## Contents

<table>
<thead>
<tr>
<th>Section</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>Foreword</td>
<td>3</td>
</tr>
<tr>
<td><strong>Key messages</strong></td>
<td>4</td>
</tr>
<tr>
<td><strong>1. Prevention and screening</strong></td>
<td>6</td>
</tr>
<tr>
<td>Prevention</td>
<td>6</td>
</tr>
<tr>
<td>Tobacco control</td>
<td>6</td>
</tr>
<tr>
<td>Weight management</td>
<td>6</td>
</tr>
<tr>
<td>Alcohol control</td>
<td>6</td>
</tr>
<tr>
<td>Screening</td>
<td>7</td>
</tr>
<tr>
<td>Breast cancer</td>
<td>7</td>
</tr>
<tr>
<td>Bowel cancer</td>
<td>7</td>
</tr>
<tr>
<td>Future development of screening for cancer</td>
<td>7</td>
</tr>
<tr>
<td>Lung cancer</td>
<td>8</td>
</tr>
<tr>
<td>Liver cancer (hepatoma)</td>
<td>8</td>
</tr>
<tr>
<td><strong>2. The capacity shortfall in diagnostic imaging</strong></td>
<td>10</td>
</tr>
<tr>
<td>The problem</td>
<td>10</td>
</tr>
<tr>
<td>The causes</td>
<td>10</td>
</tr>
<tr>
<td>The key contributory factors are:</td>
<td>11</td>
</tr>
<tr>
<td>The solution</td>
<td>11</td>
</tr>
<tr>
<td><strong>3. Improving the organisation of diagnostic radiology services</strong></td>
<td>13</td>
</tr>
<tr>
<td>The problem</td>
<td>13</td>
</tr>
<tr>
<td>A range of solutions</td>
<td>13</td>
</tr>
<tr>
<td><strong>4. Radiotherapy</strong></td>
<td>15</td>
</tr>
<tr>
<td>Radiotherapy modalities and their development</td>
<td>15</td>
</tr>
<tr>
<td>Workforce</td>
<td>16</td>
</tr>
<tr>
<td><strong>5. Chemotherapy</strong></td>
<td>18</td>
</tr>
<tr>
<td>The patient’s perspective</td>
<td>18</td>
</tr>
<tr>
<td><strong>6. Interventional oncology</strong></td>
<td>21</td>
</tr>
<tr>
<td>What is interventional oncology?</td>
<td>21</td>
</tr>
<tr>
<td>Developments in interventional oncology</td>
<td>21</td>
</tr>
<tr>
<td>Current areas of good practice</td>
<td>22</td>
</tr>
<tr>
<td>The biggest barrier to improving services for cancer patients</td>
<td>22</td>
</tr>
<tr>
<td><strong>7. Equipment</strong></td>
<td>25</td>
</tr>
<tr>
<td>Diagnostic imaging</td>
<td>25</td>
</tr>
<tr>
<td>Radiotherapy</td>
<td>26</td>
</tr>
<tr>
<td><strong>8. Data collection and analysis</strong></td>
<td>27</td>
</tr>
<tr>
<td>Clinical oncology</td>
<td>27</td>
</tr>
<tr>
<td>Clinical radiology</td>
<td>29</td>
</tr>
<tr>
<td><strong>9. Research</strong></td>
<td>31</td>
</tr>
<tr>
<td>Clinical radiology</td>
<td>31</td>
</tr>
<tr>
<td>Specific areas for development</td>
<td>31</td>
</tr>
<tr>
<td>Barriers to improving research</td>
<td>32</td>
</tr>
<tr>
<td>Radiotherapy</td>
<td>32</td>
</tr>
<tr>
<td><strong>10. Survivorship</strong></td>
<td>36</td>
</tr>
<tr>
<td>Shifting the system towards truly person-centred care</td>
<td>36</td>
</tr>
<tr>
<td>The recovery package and stratified follow-up</td>
<td>36</td>
</tr>
<tr>
<td>Information needs of people living with and beyond cancer</td>
<td>36</td>
</tr>
<tr>
<td>Identifying people with post-treatment needs</td>
<td>36</td>
</tr>
<tr>
<td>Tiered service models for consequences of treatment</td>
<td>37</td>
</tr>
<tr>
<td>Using data</td>
<td>37</td>
</tr>
<tr>
<td>Co-morbidities and incurable but treatable cancer</td>
<td>37</td>
</tr>
<tr>
<td><strong>Appendix 1. Contributors to this submission</strong></td>
<td>39</td>
</tr>
<tr>
<td><strong>Appendix 2. Glossary</strong></td>
<td>40</td>
</tr>
</tbody>
</table>
Foreword

The announcement of the development of a new Cancer Strategy for England should be welcomed by all, not least by the public and patients and those who diagnose and care for people suffering from cancer. The Royal College of Radiologists (RCR) is especially pleased by this initiative as it is centrally positioned to offer advice, expertise and input to the Strategy and its Taskforce. The RCR’s two specialties of clinical radiology and clinical oncology are at the heart of what the Taskforce aims to deliver through the Strategy, that is, more rapid and consistent diagnosis of cancer using enhanced and developing imaging techniques (which can in some instances contribute towards prevention) and the use of the major non-surgical modalities for cancer treatment of radiotherapy and chemotherapy as well as emerging techniques such as interventional oncology. All these skills and knowledge reside within the Fellows and members of the RCR. The RCR commits to leading its specialties in order to realise the aspirations of the new Strategy.

This initiative offers the potential for vital diagnostic and treatment services to be developed in ways that the RCR has been calling for over many years. The RCR has expressed its views most recently in its proposals to the next Government.1,2 The Cancer Taskforce is therefore a timely development that will lead the thinking and the delivery of improvements in diagnosis and treatment.

In this submission the RCR offers its views on ten topics.

1. Prevention and screening
2. Capacity shortfall in diagnostic imaging
3. Organisation of diagnostic services
4. Radiotherapy
5. Chemotherapy
6. Interventional oncology
7. Equipment
8. Data collection and analysis
9. Research
10. Survivorship

Each section of this submission draws on the work of one or more experts in the field to who the RCR is highly indebted. Each section is necessarily brief and much more could have been said, however, the RCR looks forward to playing an active role in the work of the Taskforce and is more than ready to expand on what is in this submission as the work progresses.

The RCR initiated and has led the development of the Radiotherapy Board, the Chemotherapy Board and the Clinical Imaging Board and is represented on the National Health Service (NHS) England Radiotherapy and Chemotherapy Clinical Reference Groups. Furthermore, the RCR has very well established working relationships with a wide spectrum of imaging- and cancer-related organisations. Through these relationships and on its own account, the RCR is well placed and has the necessary expertise to provide advice and input into cancer diagnosis and treatment.

The RCR is a UK body; while what is said here is most frequently stated in an English context, the ambitions and expectations for cancer diagnosis and delivery are the same across all four UK countries. We see no reason for public, patient and carer expectations and experiences to be different in different geographical locations; indeed eliminating such variations must be an underlying aim of the new Strategy.

References


Key messages

Under each section we have set out the commitments the RCR would like to see in the new Cancer Strategy. In the summary below are the key points. Details on each of these are provided in the sections which follow.

Screening, prevention and diagnosis

- Evidence-based measures should be implemented to improve public health and reduce cancer incidence in the areas of tobacco and alcohol control and weight management.
- There should be further measures to achieve more effective education of the public about the risks and benefits of screening and the consequences of over- and under-diagnosis.
- National cancer screening programmes should continue to be developed on the basis of a rigorous assessment of the evidence (and not for other reasons).
- There should be further research on early diagnostics for oesophageal cancer, ovarian cancer, and lung cancer with combined imaging and genomics.
- There must be a sustained increase in the numbers of clinical radiologists in training to match the increase in demand for radiological investigation and to support the national screening programmes.
- There should be a systematic approach to maximising the potential of the existing trained radiology workforce including:
  - Facilitation of home working
  - Optimising workplace health to reduce early retirement
  - Development of new models of service delivery including networked radiology services
  - Piloting and evaluation of the feasibility and impact of community based diagnostic centres.
- There should be a centrally funded programme of replacement and additional computed tomography (CT) and magnetic resonance imaging (MRI) machines to bring the installed base of cancer scanners in the UK closer to European norms.
- There should be progressive adoption of functional biomarkers for stratifying patients and monitoring treatments with particular emphasis on dynamic contrast-enhanced MRI (DCE-MRI), diffusion-weighted MRI (DW-MRI) and positron emission tomography CT (PET-CT).

Treatment

- Intensity-modulated radiotherapy (IMRT) should become the norm for all appropriate indications.
- There should be rapid development and uptake of other, newer forms of radiotherapy which demonstrate clinical and cost effectiveness.
- The first two proton beam centres should be delivered on target as the start of a programme of expanding such treatment where indicated.
- There should be investment in the size and skills of the radiotherapy workforce to ensure that this range of new treatment options can be delivered in a timely manner.
- Aging linear accelerators should be replaced through a co-ordinated national programme.
- There should be an evidence based approach to implementation of new drug therapies with health economic evaluation via the National Institute of Health and Care Excellence (NICE), with early access for drugs likely to be approved.
- There should be work to improve understanding of the cost–benefit ratio of systemic anti-cancer therapy for elderly patients leading to rational and equitable use in this patient group.
- Development of interventional oncology should be encouraged, providing equitable access to techniques of proven value and developing the evidence base for innovative approaches to minimally invasive forms of cancer treatment.
- There is a requirement to train more interventional radiologists who can undertake interventional oncology procedures.
- There should be a change in attitudes to innovation such that every patient has access to the latest evidence-based radiotherapy technology and techniques.
- There should be development of a responsive commissioning structure and provision of resources in order to allow for the early adoption of novel techniques.
- There should be increased support for clinical trials or commissioning through evaluation.
- There should be a review of academic training in oncology and provision of the necessary support and flexibility to achieve an academic profile comparable with the best in Western Europe.

