Radiotherapy UK

APPGRT
All Party Parliamentary Group for Radiotherapy

World-class Radiotherapy in the UK

Right Patient, Right Treatment, Right Time.

Foreword from Tim Farron

Chair of the APPG-Radiotherapy

1 in 2 of us will get cancer.

If it is not our diagnosis, it is that of our friend, partner, child or parent. We cannot go around cancer and it is not like other diseases. It can affect every organ in the body and every generation in a family. In the United Kingdom we are facing a perfect storm: increasing incidence, record waiting lists for treatment and no dedicated long-term cancer plan.

Radiotherapy is a valuable solution in helping us cure cancer patients. It is a lifesaving, incredibly cost-effective treatment needed in about 50% of cancer cases and in 40% of cancer cures. Its scope embodies the core of the NHS Constitution – it can harness the newest advances in science and technology, makes us better when we are ill, and when we cannot recover, stay as well as possible until the end. Remarkably, an incredibly committed and skilled multi-disciplinary workforce of only 6,400 professionals are delivering this life-saving treatment to more than 160,000 people each year in the UK. A workforce that we acknowledge for its fortitude and focus on delivering the best care possible for patients.

Sadly, we are overlooking radiotherapy as a major player in getting ahead of the UK's accelerating cancer crisis. As you will see in this vision, there is currently no plan to encourage the next generation of therapeutic radiographers, physicists, engineers and clinical oncologists needed to meet staff shortages. We have fewer treatment machines than our European counterparts. Many patients do not have fair access to this treatment and the improvements in technology that could improve how long and well patients live. We urgently need to focus now on a long-term sustainable National Plan for Radiotherapy to improve cancer survival rates, handle a growing number of cancer cases and close the care gap.

Together, the radiotherapy community has shared the best of its frontline knowledge, expertise and research to spell out the detail of what we must do. It's all here: but if you have just a short amount of time, please consider the six points outlined in the executive summary below, and how you can galvanize action within your circles. By World Cancer Day 2034 we could have something remarkable to celebrate if we mobilise our best efforts, skills and common sense around delivering world-class radiotherapy services. In doing so we can radically address one of our country's great health inequalities.

Cancer patients deserve more – more ambition, better chances of survival and better quality of life. A final thought: I wish every decision maker would drive down the M6, as I have done, with a mother of 2 young children in her late 30s, worried because she can't afford to stop working in between cancer treatments. A misery that simply cannot be conveyed by numbers alone. I ask us all to use every bit of influence we have to change the fate of UK cancer patients and deliver world-class radiotherapy services. Nothing less will do.

Tim Farron

SUMMARY

Executive Summary

In 2023, the length of time cancer patients waited for treatment in the UK reached record highs. As services struggle, wait times are rising. More and more of us are getting cancer and by 2040, the number of people in the UK with cancer is estimated to increase by one-third. UK patient survival remains near the bottom of international cancer survival tables. We urgently need to focus on how to treat cancer patients quicker and better, finding solutions to address current patient needs and prepare successfully for future challenges.

An essential component of curative cancer treatment is radiotherapy. **Radiotherapy cures cancer and is the most cost-effective cancer treatment.** It is needed by 1 in 2 cancer patients and contributes to cure in 40% of cases. Radiotherapy is personalised to each patient, is extremely cost-effective, technologically advanced, innovative and incredibly versatile – being used anywhere in the cancer treatment pathway from curative treatment of early disease, to reducing pain as part of palliative care. In the UK, radiotherapy has high training standards and enjoys extremely high degrees of quality and safety.

However, a lack of long-term planning and investment in radiotherapy in the UK has led to piecemeal implementation of the new technologies and innovations. Delivering these in a strategic and coordinated manner through a National Plan for Radiotherapy could lead to improved patient outcomes and better quality of life, while also improving expertise and enhancing productivity. This lack of investment is reflected in low levels of access to radiotherapy in comparison to international standards (24-27% [1] in England compared to 52-53%,[3,4] international estimates).

Radiotherapy has the potential to transform cancer treatment, deliver extra capacity and enhance patient outcomes in the UK, but to do so requires clear and focused direction and a national ambition to deliver a level of world-class services that radiotherapy patients in comparable countries are currently accessing. This paper sets out an ambitious but realistic vision to show what can be achieved over the next decade, transform radiotherapy services across the UK and **improve how long and well patients live.** It puts patients at its heart, outlines what a world-class radiotherapy service looks like, and the steps that need to be taken to achieve that.

Realising this vision is in the hands of politicians, NHS and healthcare commissioners across the four nations. It is in their power to take the evidence-based actions laid out in this plan and transform them into positive change for cancer patients. Our belief is that making these changes and investing in the vision will lead to improved patient survival and quality of life. In doing so, by 2034, world-class radiotherapy could be a reality nationwide. Not doing so would contribute to a further decline in cancer services and failure to capitalise on technological advances that could save patient lives.

The vision outlines six key areas of action to improve patient outcomes with higher cure rates and fewer side effects.

1. **Leadership**
   Establish an independent, accountable UK-wide planning and strategic group that is supported by healthcare commissioners across the four nations to create and deliver a new National Plan for Radiotherapy. It should inform long-term policy and investment.

2. **Access**
   Ensure equal access to radiotherapy across the four nations of the UK by 2034. Conduct a review of waiting time targets to set a higher NHS standard to improve timely access to high quality, personalised radiotherapy. Ensure, where required, that patients have access to late-effects support services.

3. **Workforce**
   Immediately put in place a plan to close the radiotherapy professionals' workforce gap, currently estimated at six hundred. Develop, fund and deliver a comprehensive 10-year radiotherapy-specific workforce plan that creates a sustainable, flexible workforce that is equipped to harness advances in healthcare system delivery.

4. **Data**
   Develop a single integrated data source from radiotherapy providers, which can drive improvement in patient outcomes by linking analyses to mechanisms that action the learning gained from data to deliver change quickly and effectively.

5. **Research**
   Develop, fund and implement an integrated radiotherapy research strategy that encompasses discovery and translational laboratory science, technological and imaging innovation, and clinical evaluation via clinical trials, health systems and economics research.

6. **Investment**
   Deliver long-term transformative investment attached to the implementation of a national plan alongside development of a reimbursement system that equitably and sustainably funds radiotherapy machines and technologies, including software and AI. Develop close academic and industry partnerships to ensure current and future innovation is rapidly implemented.

Cancer patients in the UK urgently need a National Plan for Radiotherapy. This cannot be delivered for them, without them. Patient and public involvement is essential to deliver a plan that is responsive, inclusive and accountable to the needs and preferences of radiotherapy patients.

World class radiotherapy is achievable in the UK within 10 years but planning and action needs to start now. Doing nothing will cost more in the long-term, embedding the current crisis in cancer care as the new normal and ultimately mean that more people with cancer will die needlessly.

Bryan Robson OBE (England and Manchester United football legend)

"Radiotherapy saved my life. It's given me the priceless gift of time and memories with my friends and family. I strongly believe every UK cancer patient that needs radiotherapy should have access to a world-class service. Decision makers choosing to invest in and support radiotherapy services across the UK will quite simply save lives. I want to live in a country with cancer services that are the envy of the world – and radiotherapy can play a major part. For the sake of cancer patients, I ask all of us to use our influence to make this 10-year vision a reality."

Contents

Introduction

1.1. Following two inquiries into the status of radiotherapy in the UK[5], in Spring 2023 the All-Party Parliamentary Advisory Group on Radiotherapy (APPG-RT) called for a new Radiotherapy Vision, setting out how world-class radiotherapy could be achieved in the UK by 2034. In the absence of an individual cancer plan for England, and recognising worst ever waiting times for cancer treatment across all four nations of the UK, poor performance in international comparisons concerning consistency of cancer policy[6] (with the UK nations at the bottom of this particular cancer league table), and the need to improve cancer survival, the cross-party group of parliamentarians recognised the importance of long-term radiotherapy strategic planning to improve cancer patients' survival and quality of life.

1.2. Radiotherapy is a life-saving cancer treatment, already instrumental in 40%[7] of cancer cures, that can harness ongoing technological advancements to deliver earlier and increasingly precise cancer cures, reduced side effects, and ensure personalised care.

1.3. The need for a vision for radiotherapy in the UK is clear. Cancer patients in the UK are currently experiencing a crisis in cancer care – facing some of the longest waiting times for treatment on record due to lack of investment in the workforce and inadequate capacity of vital cancer treatment services like radiotherapy. This is deeply concerning, as every four weeks of delay in cancer treatment leads to a 10% increase in mortality[8]. Despite international estimates that 52-53%[3,4] of UK cancer patients should receive radiotherapy, currently only 24-27%[1] do and access is highly variable[2]. The UK remains near the bottom of the international tables for cancer survival[10], and without a radical new approach to delivering radiotherapy services, this is unlikely to improve.

1.4. This vision has been developed with input from a diverse group of stakeholders from the radiotherapy community, including patients, professionals, academics, charities, professional organisations, industry and international experts. It follows guidance from international bodies such as the International Atomic Energy Agency and the Global Coalition on Radiotherapy on essential standards for radiotherapy within national cancer control plans[11] and outlines key steps that need to be taken to establish a world-class radiotherapy service in the UK.

1.5. The purpose of this vision is to improve cancer patient outcomes by increasing cure rates, reducing side effects, boosting productivity, providing individualised care, enhancing quality and improving access.

1.6. Central to this vision is the philosophy of patient-centred care, which empowers individuals to take an active role in their health journey. The goal is to ensure every cancer patient in the UK is supported to receive the best and most appropriate treatment, tailored to their individual needs to achieve the best outcomes and long-term quality of life.

