, Chronic Lymphocytic Leukaemia, Hairy Cell Leukaemia, Myelodysplastic Syndrome and Myeloproliferative disorders)
Liver (including Bile Duct)
Lung (including Mesothelioma)
Melanoma
Myeloma (including Multiple Myeloma)
Nasal Cavity and Paranasal Sinus
Nervous System
Neuroblastoma
Non-Hodgkin’s Lymphoma
Oesophageal
Oral Cavity and Lip
Ovarian
Pancreatic
Parathyroid
Pharyngeal
Pituitary Tumour
Primary Central Nervous System Lymphoma
Primary of Unknown Origin26
Prostate
Retinoblastoma
Salivary Gland
Sarcoma (including Chondrosarcoma, Ewing’s Sarcoma, Fibrosarcoma, Osteosarcoma, Rhabdomyosarcoma, Soft Tissue Sarcoma and Uterine Sarcoma)
Skin
Small Intestine
Stomach
Testicular
Thymoma, Malignant
Thyroid
Vaginal
Vascular System
Vulva
Wilm’s Tumour

26 For the purposes of analyses within this report Primary of Unknown Origin cancers are considered site specific cancers.

Cancer research spend in the UK 2002–2011
In some cases ‘roll-up codes’ are used where the cancer site focus of an award is not highlighted and to ensure a consistent and fair attribution of funds to specific NCRI Cancer Site codes in these cases. The roll-up codes currently in use are:

<table>
<thead>
<tr>
<th>Roll-up code</th>
<th>Cancer Site coding used</th>
</tr>
</thead>
<tbody>
<tr>
<td>Alcohol consumption-related cancers</td>
<td>Oesophageal (22%); Laryngeal (21%); Pharyngeal (16%); Oral Cavity and Lip (16%); Breast (15%); Liver (10%)</td>
</tr>
<tr>
<td>BRCA1/2 mutation-related cancers</td>
<td>Breast (70%); Ovarian (30%)</td>
</tr>
<tr>
<td>CEA-positive tumours</td>
<td>Colon and Rectal (60%); Lung (10%); Breast (10%); Pancreatic (10%); Ovarian (10%)</td>
</tr>
<tr>
<td>Childhood cancers</td>
<td>Leukaemia (35%); Brain Tumour (12%); Nervous system (12%); Sarcoma (10%); Neuroblastoma (9%); Wilm’s Tumour (9%)</td>
</tr>
<tr>
<td>Dietary-related cancers</td>
<td>Colon and Rectal (50%); Stomach (12.5%); Oral Cavity and Lip (12.5%); Oesophageal (12.5%); Breast (12.5%)</td>
</tr>
<tr>
<td>Epstein-Barr virus associated cancers</td>
<td>Pharyngeal (34%); Non-Hodgkin’s Lymphoma (33%); Hodgkin’s Disease (33%)</td>
</tr>
<tr>
<td>Familial cancers</td>
<td>Breast (50%); Ovarian (20%); Colon and Rectal (10%); Melanoma (10%); All Sites (10%)</td>
</tr>
<tr>
<td>Gastrointestinal cancers</td>
<td>Colon and Rectal (65%); Stomach (20%); Oesophageal (15%)</td>
</tr>
<tr>
<td>Gynaecological cancers</td>
<td>Cervical (20%); Ovarian (41%); Endometrial (32%); Vaginal (1%); Vulva (6%)</td>
</tr>
<tr>
<td>Germ cell tumours</td>
<td>Ovarian (50%); Testicular (50%)</td>
</tr>
<tr>
<td>Germline p53 mutation-related cancers</td>
<td>All Sites (30%); Breast (10%); Bone (10%); Adrenocortical (10%); Brain Tumour (10%); Lung (5%); Stomach (5%); Colon and Rectal (5%); Pancreatic (5%); Hodgkin’s Disease (5%); Kidney (5%)</td>
</tr>
<tr>
<td>Haematological cancers</td>
<td>Non-Hodgkin’s Lymphoma (40%); Leukaemia (30%); Myeloma (20%); Hodgkin’s Disease (10%)</td>
</tr>
<tr>
<td>Head and neck cancers</td>
<td>Pharyngeal (34%); Laryngeal (32%); Oral Cavity and Lip (27%); Salivary Gland (7%)</td>
</tr>
<tr>
<td>HIV associated cancer</td>
<td>Kaposi’s Sarcoma (40%); Non-Hodgkin’s Lymphoma (40%); Cervical (10%); Anal (10%)</td>
</tr>
<tr>
<td>HPV associated tumours</td>
<td>Cervical (60%); Anal (10%); Vulva (10%); Penile (10%)</td>
</tr>
<tr>
<td>Multiple endocrine neoplasia</td>
<td>Adrenocortical (25%); Pancreatic (25%); Parathyroid (25%); Pituitary Tumour (25%)</td>
</tr>
<tr>
<td>Neuro-endocrine cancers</td>
<td>Pancreatic (40%); Stomach (40%); Parathyroid Tumour (10%); Nervous System (10%)</td>
</tr>
<tr>
<td>Neurofibromatosis</td>
<td>Nervous System (50%); Brain Tumour (50%)</td>
</tr>
<tr>
<td>Photodynamic therapy research</td>
<td>Skin (12.5%); Pharyngeal (12.5%); Laryngeal (12.5%); Oral Cavity and Lip (12.5%); Lung (12.5%); Oesophageal (12.5%); Stomach (12.5%)</td>
</tr>
<tr>
<td>Smoking-related cancers</td>
<td>Lung (68%); Oesophageal (4%); Laryngeal (3%); Pharyngeal (3%); Oral Cavity and Lip (3%); All Sites (19%)</td>
</tr>
<tr>
<td>Smokeless tobacco-related cancers</td>
<td>Oral Cavity and Lip (34%); Oesophageal (33%); Pancreatic (33%)</td>
</tr>
<tr>
<td>Second-hand smoke-related cancers</td>
<td>Lung (100%)</td>
</tr>
<tr>
<td>Parental smoking-related cancers in offspring</td>
<td>Liver (100%)</td>
</tr>
<tr>
<td>Cancers of teenagers and young adults</td>
<td>All Sites (22%); Hodgkin’s Disease (18%); Leukaemia (11%); Brain Tumour (9%); Melanoma (8%); Non-Hodgkin’s Lymphoma (7%); Ovarian (7%); Testicular (7%); Bone (6%); Sarcoma (5%)</td>
</tr>
</tbody>
</table>
Acknowledgements

This report was prepared by the National Cancer Research Institute Secretariat. Thanks go to all the staff of NCRI Partner organisations for providing their portfolios for inclusion in the analyses. Particular thanks go to our external coders (Anna Smith and Aoife Regan) for their considerable efforts in coding portfolios, and past and present members of our Coding Panel (Lynne Davies [Cancer Research UK and ICRP], Helen Rippon and Mark Matfield [Association for International Cancer Research], Claire Wyllie and Karen Finney [MRC], Katie Dougan-Hyde [Marie Curie Cancer Care], Alex Bonner [Breakthrough Breast Cancer] and Helen Campbell [Department of Health, England]) for their contribution to coding awards and ensuring consistency and accuracy in use of the coding methodologies across the years.