**Data and information technology (IT) infrastructure**

- There should be widespread implementation of IT solutions which support effective and efficient diagnostic services including ‘airline booking’ of appointments and ‘red flag’ alerts for unreported studies and for significant unexpected findings.
- There should be national integrated electronic data capture at diagnostic level, including electronic patient records linked to laboratory and radiological data with appropriate local resources to ensure their maintenance and data quality.
- All cancer centres and units should have the facility for networked electronic prescribing.
- There must be a long-term commitment to maintaining and building on the Radiotherapy dataset (RTDS) and Systemic Anti-Cancer Therapy (SACT) database. This would include:
  - Ensuring that the historical data in the RTDS is retained and compatible with ongoing databases
  - Putting the administration of RTDS on a sound footing for the future
  - Maintenance of the associated software extraction tools and quality assurance essential for efficient and comprehensive downloads from hospitals delivering the data to the central repository
  - Continued development of the SACT Database, including robust morbidity and mortality data
  - Investment in solutions to allow linkage between the RTDS and SACT and cancer registry data for outcome and hospital episode statistics (HES) data and national general practitioner (GP) data for hospital and community consequences of interventions. This would allow exploration of new paradigms to evaluate novel interventions based on population outcome data rather than randomised controlled trials (RCTs).

**Survivorship**

- There should be a shift toward person-centred care by giving people affected by cancer the right information, support and confidence to choose and control their treatment and follow-up.
- Cancer treatment should be coded in primary care records to allow those at risk or requiring attention to be identified and appropriate advice offered.
- Attention should be given to the collection and use of new and existing patient datasets that demonstrate clinical improvements and quality of life outcomes.
1. Prevention and screening

Prevention

Wherever possible, prevention of cancer should be the primary objective. There are a number of areas where influencing the behaviours of the population would significantly decrease the burden of malignancy in the future but crucially also improve the general health of the nation. More than one demographic goal could be met by increasing the focus on cancer prevention.

Tobacco control

There is a body of evidence that increasing the price and decreasing the ‘attractiveness’ of cigarette packaging leads to decreased tobacco consumption. Although tobacco consumption continues to fall in all groups, the rate of decline in men exceeds that in women.

The Taskforce should promote/lobby for:

1. Significant rises in tobacco duty
2. Plain packaging which retains appropriate health warnings
3. Increased and equitable access to supported smoking cessation therapy programmes
4. Strict control over the marketing and availability of e-cigarettes. While these represent an alternative to smoking for those smokers who have failed to give up, they are very addictive, containing more nicotine than cigarettes. There is no long-term data yet on safety either of high-dose nicotine inhalation or inhalation of warmed aerosols.

There are a number of barriers to reducing tobacco consumption. The negative effects on health of tobacco consumption are well established, but people continue to start smoking. Education campaigns should be aimed at harder-to-reach populations, but this requires resource.

Weight management

Obesity increases the risk of developing a number of types of cancer, including three of the four most common cancers. There is emerging evidence that for some cancers the risk is increased by repeated weight gains and losses and in those adults who were obese as children. Therefore promoting a stable, healthy weight throughout life is increasingly important. This involves both nutrition and physical activity.

The Taskforce should promote/lobby for:

1. Increased emphasis on nutrition and exercise as part of health education in national curricula
2. Mandatory plain information on the content of all foods
3. Increased access to community dietetic support with greater use of newer communication media, for example, apps
4. Universal access to local physical activity at a reasonable cost.

Alcohol control

Alcohol intake in excess of recommended national daily amounts increases the risk for a number of cancers, including two of the most common cancers. For a number of cancers there is synergy with tobacco consumption.

The Taskforce should promote/lobby for:

1. An increase in the minimum unit price of alcohol
2. Giving more prominence to and plainer labelling of alcohol content.
Screening

Ideally, screening refers to the identification of a pre-malignant condition that is asymptomatic and can be easily treated. However, most screening programmes are aimed at the detection of cancers at an early stage. This stage migration results in better outcomes. However, the potential detrimental aspects of screening should always be considered, in particular the impact on members of the public of false-positive and false-negative results, as well as the direct and opportunity costs for the NHS.

The RCR fully supports the current national cancer screening programmes and encourages:

1. Regular evaluation of technique, including screening interval and benefit for all established screening programmes to ensure the best value for money spent

2. Regular review of the emerging evidence base for new screening programmes, with rapid implementation where there is evidence from randomised controlled trials, especially for cancers where outcomes are poor in the later stages, for example, lung cancer.

All screening programmes place an increased burden on diagnostic services, especially radiology and histopathology. The existing screening programmes for breast and bowel cancer rely heavily on a radiology workforce which is already significantly overstretched.1

Breast cancer

The evidence base behind the breast cancer screening programme is robust and the Marmot Review into breast cancer screening supports its continuation although there is continuing debate regarding the value of age extension from 50–70 to 47–73.2

The NHS Breast Cancer Screening Programme (NHSBSP) was implemented nationally in 1989–90. Many consultant radiologists were appointed at that time to deliver the programme. Consequently, this cohort is now approaching retirement. Skillmix in the NHSBSP was introduced in the mid- to late-1990s as a means of addressing the increase in staffing and skills needed when the first age extension to 70 was introduced. The cohort of advanced and consultant practitioners trained at that time is also approaching retirement age. The RCR is working with NHS England and the British Society of Breast Radiology (BSBR) to obtain data on the scale of the problem. A survey of all breast units is taking place in February 2015 with the results due in spring 2015. The RCR also has considerable data on the radiologist workforce in breast radiology, obtained through its annual workforce censuses which obtain 100% returns from departments throughout the UK.1

The most recent census shows that recruitment to breast radiology is difficult, with more than 50% of posts with an interest in breast imaging either unfilled or not appointed to as of 1 December 2012 and 23% of the workforce expected to retire by 2018.

Bowel cancer

The NHS bowel cancer screening programme also has implications for radiology with the move to CT colonography. This is against a background of increasing global demand for CT of more than 10% year on year for the past decade.3

To help support the move to CT colonography, the RCR together with the British Society of Gastrointestinal and Abdominal Radiology (BSGAR) has produced guidance on the key considerations in using CT colonography for patients with suspected colorectal cancer as well as guidance on all aspects of establishing a high-quality CT colonography service.4

Future development of screening for cancer

The RCR strongly believes that any future screening programmes should be evidence based, and fulfil the UK National Screening Committee (NSC) criteria for appraising the viability, effectiveness and appropriateness of a screening programme. Of the additional cancer sites for which screening has been suggested as a possible strategy to improve outcomes, the RCR does not consider that current evidence supports the introduction of screening for ovarian cancer or bladder cancer.
Evidence is, however, emerging in favour of lung cancer screening in high-risk groups and also for surveillance for those at risk of developing hepatoma (liver cancer).

Lung cancer

The report of a multicentre randomised study of current and former heavy smokers in the United States of America (USA) (the National Lung Screening Trial) raises hope that screening will be of benefit and demonstrates a relative reduction in death from lung cancer of 20% and a reduction in all-cause mortality of 6.7%. Some caution is required in attempting to translate these results to a United Kingdom (UK) population. The UK Lung Cancer Screening Trial, offering low dose CT screening to the population at high risk is now under way and although it will be some years before the effects on mortality can be determined, the cancer detection rate and intervention rate for benign nodules will be known after the first two years or so. This will enable the requirements for imaging and intervention as well as the cost effectiveness to be modelled.

Liver cancer (hepatoma)

The incidence of hepatoma is increasing rapidly but to date there is conflicting evidence on the efficacy of hepatoma screening. An article published on the British Medical Journal (BMJ) Best Practice website quotes the British Society of Gastroenterology (BSG) recommendation of six-monthly liver ultrasound and alpha-fetoprotein (AFP) blood test (AFP) in males and females with cirrhosis due to hepatitis B or C virus, haemochromatosis, alcohol-related (abstinent from alcohol and likely to adhere to treatment) and primary biliary cirrhosis.

However, the National Cancer Institute has reviewed the evidence for hepatoma screening and concludes, ‘Based on fair evidence, screening of persons at elevated risk does not result in a decrease in mortality from hepatocellular cancer.’

Hepatology organisations across the world have made recommendations for screening and in many institutions in the UK such guidelines have been adopted by stealth. This is without any specific funding of the primary ultrasound investigations or supplementary MRI examinations. It also lacks the organisational resource of a formal screening programme, and as such is not managed as a ‘programme’ within radiology.

NICE is currently evaluating the evidence to support surveillance of patients with cirrhosis for hepatoma and we look forward to their recommendations. Any increase in imaging tests required to implement their recommendations would need to be recognised and funded.

Commitments the RCR would like to see in the new cancer strategy include:

- Promoting/lobbying to achieve more effective education of the public about the risks and benefits of screening and the consequences of over- and under-diagnosis
- Implementation of evidence-based measures to improve public health and reduce cancer incidence in the areas of tobacco and alcohol control and weight management
- Continued development of cancer screening programmes on the basis of a rigorous assessment of the evidence (and not for other reasons)
- Investment in the radiology workforce to support existing and potential new screening programmes.

References


6. www.ukls.org (last accessed 26/02/2015)


2. The capacity shortfall in diagnostic imaging

NB. Unless otherwise referenced, the data contained within this section are taken from the RCR’s 2012 Clinical Radiology Workforce Census and Workforce planning response to Health Education England’s Call for Evidence 2014/2015.1,2

The problem

There is a major capacity shortfall in diagnostic imaging leading to serious reporting delays. Unless this is addressed urgently, faster diagnosis of cancer envisaged by the NHS England Five Year Forward View will not be realised.3

In October 2014, the RCR conducted a snapshot survey of English NHS radiology departments, to determine how many imaging examinations (X-rays, CT scans and MRI scans) were waiting more than 30 days for interpretation by a radiologist.4 Around a quarter of departments responded.

The survey identified major delays in many areas. There were 81,137 X-rays and 1,697 CT and MRI scans still waiting for a radiologist’s report more than 30 days after the images had been obtained. If this reflected the national picture at that time, about 300,000 patients were waiting more than 30 days for their X-rays to be analysed and about 6,000 patients had waited more than a month for the results of their CT and MRI scans.

The impact of this is likely to be significant and serious, causing delays in diagnosis, creating distress and anxiety for patients as well as inefficiencies in wider hospital services and potentially reducing cancer survival. The Care Quality Commission’s (CQC) recent decision to make diagnostic imaging a core service to be reviewed in its hospital inspections should lead to a full and urgent assessment of the size of the problem so that it can be tackled.