1.7. Healthcare is a primarily devolved responsibility. Each nation in the UK has its own processes and systems for commissioning and delivering radiotherapy services. Despite these differences, the principles of world-class radiotherapy should be attainable for all cancer patients in the UK.

PART 1 2

Approach

2.1. This paper has been developed using a five-stage process.

- Surveys with patients and frontline workforce.
- Desk research to assess the current radiotherapy provision across the UK and internationally.
- A series of engagement meetings with experts in radiotherapy from a wide range of backgrounds including clinical oncology, therapeutic radiography, medical physics, medical engineers, researchers, charities and professional organisations.
- Analysis of publicly-available cancer service data.
- Emerging vision shared back to experts for further comment and reflection.

2.2. This report is not intended to address the organisation of radiotherapy services for brachytherapy or rare cancer types including sarcoma, paediatric patients, or those under 25 years old. The focus in this vision is on adult cancer care within the context of the UK's devolved health systems, however many of the steps outlined in this report could also benefit these areas.

2.3. The data in this report comes from various sources, including members of the public, radiotherapy patients, frontline radiotherapy workforce, health services research, professional bodies reports, academics, and cancer databases across the UK. The report uses publicly available data. There are gaps in the report as some data were either unavailable or incomparable across UK nations.

2.4. Like other medical disciplines, the language of radiotherapy can be specialised, hard to understand and full of acronyms. To help with this, when you see a word or phrase in purple you can click on it to bring you to the Glossary at the end of the document with an explanation of what that word or phrase means.

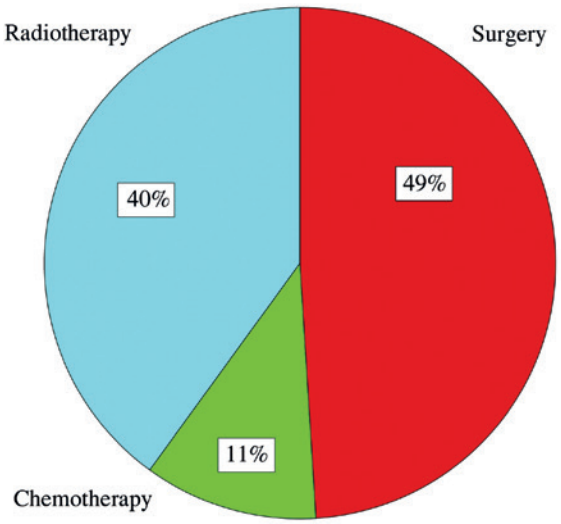
PART 1 3

Radiotherapy – a life-saving cancer treatment

3.1. Radiotherapy is a personalised cancer treatment, that uses beams of ionising radiation to kill cancer cells. The aim is to destroy, shrink, or control the growth of tumours[12]. It is the second most widely used treatment for cancer contributing to at least 40% of cancer cures[7,13].

Figure 1.

The three main cancer treatment modalities and their relative contributions as the predominant modality...



Br J Radiol, Volume 96, Issue 1152, 1 December 2023, 20230334, https://doi.org/10.1259/bjr.20230334 The content of this slide may be subject to copyright: please see the slide notes for details.

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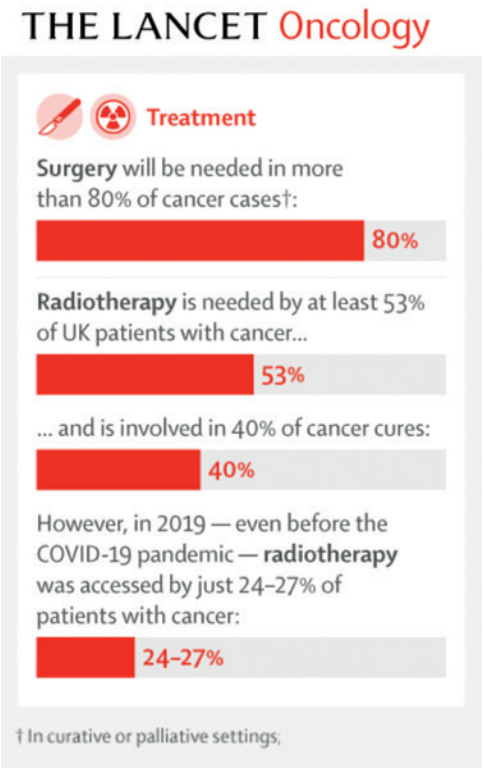
Figure 2.



Aggarwal A, Choudhury A et al The future of Cancer care in the UK-time for a radical and sustainable National Cancer Plan. Lancet Onc. Online Nov 2023, vol 25, issue 1, E6-17. https://doi.org/10.1016/S1470-2045(23)00511-9

3.2. Radiotherapy is a multi-purpose treatment that can be used to cure cancer, make other treatments more effective, preserve vital organs, eliminate cancer cells remaining after surgery, and relieve symptoms of cancer including pain. International benchmarks indicate that about half of all people with cancer should receive radiotherapy as part of their treatment plan[3,4].

3.3. It can be delivered externally - where a radiotherapy machine accurately directs beams of radiation at the cancer from outside the body, or internally – where radioactive material is placed inside the body near the cancer cells (this type of radiotherapy is called brachytherapy). There are many different types of radiotherapy available across the UK, each with specific applications and methods of delivery. A range of these are outlined in the Glossary.

3.4. Radiotherapy is an out-patient treatment that is usually delivered daily and can range from one single treatment to up to 33 separate daily radiotherapy fractions. In 2021-2022 there were over 1.5 million visits for radiotherapy treatment in England[2].

3.5. In the UK, radiotherapy is delivered by a small (currently around 6,400) highly qualified multi-disciplinary team of healthcare professionals.* Clinical Oncologists, Therapeutic Radiographers, Medical Physicists, Dosimetrists, and Engineers work together to ensure that the treatment is effective and safely delivered[14,15,16].

3.6. Costing on average only £3,650 per patient, radiotherapy is the most cost-effective cancer treatment. This equates to an estimated £370 per fraction (single treatment visit). Since most of the costs of radiotherapy are incurred during the planning and preparation stages, this can reduce to around £150 per treatment over a 25-fraction course[17].

3.7. Data on the return on investment in radiotherapy in Europe are lacking. However, it has been recognised internationally that scaling up radiotherapy services to meet demand is not only feasible and affordable but should offer an estimated 6% positive return on investment by 2035[18].

3.8. The delivery of modern radiotherapy depends on digital systems, which enable comprehensive data collection and analysis. The current national data infrastructure uses systems that extract data from the patient record-and-verify systems in treatment centres, and submit it to the National Disease Registration Service (NDRS), NHS England, where it is processed to form the national Radiotherapy Dataset (RTDS)[19].

3.9. Currently, radiotherapy research is under-prioritised and underfunded[20]. There is great potential for radiotherapy research to drive economic growth by contributing to innovation, technological advancement, and the development and application of new knowledge. It can attract international collaborations, funding, and development, and enhance workforce recruitment and retention.

3.10. Much of the clinical trial and research work in radiotherapy over the past few decades has been focused on safely reducing the number of fractions (or treatments) delivered to achieve the same outcomes. This has proven to be extremely effective. For example, the START-B trial showed that breast cancer radiotherapy could be safely reduced from 25 treatments to 15[21]. The Fast-Forward trial for breast cancer radiotherapy more recently demonstrated that 5 treatments were as safe as 15 treatments[22]. The PACE-B trial in patients with prostate cancer showed that 5 fractions of modern radiotherapy were equally effective as the standard 20 or 39 fraction courses[23]. The predominant focus of these trials was on improving patient experience, but these improvements also reduce the costs of treatment delivery.

3.11. Health systems research in radiotherapy examines issues with the performance of the health system as a whole, which often affect access to radiotherapy treatment. This type of research is essential to reduce gaps in radiotherapy accessibility, quality, and effectiveness within the healthcare system. The NHS is an excellent environment within which to deliver this type of research.

* We recognise radiotherapy nurses also play an important role in radiotherapy services but for purposes of this report workforce is limited to treatment delivery teams.

3.12. Radiotherapy's technologies are perfectly placed to capitalise on information technology innovation, artificial intelligence (AI) and machine learning. AI offers a potential solution to improve capacity and enhance the equitable implementation of highly individualised (adaptive) radiotherapy which could otherwise be costly to introduce widely.

3.13. The radiotherapy industry has made rapid advances in software, machinery, engineering, remote access and image-guided adaptive treatments, with the result that radiotherapy treatment precision has been transformed over recent years. The UK's excellent engagement with the radiotherapy industry means UK patients can benefit from these innovations and stay at the forefront of medical technology. This requires ongoing technology horizon scanning for future developments such as FLASH radiotherapy, particle therapies, and interactions with immunotherapy and other systemic therapies.

3.14. Further advances in radiotherapy accuracy and precision need to be developed in parallel with better understanding of early and late-effects in patients whose cancers have been cured by radiotherapy. Some patients are living with permanent side-effects from treatment and long-term services are needed to support these patients. Late-effects can take months or even years to develop. They can occur in any normal tissue in the body that has received radiation. Late-effects may include life-changing problems with incontinence, infertility, eating and drinking, stroke, shortness of breath, heart disease, nerve damage, poor memory and concentration.

Radiotherapy cures cancer. It is a technologically advanced, innovative treatment delivering personalised precision cancer care to each patient. Radiotherapy is cost-effective with a course of treatment costing on average an estimated £3,650[17].

Current provision

4.1. In the UK, 61 NHS providers deliver external beam radiotherapy across 79 delivery sites (Figure 4). Two high energy proton beam facilities treat children, teenagers and young adults, and adults with specific indications, as well as undertaking proton clinical trials.

4.2. Each of the four nations commission radiotherapy services differently. In England, Integrated Care Boards (ICBs) have taken on delegated responsibility for radiotherapy services. In Scotland, services are commissioned by NHS National Services Scotland. Radiotherapy in Wales is commissioned by individual health boards. In Northern Ireland, radiotherapy is commissioned through the Health & Social Care Trust.

4.3. There is no currently available central data on the number of linear accelerators (the machines that deliver external radiotherapy treatment) in clinical service in the UK. These data are essential to understand access, the capability of advanced technologies and facilitate procurement planning. Based on analysis undertaken by Radiotherapy UK, including a Freedom of Information request, an estimation is provided in Table 1 below.

Table 1.

UK	Number of linear accelerators	Population[36]	Linear accelerators machines perr million population**
England	284	56,536,400	5.0
Scotland	31	54,79,900	5.7
Wales	16	3,105,400	5.2
Northern Ireland	13	1,904,600	6.8
UK total	**344**	**67,026,300**	**5.1**[2]

Figure 4.

UK Radiotherapy Centres

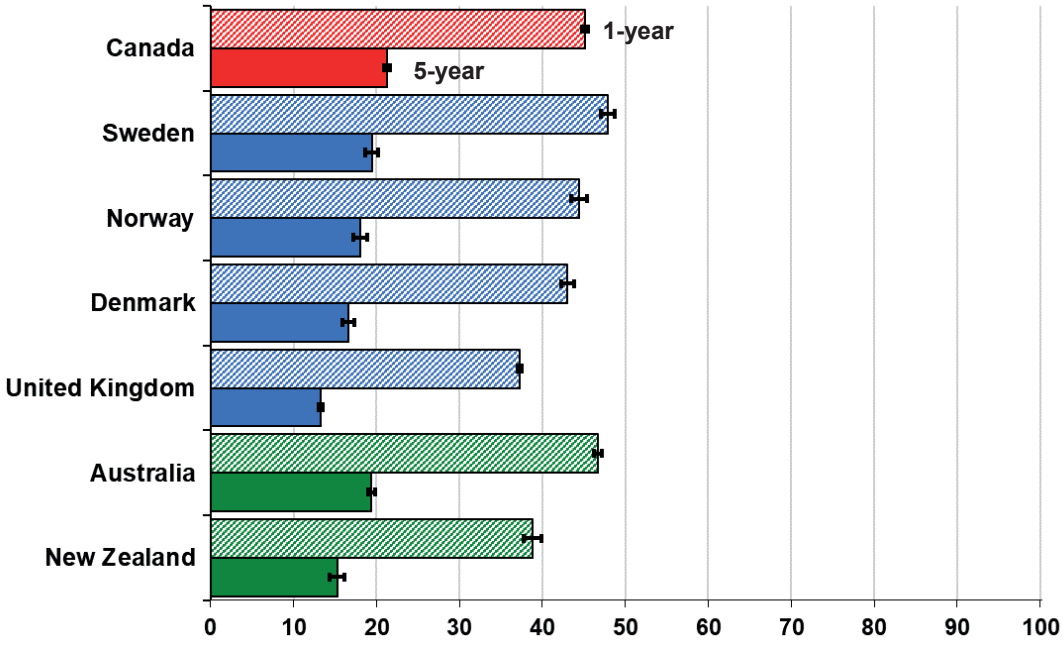
** See 9.3 for international comparisons.

Learning from the global radiotherapy community

5.1. The international context for cancer services in the UK can be understood by comparing the UK's cancer incidence, survival and mortality with other countries that have similar healthcare systems, through initiatives such as Concorde or the International Cancer Benchmarking Partnership (ICBP).

5.2. For most cancers, age-standardised 5-year net survival in the UK lags behind six other high-income countries. Survival in the UK is much lower for rectal, lung and cervical cancers, brain tumours and lymphoma. For oesophageal, breast and prostate cancers, 5-year survival in the UK does not differ from the other six countries[11] (Figure 3: see also all charts in Appendix 1).

Lung: age-standardised 1-year (pattern) and 5-year (solid) net survival (%)



Allemani et al. Lancet 2018; 391: 1023-75. https://doi.org/10.1016/S0140-6736(17)33326-3

CONCORD Global surveillance of cancer survival

5.3. Inequalities in cancer survival across different populations and each nation must also be addressed. In the UK, 5-year net survival for almost all cancers is higher in England than in Northern Ireland, Scotland and Wales. In the UK, the most deprived populations have inequalities in cancer treatment options including access to chemo-radiation and worse cancer outcomes compared to the least deprived[32].

5.4. Population-based survival is a key measure of the overall effectiveness of the health system in managing cancer in a given country or region. Sustainable collation, monitoring and access to cancer specific survival data is crucial to understand what types of treatments are being delivered to patients and equitable application of resources.

5.5. In the late 1990's, Denmark's 5-year cancer survival were significantly lower than neighbouring European countries. The Ministry of Health put in place a concerted campaign to improve outcomes - restructuring services, improving access and improving screening[33]. Corresponding political focus and investment in radiotherapy has led to Danish services delivering advanced treatments with minimal waiting lists[34].

5.6. Working together and collaborating on a global level is a crucial way to monitor and evaluate the impact of treatment advances for patient outcomes and to develop a wider base of evidence and expertise to inform best practice. In support of these objectives, The Global Coalition for Radiotherapy (GCR) has worked with other international organisations including the International Atomic Energy Agency (IAEA), CRDF Global and the Institute of Cancer Policy to create a framework of key radiotherapy components for all countries when developing or updating a national cancer plan[35].

> *"A world class service must be equal to the best in the world. To achieve this, best practices around the world need to be recognised and duplicated."*
>
> **Patient survey quote**

PART 1 6

The need for long-term planning

6.1. Cancer services in the UK are facing serious and far-reaching challenges, with nearly 1 in 3 cancer patients waiting too long for their cancer treatment to begin[8]. The Covid-19 pandemic significantly disrupted cancer services that were already struggling, leading to a backlog in cancer care which has not yet fully recovered[2,25].

6.2. The incidence of cancer in the UK is projected to rise significantly. It is expected that by 2040 there will be around 506,000 new cases of cancer each year, up by a third from approximately 384,000 now[26]. This will require increased capacity for cancer treatment. Radiotherapy can be a better alternative than other treatments for older age groups and, as screening services expand, is a highly effective treatment to cure early-stage disease. Strategic planning is needed now to deal with the rise in cancer incidence in the coming decade.

6.3. An aging population adds a layer of complexity to the challenge. Older individuals are at a higher risk of developing cancer, and the number of people aged 75 and over diagnosed with cancer each year in the UK is projected to rise to more than 227,000 by 2040[27]. This demographic shift will likely increase the demand on the NHS, as older patients often have more complex care needs due to increased frailty and comorbidities.

6.4. Recent cancer policy has focused on diagnosing a higher percentage of people at an earlier stage, for example, through increased screening programmes[28]. However, this focus has not been matched with similar investment in cancer treatment capacity. Advantages gained by early diagnosis are lost when the patient does not also receive timely and curative radiotherapy treatment, due to lack of access or treatment capacity. Cancers may progress to a later incurable stage while patients are on a waiting list.

6.5. In Scotland, the long-term plan is the 'NHS Recovery Plan;'[29] in Wales 'The Quality Statement for Cancer' sets out the Welsh Government's five year plan to improve the quality of cancer services and outcomes in Wales (March 2021)[30]. The Department of Health in Northern Ireland has published a Cancer Strategy for Northern Ireland 2021-2031[31]. All have similar aims for faster diagnosis and better outcomes.

6.6. The lack of a dedicated National Cancer Control Plan in England and poor operationalisation of plans elsewhere in the UK, was characterised in a policy review in the Lancet Oncology (published 2023) as 'strategic misdirection'[13]. The review highlighted that patients in countries with dedicated cancer specific plans have better survival than those that do not.

6.7. It is in this wider context that strategic planning and investment in world-class radiotherapy services will play a pivotal role to support and provide solutions to some of the key challenges – increasing access to effective treatment and ensuring cancer services are equipped to deal with the increasing incidence of cancer and the needs of an aging population.

6.8. Planning is needed to ensure the safe integration of AI in radiotherapy, which has the potential to enhance treatment precision, improve overall efficiency, reduce treatment times, and enhance patient experience. As with any application of AI in healthcare, it is essential to address issues related to data privacy, ethical considerations, and ongoing collaboration between AI systems and radiotherapy professionals, to ensure the best outcomes for patients.

The incidence of cancer is increasing and with it an increased need for radiotherapy. The UK must be prepared for this. Additionally, the impact of COVID and national lockdowns has created a backlog and a negative impact, which may take over a decade to resolve for certain cancers (e.g. colorectal)

Changes in demand, technology and practice means the way we plan and deliver radiotherapy over the next 10 years needs to change to close the gap between what's needed and what's available for all patients nationally. These changes can improve patient outcomes and quality of life, and can be highly cost-effective.

It is imperative that this planning starts now.

PART 1 7

World-class radiotherapy

7.1. Our ambition as a UK radiotherapy community is to put in place a pathway to achieve world-class radiotherapy services that improves patient outcomes with higher cure rates and fewer side effects.

7.2. Following engagement across the community, with patients, frontline workforce, academics, professional bodies and researchers, a consensus has emerged about what we should be aiming for when we define world-class radiotherapy.