The causes

1. Sharply rising demand for imaging

Between 2002–03 and 2012–13, there was a 41% increase in the number of radiological examinations conducted in England, from approximately 28 million to almost 40 million.5 Increasing cancer survivorship will continue to create a rising demand for review of previous images and active surveillance that involves regular imaging.

Despite this, the UK still performs fewer imaging investigations than other comparable Western nations and the RCR therefore expects year-on-year increases for the foreseeable future, reaching approximately 50 million radiology examinations by 2018–19.6

The workload for clinical radiologists is growing not only in volume but also in complexity, driven by the ever-expanding choice of available imaging techniques and the increasing complexity of the examinations themselves. The biggest percentage rise in volume has been in the more complex and time-consuming tests such as CT and MRI. Over the past ten years in England, the number of CT examinations has risen by 167% (an average 10% increase per year) and MRI examinations have tripled, with an average 12% increase per year.5

Changes to working practices are also contributing to the rise in demand, particularly with the move to seven-day working.

2. A serious shortage of radiologists

The existing workforce has so far absorbed the increase in demand but it is clear from both the data published by the Department of Health (DH) on imaging numbers and radio-diagnostic examinations, that further increased demand will not be met by the current projected radiologist workforce supply.5 The UK has around 48 trained radiologists per million population, a figure which has increased only slowly over the past five years.7 In Germany the comparable figure is 92, in Spain 112 and in France 130.1
Of consultant clinical radiologist posts in England, 8% were identified as unfilled at 31 December 2012. This proportion rose to 10% in the East Midlands, North West and South Central England. The real picture is probably worse as many trusts have given up advertising after multiple unsuccessful attempts to fill a post.

In addition to variations in the number of vacant posts, there was also significant variation in the levels of difficulty being experienced in finding suitable candidates to fill the posts. The RCR’s data from Advisory Appointments Committees (AACs) between April and September 2014 show that 43 of 219 AACs (19.6%) resulted in no appointment being made with lack of suitable applicants the most common reason given.

There are particularly severe recruitment difficulties in general, breast, interventional and paediatric radiology.

**The key contributory factors are:**

**An aging workforce**

More than a third of the radiologist workforce is aged 50 or over; 6% is aged 60 or over.

The average retirement age for clinical radiologists in 2012 was 62.

A significant proportion of the current workforce will be approaching retirement age in the next five years. Based on the average retirement age of 62, the following are examples of predicted retirements in the next five years:

- 28% of general radiologists
- 23% of breast radiologists
- More than 20% of the consultant workforce in the East of England and South East Coast.

Almost one in three consultant clinical radiologists currently in post is expected to retire in the next ten years.

This is likely a considerable under-estimate due to pressures of delivering 24/7 radiology services and NHS pension changes this year.

**Part-time working**

In 2012, one in five consultant radiologists worked part-time (one in four in London), a 2% increase on two years earlier, with women being much more likely than men to work part-time. In the under 35s, 16% of women work part-time. This compares with 0% of men in this age group. When they reach 60, men become more likely to opt for part time working.

Approximately one third of the total consultant clinical radiology workforce is female; the proportion is higher amongst consultants under 50. Of current trainees, 42% are female.

The increasing proportion of women entering the workforce is likely to increase the extent of part-time working in future years.

**The solution**

The RCR is actively taking steps to alleviate the problem:

- By encouraging the development of radiology networks to make the best use of the existing workforce, as described in our paper Radiology in the UK: the case for a new service model8
- By promoting recruitment from overseas
- Through ensuring that the radiology workplace environment supports a workforce that continues to be healthy can remain available to the NHS for longer.

Reporting times and speed of cancer diagnosis will only improve if there is a commitment to train at least 60 more radiologists per year over the coming years to address the chronic shortage of capacity.

Commitments the RCR would like to see in the new cancer strategy include:

- A sustained increase in the numbers of clinical radiologists in training throughout the UK to match the increase in demand for radiological investigation
A systematic approach to maximising the potential of the existing trained workforce including:

- New models of service delivery (see section on the organisation of diagnostic services)
- Facilitation of home working
- Optimising workplace health to reduce early retirement.

(These measures would go a little way to alleviate the current pressures before an enlarged radiologist workforce comes on stream.)

References


3. Improving the organisation of diagnostic radiology services

The problem

Although the primary problem facing radiology services in the UK is the significantly under-resourced radiologist workforce, it is likely that improvements in efficiency of the service could be achieved if services were organised differently. In the traditional model, radiologists are employed by acute trusts whose priorities for a radiology service are generally the imaging of acutely ill inpatients, sometimes at the expense of outpatients and patients referred from primary care for imaging tests. The RCR’s snapshot survey of reporting backlogs in England carried out in October 2014 demonstrated large numbers of patients waiting more than 30 days for the results of X-Rays, CT and MRI scans.1 Some of these cases will inevitably have resulted in a delay in the diagnosis or treatment of cancer.

A range of solutions

The RCR has proposed networking of radiology services in order to provide an integrated service to whole populations, with the resulting ability to smooth capacity and share specialist expertise over a larger area than that usually covered by a single acute trust.2 This would fit well with the move towards population based services advocated by the NHS Five Year Forward View and could be incorporated into some of the new models of care outlined therein.3

Consideration should also be given to the establishment of community-based diagnostic centres, separating the diagnostic imaging, as well as other tests, required by patients referred from primary care with suspected cancer, from inpatient imaging services. This model exists in Denmark but has yet to be piloted in the UK. Barriers to the implementation of such a service would include:

- The shortage of radiologists to support timely reporting of studies acquired in this setting
- The need for additional capital equipment – particularly ultrasound, CT and MRI machines – to be placed in community settings
- The need for integration of IT services and management support, with instant availability of previous imaging and other clinical data in order to avoid duplication of tests and unnecessary steps in the patient pathway
- Contractual and cultural issues related to the traditional model of employment.

Self-referral by patients for diagnostic imaging tests has been proposed as a potential model but is not considered appropriate by the RCR other than in a few, very specific circumstances. This could be considered when a patient is known to be at high risk of a certain complication of cancer or its treatment which has recognisable signs and a clear investigative pathway. Self-referral for MRI for suspected malignant spinal cord compression by a patient with known spinal metastases might be one example. In almost all other circumstances, imaging tests should follow clinical assessment by a suitably trained and experienced clinician including history taking and physical examination. Without this there is a strong likelihood that an unnecessary test or the wrong test may be arranged with the potential for false reassurance or other delays to the diagnostic pathway for that individual as well as creating delays for other patients with ‘red flag’ symptoms who are likely to have cancer.

The following are examples of good practice in cancer radiology and radiotherapy that the RCR would like to see replicated across the country.

1. When CT and MRI (or other combinations of tests) are requested together as part of cancer staging, they should be done at the same attendance, as a norm

2. Use of video-conferencing and other IT solutions should be maximised to ensure the correct expertise is available at all multidisciplinary team meetings (MDTMs)
3. The most effective test should be performed as early in the pathway as possible. There are often gains to be made in both clinical and cost effectiveness by requesting a relatively high-end imaging procedure early in the pathway rather than only when all other tests have been performed. An example is the early use of PET-CT in patients with potentially operable lung cancer found on chest X-ray.

There are existing IT solutions which have the potential to improve services but which are, as yet, infrequently available in the NHS. Examples include ‘airline booking’ of appointments for imaging tests, computerised ‘red flag’ alerts for unreported studies and for unexpected significant findings.

Commitments the RCR would like to see in the new cancer strategy include:

- Support for the development of networked radiology services
- Piloting and evaluation of the feasibility and impact of community based diagnostic centres
- Widespread implementation of IT solutions which support effective and efficient services including ‘airline booking’ of appointments and ‘red flag’ alerts for unreported studies and for significant unexpected findings.

References:
4. Radiotherapy

The rising incidence of cancer, the aging population and the drive towards earlier diagnosis will continue to increase the number of patients requiring treatment with radiotherapy.\textsuperscript{1,2} The increased conformity of radiotherapy from modern radiotherapy techniques increases the probability of local tumour cure and reduces the risk of side effects. Ensuring appropriate access to radiotherapy will be an important component of the initiative to achieve cancer survival rates equivalent to the best in Western Europe.\textsuperscript{3,4}

The ESTRO (European Society for Radiotherapy and Oncology) HERO (Health Economics of Radiation Oncology) project and other European comparisons set a standard for the provision of radiotherapy equipment and staffing.\textsuperscript{5–7} This project has reported that the provision of radiotherapy in many European countries is below what is optimum. The proportion of patients in the UK receiving radiotherapy is estimated to be approximately 65% of what is optimum.\textsuperscript{8}

Radiotherapy modalities and their development

**Image-guided radiotherapy (IGRT)**

IGRT involves the use of images taken at the time of treatment to ensure that the radiotherapy is delivered precisely as planned and allows adjustments to the treatment if necessary. Before, and sometimes during, a course of radiotherapy, images are acquired to ensure the treatment accurately targets the required area. This may involve taking X-ray images or moving the machine to get an image similar to a CT scan (cone beam CT – CBCT). The images are then compared to those taken during the radiotherapy planning process. IGRT is an essential component of advanced radiotherapy, including IMRT, Stereotactic Ablative (SABR) and proton therapy. All new linear accelerators need CBCT (or equivalent) technology.

**Intensity-modulated radiotherapy (IMRT)**

IMRT offers clinical benefit for radical radiotherapy for many cancers, predominantly due to increased conformality of the high-dose volume to the planning target volume and/or reduced dose inhomogeneity. The main clinical benefit is reduced toxicity, particularly late toxicity. This has been proven in multiple studies and RCTs for multiple clinical scenarios.

When introduced, IMRT represented an important new paradigm in radiotherapy planning and delivery. The RCR believes that the aim should be for radiotherapy centres to implement IMRT for the majority of radical courses of radiotherapy. Compared with European counterparts, the UK has been relatively slow to implement IMRT but initiatives over the past five years have partially addressed this. In England, overall access rates for IMRT now exceed the initial, 2009 target of 24% of patients to be treated by inverse-planned IMRT but there is still a wide variation in access rate between different centres. In a recent survey of English centres, five exceeded 40% but four centres did not achieve the 24% target.\textsuperscript{9}

The majority of patients being treated with IMRT have prostate or head and neck (H&N) cancer. Prostate and H&N cancer have the highest level of clinical evidence supporting the use of IMRT, accrued over many years. They have also been the subject of multiple UK-based clinical trials. There is greater variation in use of IMRT for the other major cancer types, for example for sarcoma sand brain tumours, centres ranged from treating 0% to 100% of their patients with IMRT. A recent survey has noted that total musculoskeletal (and anal) cancer patient numbers are low and the balance between local delivery and sub-specialised care should be reviewed.

A recent Radiotherapy Board review estimates that centres should be planning for the majority of their radical episodes to be delivered with inverse-planned IMRT. They need to ensure that their staffing levels, hardware and software licences reflect this. There is no upper limit of IMRT usage to which centres should be restricted and it should take over from 3D conformal radiotherapy as the ‘norm’.
Stereotactic ablative radiotherapy (SABR)
SABR is currently routinely commissioned for the curative treatment of patients with localised lung cancer, but the use of SABR in the UK for other indications falls significantly below its use in other Western European countries. Furthermore, the use of SABR for patients with lung cancer is limited by access to this technology.

NHS England has announced an extension of the Commissioning through Evaluation programme to innovative radiotherapy treatment, including SABR. This programme will enable the number of cancer patients eligible to access SABR treatment to rise significantly, by 750 new patients a year, and will include the treatment of oligometastatic disease, primary liver tumours, spinal tumours and the re-irradiation of cancers in the pelvis and other selected indications.

Proton therapy
NHS England plans to establish proton treatment centres in the Christie Hospital and University College London Hospitals (UCLH) from 2018. These will be state-of-the-art facilities offering treatment for approximately 1%–2% of patients with cancer requiring radiotherapy. Approximately one third of these will be children. It is expected that proton therapy for children will significantly reduce long-term side effects compared with conventional radiotherapy. For adults, the use of proton therapy will enable them to receive curative treatment which would otherwise have been not possible because of difficult tumour location and/or anatomy, increasing cure rates.

Stereotactic radiotherapy and radiosurgery (SRT and SRS)
Traditionally used for the treatment of arterio-venous malformations, SRS is increasingly used for the treatment of selected patients with brain tumours. There is currently an under-provision of SRS for patients with brain metastases. SRS facilities for patients with cancer need to be located within reasonable travelling times from patients seen by a neuro-oncology MDT.

Image-guided brachytherapy (IGBT)
IGBT is a means of treating gynaecological cancer with conformal brachytherapy, with the individualised dose distribution planned with MR scanning. The principles of volume-based dosimetry used in external beam radiotherapy (EBRT) are applied to brachytherapy. Through its use, local tumour control rates are significantly increased and late toxicity reduced. Although there is clear evidence of significantly improved outcomes and national professional guidance that IGBT should be routinely employed, there is variability in implementation. Brachytherapy services should be network based and configured to meet the needs of patients. Brachytherapy should only be carried out at centres with direct access to appropriate surgical oncology expertise for multidisciplinary patient assessment and treatment.

Workforce
The Radiotherapy Board has established a working party which will investigate necessary investment and also the means for optimising the use of the available skillmix (mainly clinical oncologists, medical physicists, therapy radiographers) in order to provide the necessary skilled multiprofessional workforce.

Commitments the RCR would like to see in the new cancer strategy include:

- IMRT becoming the norm for all appropriate indications
- Rapid development and uptake of other, newer forms of radiotherapy which demonstrate clinical and cost effectiveness
- The delivery of the first two proton beam centres on target as the start of a programme of expanding such treatment where indicated
- Investment in the size and training of the workforce to ensure that this range of new treatment options can be delivered in a timely manner.

References


5. Chemotherapy

The patient’s perspective

All patients should have access to a high-quality chemotherapy service to optimise cure rates and minimise morbidity in the curative and adjuvant setting and enhance quality of life in the palliative setting.¹ The RCR has recently published a special edition of Clinical Oncology focusing on evidence-based demand for cancer therapy.² It is thus essential to:

Optimise outcome and cure rates and minimise treatment related morbidity

In the curative setting:

- Patients should be treated according to agreed national guidelines of best practice
- New treatments should be quickly made available if level 1 evidence of benefit is shown in phase 3 clinical trials and subsequently approved via a NICE Technology Assessment. For drugs likely to be approved for clinical use by NICE, a mechanism for making them available in advance of NICE approval is recommended.
- The specific needs of older patients and those with complex pre-existing medical conditions should be addressed to allow safe delivery of chemotherapy. This will help to optimise access rates for these patient groups to potentially curative treatment²
- Adherence to protocol dose scheduling should be maintained by optimising toxicity management with rapid access to an oncology unscheduled care pathway via a 24-hour helpline and rapid access to diagnostics and intravenous antibiotics according to agreed national protocols
- Post chemotherapy, patients should have access to a rehabilitation programme, working with MacMillan Cancer Support, other charities and patient organisations. This should be universally available to enable patients to return to work where applicable and optimise their functional, physical and psychological recovery post treatment.³

In the palliative setting:

- Education of patients and their carers/families with optimal communication between hospital teams, primary care and palliative care teams through proper integrated community based care will improve continuity of management and help discussion about prognosis and palliative care planning. Chemotherapy delivery is just one aspect of patient management in the context of other, often complex health needs⁴
- Many palliative chemotherapy schedules can cause significant toxicity and it is important to involve the patient and their carers in honest discussions, highlighting the limitations in terms of short gains in life expectancy
- Timely access to diagnostic services to monitor the response to chemotherapy in the palliative setting is essential to avoid the toxicity of ineffective chemotherapy if disease progression is demonstrated. This approach is cost effective for the patient and the service
- Engagement with MacMillan Cancer Support and others to help patients understand the limitations of new treatments in a palliative situation and to avoid unrealistic expectations of cure or disease control is essential so as to enhance investment in community support services and avoid emotive demands for expensive and often toxic drugs often with very limited benefit.⁵ The RCR has already responded to a consultation about the change to the operational policy for the Cancer Drugs Fund.⁶

Develop the skillset of the workforce to deliver an integrated, high-quality, holistic, patient-centred chemotherapy service

- It is essential to empower the clinical and medical oncology consultant workforce to work effectively in clinical leadership roles to supervise and assure a high-quality chemotherapy service, mentoring and training clinical nurse specialists and pharmacists as non-medical prescribers, working to agreed national guidelines with local treatment guidelines and protocols in place.⁷
Changes in junior medical staff training, protected teaching and European working time directives mean doctors in training are no longer available to service busy chemotherapy clinics and appropriately trained clinical nurse specialists (CNS) and oncology pharmacists will provide a more robust, sustainable model of care.

The role of the oncology CNS is already well established with highly trained nurses acting as key workers, managing chemotherapy helplines, assessing and treating patients with the supervision of oncology consultants. This role should now be further expanded to include more universal adoption of non-medical prescribing with the CNS prescriber having their own caseload working independently but with support from the medical team. The challenges of this approach and development of effective medical and nursing team working for optimal patient care are described by Lennan et al.

Chemotherapy unit pharmacists have an essential role in quality assurance of the entire chemotherapy reconstitution and delivery processes and have excellent clinical knowledge of drug interactions. They are familiar with the challenges of polypharmacy in older patients and those with pre-existing complex medical conditions. Enhancing the role of pharmacists in clinical areas as a non-medical prescribers will help minimise medication errors, optimise communication across integrated healthcare and prove highly cost effective.

GP commissioning, with integration of unscheduled care pathways provides a tremendous opportunity for GPs to become more involved in management of oncology patients throughout their patient journey.

The proposed multispecialty community providers and other new models of care outlined in the NHS Five Year Forward View would potentially allow GPs to work more closely with oncologists throughout the patient’s chemotherapy journey. GPs developing a specific interest in oncology will help the challenge of earlier diagnosis, toxicity management during treatment and now established self-directed after care programmes post treatment.

Put in place infrastructure to support an optimal chemotherapy service

Unlike radiotherapy departments which are subject to rigorous standards and regular inspection (under the Ionising Radiation [Medical Exposures] Regulations [IRMER]), chemotherapy delivery is much more dispersed and data collection is difficult despite the tremendous progress made by the SACT data base team.

Implementation of e-prescribing by all treating units as mandated in the Improving Outcomes report 2014. Improved communication about the opportunities offered by SACT involvement within provider trusts and engagement with the central SACT team will help data quality, local usability of centrally collected SACT data and improve the value of SACT as a central governance and commissioning resource, as well as facilitating the study of the benefits of chemotherapy in ‘real world’ clinical practice.

Good communication with primary care should be implemented to allow pre-assessment blood tests to be checked and making results available via electronic laboratory systems before chemotherapy assessment.

Models of care close to home, especially weekly treatments, strategically managed by treating oncologists with treatment assessment and delivery by appropriately trained CNS should be standard.

Optimal management of acute life-threatening treatment-related complications should be achieved through locally agreed protocols with 24-hour helplines managed by cancer treating units liaising with primary care/paramedics/acute oncology/cancer specialist teams to avoid inappropriate attendance at accident and emergency departments (A&E) and minimise door to needle time for oncological assessment and intravenous antibiotics.

Commitments the RCR would like to see in the new cancer strategy include:

An evidence based approach to implementation of new drug therapies with health economic evaluation via NICE, with early access for drugs likely to be approved.
- All cancer centres and units should have the facility for networked electronic prescribing
- Continued development of the SACT Database, including robust morbidity and mortality data
- Understanding of the cost–benefit of SACT for elderly patients with cancer leading to rational and equitable use in this patient group.

References
6. Interventional oncology

What is interventional oncology?

Interventional oncology is an evolving branch of interventional radiology which relies on highly sophisticated treatment tools and precise imaging guidance to target and destroy malignant tumours. It sits alongside the traditional disciplines of medical, surgical and radiation oncology and describes a range of image-guided, minimally invasive techniques usually aimed at small volume or multifocal tumours. Techniques include microwave- and cryo-ablation and radio- and chemo-embolisation.