7.3. The patient survey undertaken to inform this report (findings in Appendix 2) identified three key themes; accessing the best treatment that will give the best result, getting treatment as soon as possible, and skilled and experienced staff.

7.4. Fundamentally, the responses underscored the importance of a personalised, comprehensive patient experience with open and honest communication. A recurring theme was the need for improved post-treatment care and support for patients experiencing long-term or late effects.

Right patient, Right treatment, Right time

- Patients who require radiotherapy as treatment have equitable access.
- Patients receive their radiotherapy on time.
- Patients receive **safe** and **high-quality** treatment that provides best outcomes and improved quality of life.
- Patients are empowered and able to use their voice to effect change.

A radiotherapy service that works seamlessly to drive forward patient care.

- Using the most recent advances in radiotherapy equipment and techniques to deliver precise, personalised, and effective treatment.
- Late-effects services for patients available as standard in all centres.
- Embedding patient reported outcome measures (PROMs) within service delivery.
- A valued, skilled and specialised workforce who are experts in radiotherapy through investment and training.
- Ongoing investment in new technology and research to improve treatment quality and outcomes.
- Innovative systems to allow rapid and appropriate introduction of ongoing new innovations in medical technology.
- Systems and processes in place that support adoption of new advances quickly and safely.

Learning from the Best

- International benchmarking.
- National networking and sharing of information, data, and best practice.

Leadership

The Challenge

8.1. Delivery of radiotherapy services across the UK is currently characterised by irregular funding streams, bureaucratic systems that disincentivise progress, limited long-term planning and a lack of technology horizon scanning. The long-standing failure to plan and invest in services has resulted in shortages in key staff, modern equipment and piecemeal implementation of advanced and automated technologies. This has contributed to significant variations in patient access to treatments and delayed introduction of innovative radiotherapy. Radiotherapy is a highly specialised, rapidly evolving technical service, which needs collaborative multidisciplinary teams working both locally and nationally.

8.2. Despite treating over 130,000 cancer patients annually in England alone[2], radiotherapy treatment throughout the UK is delivered through a relatively small number of centres (61 NHS providers in total) by a small workforce of around 6,400[14,15,16]. Although this system offers the potential to develop national coordination, planning, rollouts and protocols for proven technologies that improve patient outcomes and workforce flows, this is not happening. In England, introduction of Operational Delivery Networks are designed to address some of these issues.

8.3. The increasing devolvement of radiotherapy service provision planning can make such coordination more difficult. A Freedom of Information request by Radiotherapy UK in August 2023 found that 70% of Integrated Care Boards (ICB's) in England said they had no named person responsible for ensuring access to sufficient treatment capacity for radiotherapy.

What does world-class leadership in radiotherapy look like?

8.4. Leadership training and support is embedded within every level of radiotherapy service delivery, from the frontline to national strategic planning and policy development.

8.5. Effective leaders are in place that elevate the standard of cancer care, drive innovation, and manage change. Leaders are nurtured and invested in across the multi-professional workforce to implement positive change and transformation nationally and locally.

Next Steps.

8.6. Radiotherapy leaders from four nations come together to create an independent accountable UK-wide planning and strategic group to develop and deliver a new National Plan for Radiotherapy, supported by each devolved nations' healthcare commissioners.

8.7. This group should lead on a coordinated strategic national approach that promotes equality of access and timely national rollouts of technologies, embeds innovation development, and ensures workforce flows that empower local leaders to deliver and integrate research strategies.

8.8. Development of a radiotherapy leadership training and skills development programme for frontline workforce.

8.9. Detailed assessment of how the integration of automated systems in radiotherapy can be implemented by the workforce to ensure the highest standards of safety and efficacy. It is essential to define legal and regulatory frameworks related to data privacy, ethical considerations, and ongoing collaboration between AI systems and healthcare professionals.

Establish an independent, accountable UK-wide planning and strategic group that is supported by healthcare commissioners across the four nations to create and deliver a new National Plan for Radiotherapy. It should inform long-term policy and investment.

PART 2 9

Access

9.1. In the UK, the number of patients accessing radiotherapy is below international benchmarks and comparable access rates in Europe[1,3,4]. Access to radiotherapy is dependent on many factors, such as capacity of services, geographical location of centres, referral pathways, workforce provision, equipment type, level of technology available, transport links and community sensitivities.

9.2. The number of cancer patients, based on data from NHS England, receiving radiotherapy varies widely from about a quarter in some areas to over a half in others[2]. This two-fold variation between the most and least active radiotherapy networks suggests that in some regions patients are missing out on potentially lifesaving radiotherapy treatment. Rates suggest access is variable across the UK and lower in the UK than other countries[3,4]. In the 2019[37] and 2022[38], National Prostate Cancer Annual Reports, states 32% and 28% (respectively) of men with high-risk localized prostate cancer were potentially under-treated. These men received no curative treatment, which would have included radiotherapy as current standard of care.

9.3. In the UK, the number of linear accelerators is estimated to be 5.1 per million population (Table 1). This is below comparative European countries, which have an estimated equivalent number of between 7-10 per million population[39]. This disparity and its potential impact need to be understood, given the UK's low utilisation of radiotherapy as an essential part of cancer cure.

9.4. The data are unavailable to ascertain how many treatment machines are older than the recommended ten years[40]. Analysis undertaken by Radiotherapy UK from Freedom of Information requests and frontline intelligence estimates that between 13% - 20% of machines in England are coming to the end of or have exceeded their recommended lifespan[40]. This can mean slower treatments, more treatment interruptions with breakdowns, lack of image-guided facilities and lack of capability to undertake modern radiotherapy.

9.5. Slow adoption of technology due to procurement barriers and workforce training results in marked regional variation in services. This is evident by the variation in delivery of Intensity-Modulated Radiotherapy (IMRT) in the NHS. IMRT is considered a routine technique in many countries, but in 2022 its use varied from 45% to 65% across England[41]. In the year 2020/2021, 6% of men having curative radiotherapy for prostate cancer still received older 3D conformal methods of radiotherapy planning[38]. This type of treatment is less focussed and is associated with worse long-term side effects.

9.6. Methods to increase radiotherapy accuracy and precision are not uniformly adopted, and although information is lacking, there is likely marked variation between providers. The aspiration of Image Guided Radiotherapy (IGRT) for nation-wide adoption and adaptive radiotherapy planning set out in 2012 has not been realised[42,43].

9.7. Patient access to stereotactic ablative radiotherapy (SABR) is highly variable, due to variable access to equipment, software and trained workforce[44]. Furthermore, monitoring of patient access to SABR after the launch of the SABR clinical commissioning policy in NHSE[45] and the National Radiotherapy plan for Scotland[46] is not available.

9.8. Patients are waiting too long to start their radiotherapy treatment, leading to preventable deaths. In England, just 17 NHS England providers met the 31 -day radiotherapy target of 94%[7]. In Scotland, from July to September 2023, 11 of the 15 NHS Boards met the 31-day radiotherapy standard of 95%[47]. In Northern Ireland, the quarter ending September 2023 saw 87.9% of patients started treatment within 31 days of a decision to treat, against a target of 98%[48]. Equivalent radiotherapy waiting times data are not publicly available for Wales[49]. All cancer patients including those who will be treated with radiotherapy, also face long diagnostic waits.

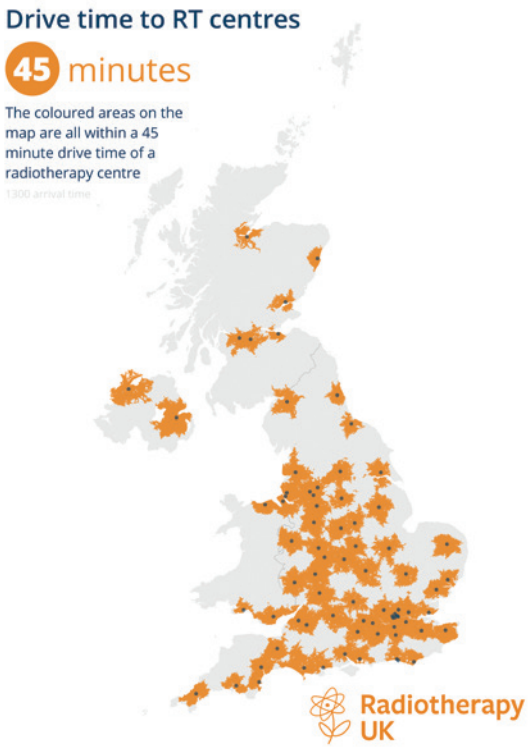
9.9. In October 2023, only 13 of the 144 listed NHS England providers hit the overall target of a cancer patient receiving treatment within 62 days of decision to treat, leaving 37% of cancer patients waiting too long to start treatment[7]. In Scotland, Northern Ireland and Wales, no provider met the 62-day target[3,4,49]. In the quarter ending September 2023, over 14,500 people waited longer than 62-days to start cancer treatment in the UK [7,47,48,49].