Interventional oncology will undoubtedly play an increasing role in the definitive management of small renal, liver and lung tumours, particularly as imaging is now frequently detecting asymptomatic smaller cancers at an early stage which may not merit open or even laparoscopic surgery. IO has significant potential benefits for patients and the healthcare system but, as a relatively new discipline, it has not yet fully established its place in the wider field of cancer treatment. It does not yet have a comprehensive evidence base or a clinical or quality assurance framework within which to operate. There are a few centres of excellence in the UK which have fully developed these novel treatments but many more patients would benefit if these services were more widely available.

Further research is required but the pressing need is to make provision for equitable access for patients across the UK to the best established treatments arising from within this developing area of cancer care.

Interventional radiology is an acute, front line clinical discipline that emerged from within a diagnostic specialty. The increasingly sophisticated and intricate techniques that were developed in diagnostic angiography provided the opportunity to adapt them for the treatment of patients. Interventional radiologists now treat conditions in almost every organ in the body. Their techniques cause minimal trauma to normal tissues, allowing rapid recovery and early return to work where applicable. They are less expensive than equivalent surgical methods as they involve a shorter stay in hospital and they are usually accompanied by fewer complications than surgery.1,2

Developments in interventional oncology

Until relatively recently, all interventional radiological procedures in the field of oncology were palliative rather than curative. Palliative procedures such as the drainage of malignant ascites and pleural collections can improve the quality of life of cancer patients. Percutaneous nephrostomy and ureteric stenting, percutaneous biliary drainage and other imaging-guided techniques make a major contribution to the quality of life of cancer patients.3–5

In recent decades, potentially curative interventional radiological methods of treatment such as ablation of tumours with laser, radiofrequency, microwaves, cryotherapy and irreversible electroporation have emerged and have been combined with palliative techniques to create the discipline of interventional oncology.6–12 Initially, such procedures were seen as ‘optional extras’ and were employed in those cancer patients in who other methods of therapy had failed or could not be used. However, as the number of patients treated using interventional radiological methods has increased, it has become obvious that, for at least some conditions, these techniques provide an attractive alternative to surgery. For example, small renal tumours can be ablated with minimal morbidity, a very short stay in hospital, a low rate of recurrence and preservation of renal function.13–17 In the liver, thermal ablation methods compare well with surgery in the treatment of hepatocellular carcinoma and are proving increasingly important in the management of liver metastases that are not amenable to surgical resection.18 In addition, percutaneous or intraoperative ablation of hepatic metastases is combined with surgical resection in patients in who either treatment modality alone is considered inappropriate.19–21 Radioembolisation and chemoembolisation are useful methods of stabilisation of disease in patients in who surgery or ablation are not appropriate.22–25
Percutaneous ablation is increasingly employed in the treatment of primary and metastatic malignant tumours in the lung. The relatively high local recurrence rate associated with radiofrequency ablation has led to the greater use of microwave and cryotherapy techniques, with promising results.26–31

It is important for those employing these techniques to undertake primary clinical responsibility for the patients they treat. The interventional radiologist must be in a position to manage the complications of the procedure personally, rather than delegating this task to the referring physician. Patients should be followed up regularly, to assess the response to the procedure, to establish whether further treatment is needed, and to assess the overall value of the treatment to the patient.

Elsewhere in this submission, we explore and explain the need for a significant increase in the number of doctors being trained in interventional radiology. That is clearly a prerequisite to delivering a more developed interventional oncology service. The RCR commits to work with the Taskforce and those who implement its recommendations to achieve this ambition.

Current areas of good practice

There are a few centres in the UK that offer a full clinical service in interventional oncology, examples include Guy’s and St Thomas’ Hospital in London (GSTT) and Southampton General Hospital.

At GSTT patients are admitted under the care of the treating interventional radiologist whose team is responsible for all aspects of care and follow-up. Adopting this pattern of practice across the UK would facilitate acceptance of interventional oncology as an integral part of cancer care.

The biggest barrier to improving services for cancer patients

The number of patients who could benefit from potentially curative interventional oncological techniques is much larger than the number currently referred. The most significant reason for the limited access to this discipline is the lack of an adequate number of interventional radiologists.

Commitments the RCR would like to see in the new cancer strategy include:

- The development of interventional oncology, providing equitable access to techniques of proven value and expanding the evidence base for innovative approaches to minimally invasive forms of cancer treatment
- Training more interventional radiologists who can undertake interventional oncology procedures.

References


7. Equipment

Diagnostic Imaging

The principal radiology tools employed in cancer diagnosis, treatment response assessment and follow-up are ultrasound, mammography, CT, MRI and PET-CT.

International comparisons show that the UK has a smaller installed base of all the main types of equipment than other comparable nations. The deficit is most stark in relation to CT scanners, where a recent report from the industry organisation European Coordination Committee of the Radiological, Electromedical and Healthcare IT Industry (COCIR) showed that the UK has fewer CT scanners per head of population than anywhere else in Europe apart from Serbia. Figures from the most recent Organisation for Economic Cooperation and Development (OECD) statistics, to which the UK submitted data (2010–13) are shown in the table below.1–3

<table>
<thead>
<tr>
<th>Modality</th>
<th>UK scanners/million</th>
<th>OECD mean scanners/million</th>
<th>OECD range</th>
</tr>
</thead>
<tbody>
<tr>
<td>CT</td>
<td>8.95</td>
<td>25.00</td>
<td>5.10 (Mexico) – 101.00 (Japan)</td>
</tr>
<tr>
<td>MRI</td>
<td>6.90</td>
<td>11.40</td>
<td>2.20 (Mexico) – 35.50 (USA)</td>
</tr>
<tr>
<td>Mammography</td>
<td>8.55</td>
<td>19.60</td>
<td>8.55 (UK) – 55.70 (Korea)</td>
</tr>
</tbody>
</table>

Perhaps related in part to this deficiency, the utilisation rates of CT in the UK are significantly lower than other countries – estimated by OECD at around 60% of that of other comparable nations over the 2010–13 period. The UK utilisation rate is estimated at 71 per 1,000 population per annum compared with an OECD basket of peers of 125 per 1000. Utilisation of MRI is also significantly lower than comparators.

As described elsewhere in this submission, the RCR would like to see a significant reduction in the time patients are waiting for imaging tests and particularly for the results of tests once performed. The current installed base of CT and MRI scanners, the great majority of which are sited within acute hospitals, is under severe pressure and sustained investment is required both in new and replacement scanners over the next three years.

The figures which follow are estimates and the RCR would be happy to work with the Taskforce in undertaking more precise modelling but our current view is that the requirements are as follows:

- The installed base of CT scanners should increase by a third from around 500 machines to around 666 machines, costing £74 million at £450,000 per item
- The installed MRI base should increase by about a fifth from 440 machines to 520 machines costing about £52 million at £650,000 per machine
- Significant capital funding for accommodation to house these machines whether in an acute hospital or community setting. This is estimated at an average of £1 million per machine
- It should be ensured that all mammography equipment is converted to digital facility and for further investment in mammography equipment to increase the installed base by 25%, from 555 machines to 700 (£40 million at £250,000 per machine) and capital funding for accommodation £250,000 per build (£40 million)
- Strategic planning and co-ordination of this capital investment is required at national level to ensure best value for the NHS.
Further important considerations are the need to minimise radiation dose, particularly to patients in a diagnostic setting who are at relatively low risk of harbouring malignancy. This means that all CT machines in particular should have the latest dose control features. To enable this, there must be a robust programme of replacement of machines at the end of their lives and definitely when ten years old.

Radiotherapy

Linear accelerator replacement
Aging linear accelerators are subject to technical problems and are limited with respect to the ability to deliver modern radiotherapy modalities. An NHS England report in 2012 stated that 26 of 265 linear accelerators were past their recommended replacement age and that a further 59 would require replacement within the next three years. A more recent estimate is that 120 will require replacement by 2017.

There should be a 'stock-take' of current radiotherapy equipment and a phased approach to any nationally driven initiative for replacing radiotherapy equipment. This should have national oversight and it should be linked to robust planning over a number of years. This initiative should explore all options, including leasing, but should be underpinned by a robust specification to ensure the latest technology is available to providers.

Machine technological capability
New and replacement equipment should be capable of delivering the techniques described in section 4 including IGRT, IMRT and where necessary, SABR, SRS and SRT. New and replacement linear accelerators should be linked to the appropriate planning technology including 4D CT. Increasingly, novel means of acquiring imaging for planning are being explored, including PET-CT and MRI.

Cost-efficiencies in the system for example Quality Innovation Productivity and Prevention (QIPP)
The implementation of clinical trial evidence-based hypofractionation protocols could mean that fewer additional linear accelerators might be needed but this does need to be future proofed so that innovation also leads to better use of capacity while driving quality improvement in terms of quality, patient experience and outcomes.

Furthermore, although hypofractionation may reduce linear accelerator requirements overall, these necessary techniques require considerable input with respect to IGRT and techniques tend to be complex in terms of physics planning and quality assurance.

Information technology
The evolution of the RTDS has provided invaluable information on radiotherapy equipment utilisation according to population parameters. It is essential that the continued support and expansion of this dataset is fully funded. Furthermore, it is important that data can be used to enable comparisons within the UK and internationally, particularly within Europe.

Commitments the RCR would like to see in the new cancer strategy include:

- A centrally funded programme of replacement and additional CT and MRI machines to bring the installed base of cancer scanners in the UK closer to European norms
- Replacement of aging linear accelerators through a co-ordinated national programme

References
8. Data collection and analysis

Clinical oncology

Improvement requires a benchmark from which progress can be made and against which comparisons with other healthcare systems can be made. In the management of cancer using radiotherapy and chemotherapy, there is a wealth of published literature on efficacy based on RCTs but there is limited national activity and outcome data from the UK. It is known that clinical trial data typically overestimates the effect that will be seen when an intervention is translated into the general community. Contradictory effects may also be seen as evidenced by a number of the Surveillance, Epidemiology and End Results Program (SEER) analyses from the USA. Unless population-based data can be collected, linked and analysed progress will be severely hampered.

In the UK we have a comprehensive cancer registry network collecting demographic and survival data but this currently exists in isolation from details of intervention, other than the fact of the provision of surgery, radiotherapy or chemotherapy, and without data on recurrence of cancer or toxicity; second malignancies may be captured but this is not reliable. National audits on breast and prostate cancer have been initiated but with no resources for data capture from these audits their quality and value will be uncertain.

The UK has a unique, comprehensive radiotherapy activity database, the RTDS, initiated some years ago by the Natcansat team at Clatterbridge and subsequently funded and promoted by the former National Cancer Action Team (NCAT) in England. Data collection on a monthly basis has been achieved from 100% of radiotherapy centres for the past three years. Changes in the structure of the NHS in April 2013 resulting in the demise of the NCAT have meant that ownership of the RTDS has now passed to Public Health England (PHE) and currently negotiations to withdraw the RTDS from Natcansat and incorporate it within the cancer registry system are underway. There are concerns that this may destabilise a highly effective network.

More recently mandated in 2013, a similar chemotherapy data set, the SACT dataset, was established, run through the Oxford cancer registry. Compliance with data returns has been less comprehensive reflecting the patchy uptake of electronic prescribing systems and the use of chemotherapy in district general hospitals away from main cancer centres.

The existence of these two large datasets offers a great opportunity for both defining a benchmark and monitoring compliance with changes in service. Current achievements include:

1. Web-based data access to radiotherapy and chemotherapy data and for RTDS inclusion in the Cancer Commissioning Toolkit (CCT) providing quarterly updated activity analyses

2. RTDS being used to populate the radiotherapy dashboard to monitor compliance with Commissioning for Quality and Innovation Payment Network (CQUIN) targets

3. Publication of radiotherapy activity in relation to demographics identifying variations in practice and inequalities in access and delivery

4. Biannual radiotherapy equipment surveys mapping radiotherapy equipment throughout England and workforce surveys mapping radiotherapy workforce throughout England

5. Collaboration in the European HERO project mapping radiotherapy resources across Europe and now published

6. Numerous ad hoc reports for local cancer centres and networks planning changes in radiotherapy delivery.

Despite these achievements, much more could be delivered with appropriate support and infrastructure around these datasets. Specific issues which should be considered integral to a new cancer strategy might include:
7. A long-term commitment to maintaining RTDS and SACT which extends to all four UK nations. This would include maintenance of the associated software extraction tools and quality assurance essential for efficient and comprehensive downloads from hospitals delivering the data to the central repository for several years, and in many of these cases well designed and feasible RCTs may not be possible. The concept of ‘innovation through commissioning’ can only be effectively delivered if reliable quality assured data is available for such evaluations on a population basis.

8. Stabilisation of the current situation with regard to RTDS and its administration ensuring that historical data is retained and compatible with ongoing databases.

9. Investment in solutions to allow linkage between the RTDS and SACT and registry data for outcome and HES and national GP data for hospital and community consequences of interventions.

10. National integrated electronic data capture including electronic patient records linked to laboratory and radiological data with appropriate local resources to ensure their maintenance and data quality.

11. Development of a process for regular review of the data fields to ensure that they remain current and new activities are captured.

Opportunities for delivery of significantly improved cancer services resulting from these proposals would include:

12. Close collaboration with commissioning processes which will inform on the impact of changes in practice and their consequences. Hospitals and cancer centres which are not delivering treatment in line with the commissioning blueprint will be readily identified; outliers can be seen and addressed and the impact of any changes can be measured in terms of treatment outcome.

13. Exploration of new paradigms to evaluate novel interventions based on population outcome data rather than RCTs. In many areas, particularly in recent times in relation to new radiotherapy techniques, UK practice has lagged behind similar countries because of the insistence from commissioners that gold standard RCT evidence is presented before funding is allocated. This may deny UK patients access to state of the art interventions, such as IMRT, IGRT and SBRT.

14. Engagement with the research community through the Clinical and Translational Radiotherapy Research Working Group (CTRAD), site-specific National Institute for Health Research (NIHR) groups and National Cancer Intelligence Network (NCIN) site specific groups to develop a comprehensive, co-ordinated research programme optimising use of the datasets and the enormous potential for linkage with detailed demographic and outcome data. This will enable high-quality research to inform the optimal use of radiotherapy and chemotherapy, identify population based factors which may hamper access or delivery, address issues related to equality and diversity in delivery of cancer treatment and model trends in cancer treatment and survival.

These aspirations depend critically upon adequate investment in data collection, data storage and timely data analysis with close collaboration between the clinical oncology community and those charged to deliver this activity. Investment in research and development through the NIHR and charities will also be a critical component in optimising the vast opportunities offered by this development.

Commitments the RCR would like to see in the new cancer strategy include:

- A long-term commitment to maintaining RTDS and SACT, the Radiotherapy and Chemotherapy datasets. This would include maintenance of the associated software extraction tools and quality assurance essential for efficient and comprehensive downloads from hospitals delivering the data to the central repository.
- Stabilisation of the current situation with regard to RTDS and its administration ensuring that the historical data is retained and compatible with ongoing databases.
- Investment in solutions to allow linkage between the RTDS and SACT and registry data for outcome and HES and national GP data for hospital and community consequences of interventions. This would allow exploration of new paradigms to evaluate novel interventions based on population outcome data rather than RCTs.

- National integrated electronic data capture including electronic patient records linked to laboratory and radiological data with appropriate local resources to ensure their maintenance and data quality.

Clinical radiology

There is a need to generate the best possible value from available data. Datasets such as the National Cancer Registration Service (NCRS) and Diagnostic Imaging Dataset (DID) should be linked and data from treatment and diagnostic activity from HES should be similarly linked at anonymised patient level. This has been well documented in the latest National Audit Office review of delivery of the last cancer strategy.7 Concerns about patient confidentiality have reduced the effective flow of data in the system, making data linkage more difficult and putting effective strategic planning at risk. With good data linkage it will be possible to estimate effective intervention rates for diagnostic tests more accurately.

Collaborative, centralised data collection of therapeutic interventional radiology procedures would provide objective evidence of clinical outcomes to support clinical decision making and commissioning. National registries are required for index procedures including biliary, oesophageal and colonic stenting, radiofrequency and cryo-ablation, bland and chemo-embolisation, venting gastrostomy for bowel obstruction versus nasogastric tubes and so on. This could be coordinated by the BSIR with technical support to set up the registries online.

Centralised data collection has the potential rapidly to address some key questions surrounding the use of novel therapeutics in personalised healthcare. Well standardised CT, MRI and PET are available for many thousands of patients treated with targeted agents such as Vascular Endothelial Growth Factor (VEGF) inhibitors. Small, single-centre studies suggest that quantitative biomarkers derived from CT, MRI and PET may be prognostic and even predictive of patient benefit with some of these agents. Evaluation of large datasets – ideally placed in a national cancer imaging databank, akin to a Biobank – would enable rapid, cost-effective evaluation of critical research questions and could be readily achieved (with investment into secure data anonymisation, storage and archiving). This could change how conventional imaging data is used in personalised healthcare. This idea has strong support from radiologists and imaging experts in the four Cancer Research UK Engineering and Physical Sciences Research Council (CRUK-EPSRC) cancer imaging centres but needs to be part of a co-ordinated funded strategy.

More information about diagnostic equipment availability, usage and its age would facilitate better commissioning for cancer patients and for imaging services generally. While the DID reports information about diagnostic tests that may diagnose cancer, as well as other health conditions, it does not include the time taken to report those tests or efficiency data, such as the number examinations per machine being used by each trust. The NHS would benefit from being able to benchmark rates of machine use effectively.

It is not possible to separate diagnostic imaging activity for cancer from that for other conditions in a meaningful way as all data on diagnostic services are for all registered patients regardless of health condition. It would be ideal to collect data by referral criteria or subsequent diagnosis to enable effective service commissioning.

In 2012, the NHS England Operating Framework introduced an expectation that fewer than 1% of patients should wait six weeks or longer for a diagnostic test, including those for cancer. To meet this aspiration, better data is needed and more meaningful measurements, including when an accurate report of a diagnostic test is available for clinical decision making will help improve cancer outcomes.
Commitments that the RCR would like to see in a new cancer strategy include:

- Networked ways of working with effective image and report sharing and agreed cancer imaging protocols to avoid duplication of imaging studies
- Routine monitoring of time from referral to report verification and not just time to test being performed
- Functional linkage of imaging data via the DID to HES, cancer registries and cancer audit data. We understand that the Health and Social Care Information Centre (HSCIC) have costing data for this if required
- The establishment and maintenance of national registries for novel as well as established interventional radiological procedures allowing comparison of outcome data and establishing efficacy.

References
1. www.rtds.nhs.uk/microsite/rtds/ (last accessed 26/02/2015)
2. www.chemodataset.nhs.uk (last accessed 26/02/2015)
9. Research

Clinical radiology

There is enormous scope for further expanding the role of imaging in cancer research. This includes both the primary roles of novel as well as established imaging techniques in, for example, early diagnosis of cancer, accurate guidance of targeted treatments, evaluation of treatment response, monitoring and surveillance of cancer patients and so on, as well as ‘secondary’ uses of imaging to evaluate new treatments and, of course, in improving our understanding of the biology of the disease and its response to intervention. A full description is not possible in the space available. In this section a number of general measures which could facilitate imaging research are outlined, followed by some specific examples.

Facilitation of research

A number of general measures could be considered which would facilitate the role and effectiveness of imaging in cancer research. These are listed in outline below. Further detail on any of these could be provided on request.

1. Reintroduction of subventions instead of excess treatment costs for imaging examinations

2. Increasing the funding envelope for studies involving complex imaging examinations

3. Promoting more biomarker validation studies (usually around 400 patient size studies)

4. Funding of more radiology clinical Fellows and more academic consultant radiologist positions with an interest in molecular imaging and oncology imaging

5. Funding of more clinical scientists in imaging to promote both novel MR techniques, and developments in PET physics and radiochemistry

6. Promoting the adoption of unified imaging protocols for different organs to enable pooling of studies from different trials

7. Developing an imaging repository for data mining (see data section of this submission)

8. Combining imaging/genomic/phenotyped repository for tumours at baseline and at follow-up in different clinical trials and in clinical practice

9. Encouraging imaging vendors to standardise analysis tools so as to facilitate multicentre studies

10. Creating an MR quality assurance (QA) hub along the lines of the National Cancer Research Institute (NCRI) PET Core Lab

11. Collecting all raw data from NHS Breast Screening Programme mammograms to allow density measurements and subsequent data analysis.