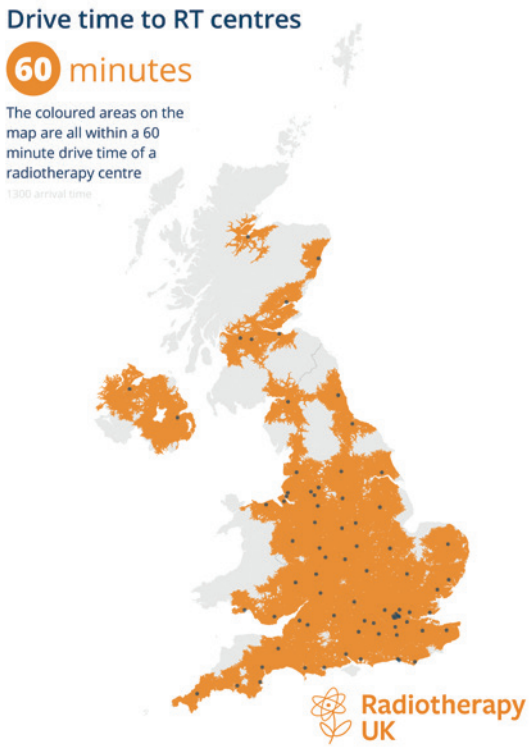
9.10. The time it takes to get to a radiotherapy centre either by private car or public transport can affect a patients' decision to access radiotherapy treatment[50]. In 2007, the National Radiotherapy Advisory Group (referenced in a Department of Health report in 2012[42]) stated that the recommended travel time to/from a radiotherapy centre is no more than 45 minutes. Recent analysis undertaken by Radiotherapy UK, based on travel times to a 1pm appointment when driving a private car, shows that 7.4 million people in the UK are further than 45 minutes and 2.4 million are further than 1 hour from their closest radiotherapy centre. When taking public transport to travel for a radiotherapy appointment at 1pm, the number of people further than 45 minutes away is 49.6 million and more than 1 hour from a centre is 39.9 million. The analysis highlights geographical areas (Figure 5 page 22) across the UK where access to radiotherapy is extremely limited, especially for those reliant on public transport.

9.11. Inequalities in access to radiotherapy are also magnified when centres are difficult to get to. Travel comes with costs of fuel, parking and when using public transport, ticket fares. Lower income households have higher levels of reliance on public transport and 40% do not have access to a private car[51]. Low-income households will therefore face longer travel times to access radiotherapy treatment, which may be associated with lower uptake of treatment. This group are more likely to have female heads of house, children, young and older people, and disabled people[51].

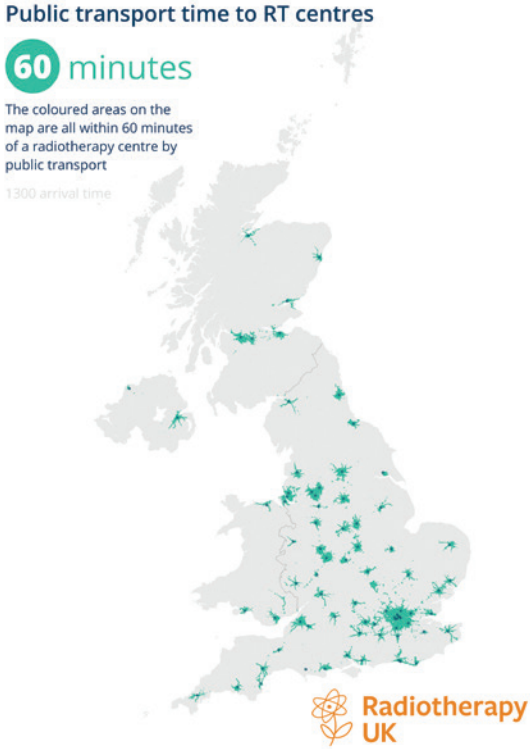
9.12. Referral pathways and access to late-effect clinics for cancer patients must be equitable. Patients raise the need for increased access to late-effects support as a major issue (Appendix 2). Long term side effects of radiotherapy and their impact on patients are not well understood. Better understanding is essential to drive modification in treatment protocols and improve patient experience.

Figure 5.


Drive time to RT centres
45 minutes
The coloured areas on the map are all within a 45 minute drive time of a radiotherapy centre
1300 arrival time
Radiotherapy UK


Drive time to RT centres
60 minutes
The coloured areas on the map are all within a 60 minute drive time of a radiotherapy centre
1300 arrival time
Radiotherapy UK


Public transport time to RT centres
45 minutes
The coloured areas on the map are all within 45 minutes of a radiotherapy centre by public transport
1300 arrival time
Radiotherapy UK


Public transport time to RT centres
60 minutes
The coloured areas on the map are all within 60 minutes of a radiotherapy centre by public transport
1300 arrival time
Radiotherapy UK

How long travel times impact patients: Nick's story

Nick, 58, was diagnosed with prostate cancer in April 2022. After hormone therapy he was given 20 sessions of radiotherapy, starting in September 2022.

From Malton, in North Yorkshire, Nick was sent on a 90-mile round trip to Leeds for treatment, since no local hospitals had the radiotherapy machines needed to treat him. Nick's daily travel times added up to a 2.5-hour car journey each day. Looking back, Nick says he is not sure how he got through it.

"The team that treated me were so lovely, and I really appreciate what they did for me. I was quite lucky because my brother and sister could take me and that took the sting out of it, but I still felt quite guilty for putting on them.

"Cancer comes with a lot of stress anyway, but the extra travel was very challenging, and I was glad to have it done and dusted."

> *"Living in rural areas can prove difficult, travel wise, when receiving treatment. Travelling 1.30 / 2 hours to the closest hospital every day for 7 weeks to receive treatment, realistically is too far"*
>
> **Patient survey quote**

What does world-class access to radiotherapy look like?

9.13 The highest level of accurate and precise radiotherapy is delivered to all patients in the UK.

9.14 Patients have equal access to the most appropriate high quality radiotherapy treatment, without unnecessary regional variation.

9.15 Patient waiting times for treatment are based on achieving the best possible outcomes. Waiting time targets should reflect the best time for treatment, not the slowest, achievable time. Radiotherapy referrals are expedited and integrated with diagnostic and treatment pathways.

9.16 Patients have equal access to ongoing technological advances that provide best possible outcomes.

Next Steps

9.17 A comprehensive analysis undertaken to understand why the utilisation of radiotherapy within the UK is highly variable and below international benchmarks, to help identify potential barriers and consequences including the impact of survival on waiting times.

9.18 UK-wide mapping exercise of radiotherapy services, including a census of all existing radiotherapy machines, motion management, IGRT, adaptive radiotherapy, AI or automated processes and other capabilities, procurement cycles, and actual service delivered to patients. Barriers to implementation of modern services to be analysed. Findings should be publicly available to promote transparency and enhance understanding of service delivery locally and nationally.

As part of a National Plan for Radiotherapy

9.19 A national standard of equal access to the most appropriate, accurate and precise radiotherapy. While 4D adaptive radiotherapy may not be indicated in each individual case, a national approach to be developed for enhancing tumour delineation, treatment delivery including motion management, and IGRT.

9.20 A dynamic modernisation framework developed to drive the adoption of the latest innovations that improve patient care and outcomes and reflect the complexity and workforce capacity required in delivering modern, image-guided radiotherapy.

9.21 Access to late effects services to be embedded as a national standard of care, locally delivered to support patients through the whole radiotherapy journey, not just their treatment.

9.22 Review of access to radiotherapy for patients to consider all options for providing treatment closer to home, or where not possible provision of financial support with travel, parking and accommodation.

9.23 A review of practices to ensure that treatment targets reflect a start date for cancer treatment and not for pre-treatment interventions such as dental care and feeding tube insertions[52]. Measuring time to treatment from MDT decision to booking and consent (without measuring the increasing gap between the two) should be undertaken to avoid misleading improvements in cancer wait times.

> *"I felt very alone getting my radiotherapy, a better after-care service ensuring patients are coping with it mentally & physically would have helped me tremendously."*
>
> **Patient survey quote**

Ensure equal access to radiotherapy across the four nations by 2034. Conduct a review of waiting time targets to set a higher NHS standard to improve timely access to high quality, personalised radiotherapy. Ensure, where required, that all patients have access to late-effects support services.

PART 2 10

Workforce

The Challenge

10.1. Radiotherapy treatment in the UK is delivered by a relatively small, multi-disciplinary and highly skilled workforce of 6,400[13,14,15]. There are chronic workforce shortages across all disciplines, driven by poor recruitment and retention.

10.2. Data from the three professional bodies representing the main radiotherapy workforce; Institutes of Physics and Engineering in Medicine (IPEM)[13], Royal College of Radiologists (RCR)[14] and Society of Radiographers (SoR)[15] show there is a current shortfall of about 9% or 582 WTE staff. To meet the increasing number of cancer patients forecast by 2040, the workforce will need to increase by a third, or about 2,000 professionals.

10.3. Recruitment for Clinical Oncology is particularly concerning with 50% of clinical oncology training posts remaining unfilled[53,54]. The speciality has been struggling to recruit since 2016[56]. The reasons for this are unclear but may include lack of exposure during medical school and clarity of the clinical oncology role.

10.4. Therapeutic Radiography training places are unfilled. Only eleven universities in the UK currently offer radiotherapy & oncology/therapeutic radiography and attrition from these courses is extremely high (24% in 2019)[56]. Therapeutic Radiography university courses are not funded and the financial burden of study and travel for placements has been highlighted as a key factor in student attrition[57].

Table 2.

	Current number WTE	Short fall	Current short fall number	Number required currently	Estimated number staff required with forecasted 20% rise in cancer in the UK by 2040
Clinical Oncology	998	15%	150	1,147	1,376
Therapeutic Radiographers	3,640	8%	291	3,931	4,717
Medical Physics and engineering	1,759	8%	141	1,900	2,280
	6,397		582	6,978	8,373

10.5. Interest in Clinical Scientist careers in the radiotherapy physics specialism remains high, with 5 to 10 applicants per funded place on the National School of Healthcare Science's Scientist Training Programme[58]. This highlights the potential to close the medical physics workforce shortfall by increasing funded training places. However, barriers to increasing training numbers predominantly relate to existing staff in already stretched clinical departments not having the time and resources available to train the extra scientists that are needed to close the gap.