Specific areas for development

1. There is an increasing evidence base supporting multisequence whole body MRI staging of certain cancers as a superior and cost effective alternative to conventional imaging techniques using X-rays. Examples include multiple myeloma as well as large scale trials in lung and colon cancer currently underway in the NHS. Appropriate implementation of whole body MRI staging techniques should be considered in order to replace current resource intensive multimodality staging pathways.

2. Several functional imaging techniques – notably CT perfusion and MRI diffusion weighted imaging – are supported by an increasingly strong evidence base as clinically useful biomarkers of tumour phenotype, prognosis and treatment response, and are the subject of multicentre clinical trials in the NHS. Implementation is hampered by a lack of standardisation in data acquisition and analysis which requires appropriate investment as a prelude to dissemination. The objective should be to standardise and implement functional imaging techniques.
as biomarkers of tumour phenotype, prognosis and treatment response.

3. Many promising imaging technologies and analysis techniques will require significant investment by research bodies such as the NIHR to evaluate their clinical and cost-effectiveness such that appropriate evidence based implementation can be realised. **Clinical trials of nascent technologies such as PET-MRI, high field strength MRI and hyperpolarised MRI, novel FDG tracers and advanced image analysis techniques such as textural analysis should be funded and organised.**

4. Digital breast tomosynthesis (DBT) is a 3D imaging modality in which tomographic images of the breast are reconstructed from multiple low dose projection images acquired by moving the X-ray tube over a limited angular range. Results from the TOMMY Trial (a comparison of TOMosynthesis with digital MammographY in the UK NHS Breast Screening Programme), a large, retrospective reading study, show a modest 2% improvement in cancer detection rate for DBT+2D compared with 2D alone, but a clear improvement of 11% in specificity.\(^1\,^2\) This technology is ready for adoption in the UK. **DBT should be adopted in the breast screening programme, medium and high risk screening and in symptomatic clinics.\(^2\,^4\)\(^2\)**

**Barriers to improving research**

The biggest barrier to improving radiology services and imaging research for cancer patients is a shortage of consultant radiologists. Services under pressure are unable to undertake research and this becomes a barrier to recruitment.

Commitments the RCR would like to see in the new cancer strategy include:

- Adoption of functional biomarkers for stratifying patients and monitoring treatments – dynamic contrast-enhanced CT (DCE CT), DCE MRI identifying patients with more vascular lesions, DW MRI for metastases
- More research on early diagnostics for oesophageal cancer, ovarian cancer and lung screening with combined imaging and genomics
- Further research and evaluation of interventional techniques as described in section 6.

**Radiotherapy**

The next steps required in improving radiotherapy services in the UK are as follows.

- **Further reduction of waiting times** in the cancer pathway, including reduction in time to surgery, reduction in time to radiotherapy and, if necessary, reduction in time to chemotherapy. Every patient starting a radical course of radiotherapy should be able to commence treatment within two weeks of the decision to treat
- Every cancer patient should have access to the latest radiotherapy techniques and technologies for treating their cancer with maximum efficacy and safety, supported by the relevant tariff
- Every cancer patient should have the opportunity to take part in clinical trials which will evaluate ways of improving outcomes for cancer

These goals require a commitment to a continuing policy of service innovation and equipment replacement enabling innovation in radiotherapy treatment and imaging to remain a part of everyday practice across the UK cancer service in a culture which uses these opportunities effectively. They also require a commitment to providing resource for timely imaging, for staging (during the cancer pathway) and treatment planning, but also in follow-up. Outcomes for cancer patients have improved to 50% overall ten year survival. If we are to achieve a further reduction in cancer-related mortality then a continuing commitment to removing barriers to research must be supported in the cancer service.
Examples of good practice in radiotherapy that the RCR would like to see replicated across the country

The roll out of IMRT and stereotactic radiotherapy across the UK has seen the late but ultimately effective implementation of these new techniques which reduce side effects for the majority of patients treated with radical radiotherapy. This came about through clear setting of standards (24% of radical treatments to use IMRT by the end of 2012) through the former NCAT (England). The delay in SBRT roll out is further hampered by tariff and commissioning restriction. The same focus needs to be applied to the next generation of innovative techniques which will further improve the tolerability and efficacy of radiotherapy, with a responsive commissioning structure to allow for their early adoption based on support for clinical trials or commissioning through evaluation. One fundamental paradox for radiotherapy in the UK is that we are unable to provide evidence for a new technique or a new piece of equipment if there is no installed base in the UK. Where a greater level of evidence is required in this country, it is quite likely that the evidence will only be provided by work done here. In which case, appropriate provision of new technologies needs to be made so that these can be fully evaluated.

New techniques and technologies for implementation in the near future include:

- **SABR** for sites outside lung and brain, including liver and oligo-metastatic disease. This delivers curative doses in few fractions with high cost effectiveness.

- **Integration of advanced imaging into radiotherapy planning.** PET and MRI scans are used routinely to evaluate tumour anatomy and spread but are not yet used routinely to guide radiotherapy planning, where they have been shown to increase accuracy and reproducibility of plans. Greater use of co-registration of imaging and integration of functional (for example, DCE MRI, DW MRI and PET) imaging in radiotherapy planning enables increased accuracy in the planning process. The development of MRI-PET scanners bringing together these two powerful functional imaging approaches should be evaluated and supported in a timely way.

- **IGRT** with 4D adaptive radiotherapy: this ensures radiotherapy treatment is hitting the cancer every day, allows reduction in margins around the tumour and adapts treatment in the light of changing tumour anatomy during treatment (for example, tumour shrinkage, lung re-expansion and so on). The development and introduction of MRI-Linear accelerators will bring this to a new level of safety and efficacy and should be supported.

- **Collaboration of radiology services with radiotherapy services** in radiotherapy planning. As radiotherapy planning becomes more precise, the close collaboration of radiology consultants inputting expertise in image interpretation improves radiotherapy treatment planning accuracy. This should be reflected in radiology job plans in cancer centres.

- **Proton beam therapy** will be introduced in the coming three years into the NHS and research based clinical practice. Proton beam therapy provides much improved targeting of the dose to the tumour and sparing of normal tissues. This is applicable to many clinical settings and development of its utility must be supported through research and commissioning routes.

How to improve standards of radiotherapy services for cancer patients

If every patient starting a radical course of radiotherapy is to commence treatment within two weeks of the decision to treat and treatments incorporated the appropriate evidence-based novel techniques and technologies, this would require a change in the nature of working practice. This is routinely achieved in European cancer centres where, in many centres, patients commence treatment within five days of the decision to treat and novel techniques are introduced rapidly, delivering clinically excellent treatment. The biggest barrier is the presence of insufficient flexibility within the workforce and allocation of technological resources in the NHS service in radiotherapy. This contrasts with many other specialties, in which innovation is a continuing process transforming the clinical service and improving outcomes. Haematology is a good example of this clinical excellence, with close integration between laboratories and clinics, research and service and very high clinical trial accrual.
In order to achieve innovation in the radiotherapy service, the following steps need to be taken.

- Attention should be given to unreasonable pressures of work (consultant clinical oncology figures as reported in the RCR oncology workforce census), and the provision of adequate ring-fenced time for radiotherapy planning and review in consultant job plans.\(^6\)

- More flexibility is needed in training programmes, making it easier for trainees to take out of programme experience or change discipline from clinical oncology and radiotherapy physics (Modernising Scientific Careers).\(^7\)

- A more innovative approach to radiotherapy practice should be facilitated, building on the principles that innovative radiotherapy techniques generally reduce the risk of toxicity and improve long-term quality of survival.

- More attention should be given to resources. In most cancer centres, resources for imaging treatment planning, and treatment delivery are stretched to the limit. A relatively modest increase would provide much better flexibility and would allow the shortening of waiting times.

- Improved resources for technical radiotherapy research and development should be made available, with enhanced opportunity for co-investment from equipment manufacturers.

- Greater understanding is needed from research funding bodies of the importance of research into the application of innovative technologies.

To achieve the best possible outcomes, radiotherapy services require a change in culture which needs to be clinically led, evidence-based, informed by research and innovation-orientated. This will happen through training and empowerment of clinical and research leaders. The opportunity to take time out of training to undertake research will foster this attitude in the medical and physics workforces, training people to think imaginatively and critically, to develop and implement novel approaches and to change the culture. For this to be achieved, training institutions will need to consider the optimum pathway from medical school through to consultant appointment, and not necessarily via the shortest route.

Part of the solution should be the establishment of better networks between cancer centres (such as the Experimental Cancer Medicine Centre [ECMC] for research and NHS England Commissioning through Evaluation for referrals for highly specialised treatments only available in a few centres in the UK). This should improve the quality of care and equity of access.

Commitments the RCR would like to see in a new cancer strategy include:

- A change in attitude to innovation such that every patient has access to the latest evidence-based radiotherapy technology and techniques

- Development of a responsive commissioning structure and provision of resources in order to allow for the early adoption of novel techniques

- Support for clinical trial or commissioning through evaluation

- A review of academic training and provision of the necessary support and flexibility in order to achieve an academic profile comparable with the best in Western Europe.

References


10. Survivorship

The Taskforce should give high priority to the needs of the 2.5 million people living with cancer, many of whom struggle with long-term physical, psychosocial and financial effects of treatment for which very few services or support exist. The vision and work of the National Cancer Survivorship Initiative (NCSI) should be built upon. The many potential benefits for patients of improved survival will not be realised unless rehabilitation after cancer treatment, effective follow-up care and adequate detection and management of consequences of treatment are implemented.

Shifting the system towards truly person-centred care

A shift toward person-centred care is needed. To achieve this, the role of professionals and the patient needs to change. People affected by cancer need to have the right information, support and confidence to choose and control their treatment and follow-up. At the same time, the system needs to allow time for professionals to adapt to new models of working. It is important to ensure training of oncologists, therapeutic radiographers and nurses to understand how they can support the rehabilitation of patients after cancer treatment through the use of emerging competence frameworks and clinical guidance. 1–4

The recovery package and stratified follow-up

The RCR supports the recovery package intervention at the end of treatment, its key aspects being holistic needs assessment, a treatment summary, a cancer care review in primary care and a health and well-being clinic. 5 In addition, the widespread implementation of stratified cancer patient follow-up could release up to £90 million over five years.6 Protocols with fail safe mechanisms are needed so that if patients do not attend for tests or if a test is abnormal then reassessment is triggered, or if the patient has concerns then they have open access back to secondary care through a trusted route.

Information needs of people living with and beyond cancer

It is estimated that there are currently 500,000 living with the consequence of cancer and many more are at future risk of common illnesses such as osteoporosis, other musculoskeletal diseases, cardiovascular/cerebrovascular disease as well as second malignancy. 7,8 Many of these individuals can be supported to self-manage their problems if they are provided with personalised support and information in a timely way. This could prevent problems emerging, such as by preventing lymphoedema by avoiding stress/damage to the limb at risk, by preventing erectile dysfunction through early penile rehabilitation or by preventing fatigue, osteoporosis, depression or cancer recurrence through physical activity. 9–11 Patients should have information to help them to get back to work. However, the most recent Cancer Patient Experience Survey reported that 34% of patients were not informed about the long term side effects of treatment and responses to this question have not improved over time.12 There remains significant scope to improve how and when patients are provided with information throughout their cancer journey and are helped to minimise the effects on their quality of life.

All professionals should be aware that cancer is covered by the Equality Act.

Identifying people with post-treatment needs

A key priority is to ensure that cancer treatment is coded in primary care records to allow those at risk or requiring attention to be identified and appropriate advice offered. This should be achievable by mandating the production of a treatment summary by the oncology team, including Read codes for radiotherapy and chemotherapy.

One of the main barriers to people receiving timely care for post-treatment needs is the willingness of cancer teams and other professionals to initiate conversations about problems that for whatever reason the patient
may be reluctant to mention themselves. Trigger questions or patient reported outcome measures (PROMs) can assist with this.

**Tiered service models for consequences of treatment**

As stated above, many people can be supported to self-manage after treatment, but a minority will need specialist help. There is clear evidence from the National Cancer Survivorship Initiative Pelvic Cancer Project that many people with persistent treatment related symptoms can experience a very adverse impact on life quality, for example, poor bowel control after pelvic radiotherapy. If a case is not complex, specialist care can often be delivered locally, for example via a gastroenterologist or a dietetics service. However, there is very patchy access to suitably experienced professionals, hence any complex cases which involve effects on bladder, bone, sexual function and psychological problems and which require team expertise not currently available in any provider means that people are left for years in very distressing circumstances.

The tiered service model developed by the Pelvic Cancer Project should be commissioned, so that local care pathways are developed by clinical commissioning groups and a small number of supra-regional specialist teams are created to manage the highly complex cases. The supra-regional teams will act as a hub for advice, education and research which will enable local secondary and primary care to develop their knowledge and clinical skills to manage the growing number of people living with and beyond cancer. A similar case can be made for other post-treatment syndromes such as multiple health problem experienced by adult survivors of childhood cancer and people with brachial plexopathy. Significant savings could be made if more was done to ensure that patients do not need inpatient care for non-cancer complications of their cancer treatment.

**Using data**

It is vital that attention is given to the collection and use of new and existing patient datasets that can demonstrate clinical improvements and quality of life outcomes, so that we no longer have only the survival outcome end-point that cancer services are currently measured by. The experience of other NHS services with mandatory PROMs should be used to develop collection of routine data on patient outcomes, which has the potential to be linked to HES and cancer registry databases to create powerful longitudinal data on patients throughout their cancer journey. This information has the potential to be used for a range of purposes, such as provider audit, evidence of need in the population, and also (if PROM data is used in real-time) to trigger patient care pathways for problems arising after treatment.

**Co-morbidities and incurable but treatable cancer**

There is an increasing number of people living with incurable but treatable cancer or with active disease which is not optimally managed because of co-morbidities. These patients are poorly served. There is a need systematically to record recurrence using imaging techniques so biopsy is not the only systematically recorded evidence to date the recurrence in disease registries. Many people with metastatic disease can live productive lives and will be the most expensive cohort where the decision-making about new anti-cancer treatment and palliative care is difficult.

Commitments the RCR would like to see in a new cancer strategy include:

- A high priority given to the needs of people living with cancer for who very few services or support exist
- A shift toward person-centred care by giving people affected by cancer the right information, support and confidence to choose and control their treatment and follow-up
- Cancer treatment coded in primary care records to allow those at risk or requiring attention to be identified and offered appropriate advice
- Attention given to the collection and use of new and existing patient datasets that demonstrate clinical improvements and quality of life outcomes.
References


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- Professor Stuart Taylor
- Virginia Wykes

Overall editing and compilation was by Dr Giles Maskell and Andrew Hall.
**Appendix 2. Glossary**

<table>
<thead>
<tr>
<th>Abbreviation</th>
<th>Description</th>
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<tbody>
<tr>
<td>A&amp;E</td>
<td>accident and emergency department</td>
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<tr>
<td>AAC</td>
<td>Advisory Appointments Committee</td>
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<tr>
<td>AFP</td>
<td>alpha-fetoprotein</td>
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<tr>
<td>BMJ</td>
<td>British Medical Journal</td>
</tr>
<tr>
<td>BSBR</td>
<td>British Society of Breast Radiology</td>
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<tr>
<td>BSG</td>
<td>British Society of Gastroenterology</td>
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<tr>
<td>BSGAR</td>
<td>British Society of Gastrointestinal and Abdominal Radiology</td>
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<tr>
<td>BSIR</td>
<td>British Society of Interventional Radiology</td>
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<tr>
<td>CBCT</td>
<td>cone beam computed tomography</td>
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<tr>
<td>CCG</td>
<td>clinical commissioning group</td>
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<td>CCT</td>
<td>Cancer Commissioning Toolkit</td>
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<td>CNS</td>
<td>clinical nurse specialists</td>
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<tr>
<td>COCIR</td>
<td>European Coordination Committee of the Radiological, Electromedical and Healthcare IT Industry</td>
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<td>CQC</td>
<td>Care Quality Commission</td>
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<td>CQIN</td>
<td>Commissioning for Quality and Innovation Payment Network</td>
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<tr>
<td>CRUK</td>
<td>Cancer Research UK</td>
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<tr>
<td>CRUK-EPSRC</td>
<td>Cancer Research UK Engineering and Physical Sciences Research Council</td>
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<tr>
<td>CT</td>
<td>computed tomography</td>
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<tr>
<td>CTRAD</td>
<td>Clinical and Translational Radiotherapy Research Working Group</td>
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<tr>
<td>DBT</td>
<td>digital breast tomosynthesis</td>
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<tr>
<td>DCE-CT</td>
<td>dynamic contrast-enhanced computed tomography</td>
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<tr>
<td>DCE-MRI</td>
<td>dynamic contrast-enhanced magnetic resonance imaging</td>
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<tr>
<td>DH</td>
<td>Department of Health</td>
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<tr>
<td>DID</td>
<td>Diagnostic Imaging Dataset</td>
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<td>DW-MRI</td>
<td>diffusion-weighted magnetic resonance imaging</td>
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<td>Acronym</td>
<td>Full Form</td>
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<tr>
<td>EBRT</td>
<td>external beam radiotherapy</td>
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<tr>
<td>ECMC</td>
<td>Experimental Cancer Medicine Centre</td>
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<tr>
<td>ESTRO</td>
<td>European Society for Radiotherapy and Oncology</td>
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<tr>
<td>GP</td>
<td>general practitioner</td>
</tr>
<tr>
<td>GSTT</td>
<td>Guy’s and St Thomas’ Hospital in London</td>
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<tr>
<td>H&amp;N</td>
<td>head and neck</td>
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<tr>
<td>HERO</td>
<td>Health Economics of Radiation Oncology</td>
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<td>HES</td>
<td>hospital episode data</td>
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<tr>
<td>HSCIC</td>
<td>Health and Social Care Information Centre</td>
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<tr>
<td>IGBT</td>
<td>Image-guided brachytherapy</td>
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<td>IGRT</td>
<td>Image-guided radiotherapy</td>
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<tr>
<td>IMRT</td>
<td>intensity-modulated radiotherapy</td>
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<tr>
<td>IRRMER</td>
<td>Ionising Radiation (Medical Exposures) Regulations</td>
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<tr>
<td>IT</td>
<td>information technology</td>
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<tr>
<td>MDTMs</td>
<td>multidisciplinary team meetings</td>
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<td>MRI</td>
<td>magnetic resonance imaging</td>
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<tr>
<td>NCAT</td>
<td>National Cancer Action Team</td>
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<td>NCIN</td>
<td>National Cancer Intelligence Network</td>
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<tr>
<td>NCRI</td>
<td>National Cancer Research Institute</td>
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<tr>
<td>NCRS</td>
<td>National Cancer Registration Service</td>
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<tr>
<td>NCSI</td>
<td>National Cancer Survivorship Initiative</td>
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<tr>
<td>NHS</td>
<td>National Health Service</td>
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<tr>
<td>NICE</td>
<td>National Institute of Health and Care Excellence</td>
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<tr>
<td>NIHR</td>
<td>National Institute for Health Research</td>
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<tr>
<td>OECD</td>
<td>Organisation for Economic Cooperation and Development</td>
</tr>
<tr>
<td>PET-CT</td>
<td>positron emission tomography computed tomography</td>
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<tr>
<td>PHE</td>
<td>Public Health England</td>
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<tr>
<td>PROMs</td>
<td>patient reported outcome measures</td>
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</tbody>
</table>
QA  quality assurance
QIPP  Quality Innovation Productivity and Prevention
RCR  The Royal College of Radiologists
RCT  randomised controlled trial
RTDS  radiotherapy dataset
SABR  stereotactic ablative radiotherapy
SACT  Systemic Anti-Cancer Therapy
SEER  Surveillance, Epidemiology and End Results Program
TOMMY trial  A comparison of TOMosynthesis with digital MammographY in the UK NHS Breast Screening Programme
UCLH  University College London Hospitals
UK  United Kingdom
USA  United States of America
VEGF  Vascular Endothelial Growth Factor
Citation details


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