10.6. Retention is a significant concern across the entire workforce, with surveys forecasting age and burnout leading up to 1:5 doctors and 1:20 therapeutic radiographers leaving in the next five years[14,15]. One in four of the radiotherapy physics workforce is over the age of 50 years and nearly half of the clinical technologists (engineers) are over the age of 50[13].

10.7. Over a third of clinical technologists in engineering are approaching retirement age. This combined with a greater than 7% shortfall of engineers due to poor retention in the UK is a major concern for radiotherapy provision[13].

10.8. Over 9% of clinical scientists in physics and engineering trained in the NHS between 2007 and 2015 are no longer in the workforce[13]. The percentage of the therapeutic radiography workforce (headcount) on long- term leave is 7%[15].

10.9. Such chronic shortages of staffing limit the workforces training and development opportunities, impacting on the capacity to train new staff and capacity to develop individuals' skills and experience, which leads to staff leaving. These high levels of attrition place increased pressure on the remaining workforce who are at a high risk of burn-out. In a 2022 workforce survey conducted by Radiotherapy UK, 87% of respondents said that they or a colleague they knew of were considering leaving the profession[60].

10.10. Understaffing has profound consequences for patients, meaning prolonged waits for treatment, which reduces the potential for cure, and increasing complications due to delayed access. Implementing advances in radiotherapy needs sufficient experienced and trained staff in place to establish and deliver more complex treatments. IPEM reported that 61% of survey respondents felt that staffing provision was below the requirement to provide a safe radiotherapy service[13] and the RCR identified that 67% of Heads of Service are worried that shortages are affecting the quality of patient care[14].

Embracing treatment: Warren's story

Warren, 75, received radiotherapy treatment for prostate cancer.

"As soon as you know there is this horrible cancer, you just accept everything they throw at you in as good a spirit as you can. The staff are just so patient when you think there's a waiting room full of 16 people and they have to stop and start all the time.

I think if you get a positive prognosis you just have to get stuck in with the treatment and wrap yourself around it.

Treatment was virtually painless, luckily, but it was difficult working out how to hold your bladder. I leak easily and wear a pad anyway and when I had to raise my arm to stop the treatment that was the most embarrassing and upsetting part. I did learn to judge it and the radiotherapists were so patient and understanding."

What does a world-class radiotherapy workforce look like?

10.11 A resilient, skilled and valued radiotherapy workforce of sustainable numbers with capacity to develop and train new staff, undertake personal development and training, and harness the transformative potential of AI to deliver high quality and innovative cancer treatment for all patients.

Next Steps

10.12 Immediate investment in delivering the estimated six hundred additional workforce required to bring current radiotherapy services to full capacity. This is a tiny number and represents a small, focused investment in specialist areas that could have a significant impact on cancer treatment capacity and therefore on patient survival.

10.13 Undertake an analysis of the factors driving reduced recruitment and training across all disciplines and develop a plan to promote radiotherapy as a protected specialism and valued profession.

As part of a National Plan for Radiotherapy

10.14 Develop a comprehensive 10-year radiotherapy workforce plan to reflect increasing cancer incidence, with associated finance and service planning, uncoupled from short-term political targets. This should

- Address working conditions and employment packages to create a supportive and attractive work environment for a resilient and flexible radiotherapy workforce.
- Reflect new ways of working and inter-disciplinary flexible collaboration.
- Plan for what radiotherapy training looks like now and in the future, as technology advances, automated systems, and digital transformation change how healthcare professionals' work.
- Ensure career development and promotion opportunities to drive excellence in clinical care, retention, and well-being in staff

Immediately put in place a plan to close the radiotherapy professionals' workforce gap, currently estimated at six hundred. Develop, fund and deliver a comprehensive 10-year radiotherapy-specific workforce plan that creates a sustainable, flexible workforce that is equipped to harness advances in healthcare system delivery.

PART 2 11

Data

11.1. There is marked variation in treatment and outcomes (including toxicity and cure) across the UK[1,32,37,38]. Some level of variation is expected and could be attributed to factors such as patient preferences and population health needs, but excessive and unjustified variation can have negative consequences and indicate safety or quality concerns.

11.2. Despite the potential for routine radiotherapy data to drive improvements in care and efficiency, their use is not yet optimized, which is exacerbated by a lack of basic IT connectivity. This means that understanding variation in radiotherapy services, access and patient outcomes (including toxicity and cure) across all four nations is not well understood.

11.3. The data available to the radiotherapy workforce and providers are not always accessible or aligned with what is needed to understand outcomes at a provider level or benchmark services nationally. Data is currently collected by different groups including clinicians, professional bodies, health commissioners and multiple initiatives within or linked to the NHS framework. This places an unnecessary burden of multiple and repetitive data collection on providers and risks there being multiple "inaccurate" versions of the truth.

11.4. Limited data is currently collected on long term side effects from radiotherapy. An understanding of the number of patients experiencing late-effects could inform services and enable delivery of the necessary support to these patients. Beyond this, linking data on the dose of radiotherapy the patient receives to tumour or normal tissues (dosimetry data) to patient outcomes including cure and toxicity can help to inform improvements in treatment planning and techniques. Coping with long-term effects of radiotherapy treatment is a major issue for patients and improving data collection in this area, allowing learning and changes to protocols, could have a huge impact on their long-term quality of life.

Life after radiotherapy and the need for late effects support: Amanda's story

62-year-old Amanda lives in Scotland and received chemotherapy and radiotherapy for Stage 3 cervical cancer in 2022.

"I developed Radiation proctitis (swelling of blood vessels of rectum/colon post radiation) so my bowel has been damaged irreparably and it's a progressive condition.

"I would have the treatment again because it saved my life and these are the risks, but I need more after care. I have worked for 35 years and never claimed any benefits and now I have had to apply for disability benefit. I am in constant pain, and that changes you. I feel very depressed sitting at home all day but I can't go out because I need the toilet 20 times a day.

I had my twins 29 years ago and I've never used the NHS since then, until now. It is under so much strain and I feel no one wants to know, or to help me.

11.5. Quality improvement goals that include radiotherapy as part of the cancer pathway are limited. The paucity of national goals and audit cycles limits improvements or understanding for ongoing research and quality improvement initiatives.

11.6. Change management within the NHS to restructure and improve outcomes can be slow and ineffective. National groups who design cancer strategies for change must work with front line staff to ensure environments to provide the capacity and motivation to change are strengthened.

What does world-class radiotherapy data look like?

11.7 Mechanisms and systems are established that utilise the learning gained from data to deliver change that improves outcomes quickly and effectively.

11.8 An accessible and single integrated system of accurate data from all radiotherapy providers in the UK that allows transparent analysis to address clinically identified questions with appropriate pathways and resources to deliver improvements where required.

11.9 Seamless Linkages between data systems, including collection of dosimetric data and patient reported outcomes to enable comparisons of radiotherapy plans between providers and drive improvements to reduce the risk of long-term side effects for patients. This is fundamental to maintaining the quality and safety of radiation therapy treatments.

11.10 A National radiotherapy data system that is aligned and can be used by quality improvement programmes for radiotherapy including, NATCAN[61], expanded to all providers in the four nations and expanded to include all tumour sites to allow understanding of providers delivery of evidenced-based processes and the impact on unwanted variation and poor outcomes.

RAPID-RT CASE STUDY: Using 'real-world' patient data to change radiotherapy practice and improve patient outcomes.

A research team from Manchester Cancer Research Centre, University of Manchester and The Christie NHS Foundation Trust, are leading on a programme of research that uses Real-World Data (RWD), the information that is collected about all patients as part of their normal care, to evaluate and optimise changes in radiotherapy practice.

This approach, often referred to as 'rapid-learning', involves multiple learning cycles of refining care based on real-time patient outcomes. This method aims to be inclusive and representative of all patients, tune treatments for the best outcomes, generate evidence without additional staff burden or collecting additional data, and allow monitoring and evaluation of all changes in radiotherapy practice as part of standard care.

By collecting RWD about patients as part of their normal cancer care, the team have introduced a new technique of heart sparing radiotherapy for Non-Small Cell Lung Cancer (NSCLC) patients treated with curative intent. It is hoped that this research (the RAPID-RT study) will demonstrate that introducing a new dose limit for the top of the heart improves the overall survival of NSCLC patients. More widely, the learning regarding collation and reporting of information about how to implement a rapid-learning approach in the clinic will provide comprehensive evidence that other institutes can use to support the use of RWD to explore the impact of changes in radiotherapy practice on patient outcomes.

Full case-study: Appendix 3

Next steps

As part of a National Plan for Radiotherapy

11.11 Develop an overarching data strategy, bringing together multi-stakeholder groups to identify information and data needs from patients, health workers and commissioners and develop joined up planning and co-ordination of all data driven activities within the NHS framework. The aim of this strategy is to ensure alignment between existing data users in terms of methodology, definition and presentation of metrics that are relevant and avoid duplication.

11.12 Ensure one version of radiotherapy data which is accurate, accessible and transparent to support informed analysis and hence, understanding and learning for clinicians, researchers, providers and the public.

11.13 Implementation of an interconnected approach between data collection and action, to enable the implementation of service change that reduces variation and enhances equity, quality of care and improves outcomes for patients in all four nations.

11.14 Review of data workforce and IT capacity needed in every radiotherapy provider to support basic IT connectivity and interoperability, data collection, ensure accuracy and transfer to a central system.

11.15 There needs to be a robust cyber-security plan that is able to be enacted locally and nationally to protect the confidentiality, integrity and availability of sensitive data and systems.

11.16 Expansion of patient reported outcome measures (PROMS) for cancer beyond the current NHS programme to include radiotherapy late effects and patient experience.

Develop a single integrated data source from radiotherapy providers, which can drive improvement in patient outcomes by linking analyses to mechanisms that utilise the learning gained from data to deliver change quickly and effectively.

PART 2 12

Radiotherapy research, innovation, and health services research

The UK has a strong history of undertaking high quality radiotherapy research with limited resources and investment, but now risks being left behind without a coordinated and funded approach at a time when innovation and developments in radiotherapy are transforming practice globally. Evidence shows that providers participating in research activities achieve better patient outcomes and overall quality of healthcare.

12.1. The capacity of radiotherapy research to drive improvement in cancer care - leading to better outcomes, enhanced quality of life, and increased survival, is not sufficiently optimised[62,63]. The UK offers a unique network of radiotherapy providers, tightly connected though the NHS, and its remarkably coherent and supportive research community provides a unique environment within which world-leading translational research can flourish.

12.2. The potential of radiotherapy research to attract international collaborations, partnerships, investments, positively influence economic development, and enhance recruitment and retention of staff across the relevant disciplines is not being realised.

12.3. There is high quality evidence that providers participating in research activities achieve better patient outcomes and overall quality of healthcare[63]. Despite this, current funding levels for radiotherapy research fall far below those for systemic cancer treatments and do not reflect the widespread utilisation and importance of radiotherapy treatment.

12.4. With the demise of the National Cancer Research Institute (NCRI), the central coordination of radiotherapy research has been lost. Funding for radiotherapy research is becoming increasingly difficult to obtain, as it is not sufficiently prioritised by funding bodies[62]. The number of clinical trials is dropping and the ability of individual patients to participate in clinical trials is reducing. Inequality of access to clinical research and clinical trials across the four nations is worsening, particularly with regard to advanced radiotherapy modalities and molecular radiotherapy.

12.5. As new radiotherapy treatment protocols and indications emerge in common cancers, it is critical that further research is undertaken to ensure that treatments delivered are cost-effective and are personalised to give maximum benefit to each individual patient.

12.6. There is no national organised strategy to test the value of new radiotherapy innovations including their impact on outcome and cost. This means the UK has been slow to adopt new radiotherapy technologies including adaptive, MRI-guided, proton beam and FLASH radiotherapy. It is important that innovations are quickly and robustly evaluated. Those that meet agreed standards should then be rolled out nationally to ensure equity of access for all patients.

12.7. Artificial Intelligence (AI) has the potential to play a significant role in radiotherapy[64,65], offering advancements in treatment planning, delivery, and monitoring. The challenge is harnessing the improvements AI can bring and implementing them safely and quickly within the clinical environment.

12.8. There is a paucity of health systems research in the UK which means that opportunities to improve performance and ensure patients can access the best treatment in a cost-effective way are missed. Health system research plays a crucial role in shaping policies, improving patient outcomes, and ensuring the efficient and equitable delivery of radiotherapy services within the broader healthcare landscape, and should be prioritised.

Innovation in Radiobiology

Radiotherapy can have adverse side effects due to the irradiation of normal tissues near the treated cancer, and some cancers are highly resistant to treatment. Pioneering developments in radiotherapy delivery are currently being explored, such as ultra-high dose rates ("FLASH" radiotherapy) and spatially fractionated radiotherapy (minibeams and microbeams). These developments have shown potential in pre-clinical experiments to spare normal tissue while still killing tumour cells.

Other techniques, like charged particle (ion) therapy and boron neutron capture therapy, can create more localized, biologically effective damage that targets the cancer specifically, potentially overcoming some cancers' inherent resistance and stimulating the immune response.

A group of multidisciplinary UK scientists are working together, under the auspices of the Science and Technology Facilities Council (STFC) to develop LhARA; a revolutionary, internationally leading system that uses a laser to produce high energy protons and ions to serve the Ion Therapy Research Facility.

These developments have the potential to revolutionise radiotherapy treatment and lead to significant patient benefit. With appropriate investment, planning and vision the UK is in a position to lead on these novel radiotherapy deliveries.

https://lhara.org

The Clinical and Translational Radiotherapy Research Working Group (CTRad) was widely hailed as the most influential and effective initiative of the now closing National Cancer Research Institute (NCRI).

A very modest but ringfenced budget (c.£180k per year) enabled CTRad to build, sustain and engage a highly collaborative and diverse community of radiotherapy researchers from all the relevant disciplines (Clinical Oncology, Medical Physics, Therapeutic Radiography, laboratory and translational science). Between 2009 and 2022, CTRad reviewed more than 250 clinical trial proposals, of which at least 80 were funded and contributed to the UK's vibrant and innovative clinical trials portfolio.

CTRad coordinated a national approach to the development and execution of proton beam therapy clinical trials and facilitated interactions between patients, researchers, clinicians, funder and industry partners to maximise productivity and coherence. It also spearheaded international efforts to realise the potential of radiotherapy-drug combinations, resulting in two highly cited guidance documents and a national network of laboratories and clinicians.

The closure of the NCRI and hence CTRad due to funding insecurity is a further blow to the research community and will stifle improvement in patient centred care.

Examples of trials and key outputs from CTRad

PLATO[66] Is a multiarm platform study in a rare cancer. Anal cancer is rare, but its incidence is rising rapidly. Approximately 1,000 cases are diagnosed each year in the UK. This study is a step towards personalized treatments that aim to improve cure and prevent patients from suffering side effects. The NHS network of radiotherapy centres and tight knit community ensured that despite the rarity of anal cancer, patients have access to trials and improvements in their care is not overlooked.

CONCORDE[67] is a highly innovative phase I platform study in advanced lung cancer testing multiple DNA repair inhibitors in combination with radical radiotherapy in partnership with AstraZeneca. The study design means that a range of new treatments that target the ability of tumours to repair the DNA damage inflicted by radiotherapy can be tested in parallel to see if they treat lung cancer more effectively. This study is an example of the UK research community collaborating with industrial partners to delivery groundbreaking studies.

TORPEdO[68] is investigating whether a new type of radiotherapy called proton beam therapy can lessen the side effects of treatment for cancer of the mouth and throat. Patients are treated with standards radiotherapy at their local NHS provider or in one of the two NHS Proton centres in Manchester and London. This study is important for the NHS as it will gather evidence whether the high cost of proton treatment is justified by its benefits to patients.

What does world-class radiotherapy research and innovation look like?

12.9. A funded strategic plan for radiotherapy research that recognises the importance of radiotherapy as a cure for cancer and provides the foundation for continuous improvement in cancer care, leading to better outcomes, enhanced quality of life, equitable access and increased survival.

12.10. Research is recognised and invested in as a means to drive economic growth by contributing to innovation, technology advancement, and the development and application of new knowledge.

12.11. Partnerships with industry are enhanced and supported to unlock the exciting potential of new technologies and possibilities for combining radiotherapy with systemic agents including molecular or isotope therapy and immunotherapies. These new approaches have potential to enhance tumour control both within the radiotherapy treatment areas and beyond.

12.12. Centres of innovation are created to investigate new treatments, technologies, and generate evidence, including assessing cost-effectiveness and optimisation of health systems. These centres would provide the framework to assess the appropriateness and feasibility of new innovations including: magnetic resonance imaging linear accelerators, adaptive radiotherapy, automation and artificial intelligence, proton beam therapy and molecular radiotherapy.

12.13. Investment in health systems research to ensure that radiotherapy services are not only technologically advanced but also effectively delivered, accessible, and aligned with the broader goals of patient-centred care and population health.

Next steps

As part of a National Plan for Radiotherapy

12.14 An integrated radiotherapy research strategy that encompasses discovery and translational laboratory science, technological and imaging innovation, and clinical evaluation via clinical trials, health systems and economics research. This strategy should unite the four Nations and include academic institutions, all NHS radiotherapy providers, patient and public representatives, charitable stakeholders and industry partners.

12.15 Access to proportional funding to clinical utilisation will enable UK radiotherapy researchers to increase the quantity, quality and impact of their research outputs. Funding and career development of full-time academic researchers who will generate and drive new scientific concepts and develop global partnerships, as well as provision of research capacity on the frontline in every NHS radiotherapy centre.

12.16 Develop a plan to channel and implement AI development through research that can be translated rapidly, effectively and equitably into the clinical environment. Consideration to be given to the information governance, transparency and bias in data used to train AI and the development of clear lines of responsibility to ensure patient safety.

12.17 Develop systems that enable innovations to be translated into routine clinical practice to improve patient outcomes and experiences, and enhance NHS staffing capacity. Systems need to be capable of ensuring that equipment and digital systems are deployed in a safe way and are continuously monitored in terms of time savings, safety and treatment quality. Examination is needed of how central treatment planning for some tumour types could enhance capacity and efficiency.

Develop, fund and implement an integrated radiotherapy research strategy that encompasses discovery and translational laboratory science, technological and imaging innovation, and clinical evaluation via clinical trials, health systems and economics research.

PART 2 13

Investment

The Challenge

13.1. Radiotherapy in the UK has been systematically under-funded for decades. Only 5% of the cancer budget is directed towards it[69].

13.2. Funding for radiotherapy services can be bureaucratic and hard to navigate. Current systems do not reflect the significant technical advances in the way that radiotherapy treatment is planned and delivered - notably an increase in imaging both pre-treatment and delivery, and a transition to hypofractionation and more complex image-guided techniques.

13.3. There is a lack of funding for PROMs data collection which is a significant barrier to collecting patient-centred data that could highlight variations in outcomes in terms of toxicity.

13.4. The digital transformation has floundered for over a decade, leaving NHS providers fragmented. The lack of interoperability, basic IT connectivity and poor data governance has direct consequences for improving and modernising services[70].

13.5. Current digital infrastructure is not suitable for linking real-world data and clinical trial data or enabling the rapid transfer of data and images within and between centres. There is uncertainty about legal issues including GDPR and a lack of cyber-protection for radiotherapy at a national level.

13.6. Funding for radiotherapy machines and associated IT infrastructure and software is intermittent. Although Scotland implements a rolling programme of replacement, the other nations in the UK are reliant on sporadic centralised funding or mechanisms that do not guarantee regular or up-to-date machine replacement or improvements. For example, in 2016 £130 million of capital funding was made available by NHS England, replacing 69 radiotherapy machines. In September 2021, following advocacy from Radiotherapy UK and the APPG for Radiotherapy, a further £32 million of central funding from the government's spending review was provided for replacement machines. This funding was reported by the government to have replaced 17 LINACs. No further central funding has been made available for radiotherapy machinery since then.

What would world-class investment look like?

13.8 Payment systems that fund and support the rapid technological, innovation and clinical development that characterise radiotherapy services.

13.9 Sustainable and ringfenced funding of radiotherapy machines replacement and infrastructure, with a mechanism to upgrade and reflect advances in equipment and technology.

13.10 Commissioners understand the population need for radiotherapy and appropriately plan resources for equality of access to advancements and patient demand.

13.11 Long-term budget and financial planning, independent of political cycles reflecting a strategic national plan for delivery of advances with local implementation.

Next Steps

As part of a National Plan for Radiotherapy

13.12 Long-term transformative investment in medical technologies attached to the delivery of a national plan.

13.13 Work with all four nations commissioning groups to develop a payment system that can fund new radiotherapy machines and technologies equitably and in a way that promotes developments and advances in patient treatment.

13.14 A national radiotherapy digital taskforce is needed to develop and deliver the necessary digital infrastructure. Legal issues need to be the responsibility of central government including GDPR. Cyber-protection for radiotherapy is needed at a national level. Training in data use needs to be embedded. Access to data needs to be safe and secure, and easy for patients, clinicians and use for analysis and audit.

Deliver long-term transformative investment attached to the implementation of a national plan alongside development of a reimbursement system that equitably sustainably funds radiotherapy machines and technologies, including software and AI. Develop close academic and industry partnerships to ensure current and future innovation is rapidly implemented.

Conclusion

World-class radiotherapy can drive improvements in patient outcomes with higher cure rates and fewer side effects.

Radiotherapy is needed in an estimated 50% of cancer patients and involved in 40% of cancer cures. It is the most cost-effective cancer treatment. As a highly-technical discipline it is primed to harness the digital transformation of healthcare.

The NHS need for radiotherapy will increase by around 30% over the next ten years to meet increasing patient demand. However, the service currently is reaching a watershed moment, with chronic underinvestment, a workforce under increasing pressure and inequitable access to advances in technology threatening UK cancer care.

We are however also at a time of huge opportunity for improving cancer care. By delivering a UK national radiotherapy plan based on the vision outlined in this document, the UK has the potential to develop a truly world class radiotherapy service by 2034. Action is now needed, and urgently.

Acknowledgements

This document has been co-authored by Dr Katie Wakeham (Consultant Clinical Oncologist, Barts Health NHS Trust), Tim Cooper (Specialist Advisor) and Sarah Quinlan MBE (Director, Radiotherapy UK).

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Nicky Whilde
Head of Radiotherapy Physics, Mid and South Essex NHS Foundation Trust

Institute of Physics and Engineering in Medicine

Society of Radiographers

AXREM Special Interest Group - Radiotherapy

"This 10 Year data-informed, research-empowered, patient-centred plan for World Class Radiotherapy in the UK is urgently needed - it sets out a vision to deliver quality cancer care for patients right across the UK into the next decade. We do not have a choice - if we don't implement such a forward-thinking plan, we are letting down not only current cancer patients, but also the cancer patients of the future - they will not forgive us if we fail them. So let's act. Now!"

Professor Mark Lawler, Professor of Digital Health at Queen's University Belfast and Chair of the Lancet Oncology European Groundshot Commission

"It's time to realise the immense potential of radiotherapy by harnessing proven technical advances and innovation to improve patient outcomes. Let us prioritise this cost-effective and curative treatment, where a modest investment could yield a huge leap in progress. If we do this, the world will watch, and we will all be empowered."

Professor Pat Price – Academic Clinical Oncologist at Imperial College London, Chair of Radiotherapy UK and co-founder of Catch Up With Cancer Campaign

"This document sets out a much-needed framework for radiotherapy provision going forwards across the four nations of the UK. It harnesses the passion and energy amongst the many health care professionals involved in the specialty who want to do the right thing for our patients: I would commend it to those in authority to translate it to a reality."

Dr Christopher Scrase – Consultant Clinical Oncologist, Lead Clinician for Radiotherapy, North Wales Cancer Treatment Centre

"I am delighted to see the publication of the vision document "World-class Radiotherapy in the UK: Right Patient, Right Treatment, Right Time." This sets out a clear, practical, achievable and essential strategy to ensure that everyone in the UK has access to life saving and life improving radiotherapy. On behalf of patients with cancer, can I extend a huge thank-you to Radiotherapy UK, the All-Party Parliamentary Group and everyone involved in bringing this to fruition. Urgent implementation of all the key recommendation is now needed!"

Professor Gerry Hanna – Consultant in Clinical Oncology, Chair of Division, Cancer and Specialist Medicine at Belfast Health and Social Care Trust; Honorary Professor - Patrick G Johnston Centre for Cancer Research at Queen's University Belfast

"Radiotherapy has incredible potential to improve outcomes for cancer patients. A large proportion of my career has been dedicated to finding ways to enhance the effectiveness of radiotherapy by combining the latest technologies with novel targeted drugs. While we have made good progress in some areas, its impact has been severely limited by the lack of research funding. Nonetheless, our knowledge is growing all the time and there are multiple opportunities to improve patient outcomes. The full impact of radiotherapy research will only be realised when cutting edge technologies and drug combinations are made available across the UK for every patient that needs them."

Professor Anthony Chalmers – Chair of Clinical Oncology, University of Glasgow

Glossary

3D conformal	In 3D conformal radiotherapy, the radiation beams and resulting treatment plan are shaped to conform or match the shape of the tumour or area needing treatment in a 3-dimensional view. 3D treatment is less precise than the more modern IMRT technique.
Advanced radiotherapy modalities	Techniques and technologies that use the most modern radiation delivery methods to deliver high doses to the tumour, or treatment area, while sparing the surrounding healthy tissues and any organs at risk. E.g. intensity modulated radiation therapy (IMRT), volumetric modulated arc therapy (VMAT) or high-dose stereotactic body radiotherapy (SBRT).
Brachytherapy	A form of radiation therapy where a sealed radiation source is placed inside or next to the area requiring treatment.
Chemo-radiation	A treatment method where chemotherapy and radiotherapy are given alongside each other. Chemotherapy drugs can be given at the same time as radiotherapy are used to make cancer cells more sensitive to damage caused by radiotherapy.
Chemotherapy	Drugs that destroy cancer cells • Chemo can be given before surgery, to help shrink the tumour. This is called neo-adjuvant treatment. • Chemo given after surgery, to reduce the risk of the cancer coming back. This is called adjuvant treatment.
Clinical Oncologists	Doctors who use systemic anti-cancer therapy (SACT), radiotherapy and a range of other treatments to care for patients with cancer.
Dosimetric data	Information relating to the amount or dosage of radiation planned, delivered and absorbed by the body during radiotherapy treatment.
Dosimetrists	Medical professionals who perform calculations for accurate delivery of the radiation oncologist's prescribed dose, document pertinent information in the patient record, and verify the mathematical accuracy of all calculations[11]. Their primary task is to determine the proper radiation dosage to treat cancer.
Engineers	Individuals trained and skilled in the design, construction, and use of radiotherapy machines, trained to trouble shoot, service and maintain machine functionality.
FLASH radiotherapy	FLASH radiotherapy (FLASH-RT) is a new technique, involving treatment of tumours at ultra-high dose rates which actually reduces the trauma to normal tissue around the tumour, whilst equalling the anti-tumour effect of conventional dose rate radiotherapy.
Health systems research	An emerging field that seeks to understand and improve how societies organize themselves in achieving collective health goals, and how different actors interact in the policy and implementation processes to contribute to policy outcomes.

High energy proton beam	Proton beam is a particle therapy, Protons are small particles of an atom. The advantage of particle therapy is that less energy is deposited into the healthy tissue surrounding the tumour. This enables higher doses to be delivered to the tumour, theoretically leading to a higher local control rate, as well as achieving a low toxicity rate. (To note, there is also a low energy unit in Clatterbridge for treatment of eye cancers).
Immunotherapy	Immunotherapies are treatments that use the body's own immune system to find and attack cancer cells within our body. Each immunotherapy drug uses the immune system in different ways.
Image Guided Radiotherapy (IGRT)	The use of a variety of imaging modalities (X-rays, Cone beam CT scans, MRI) taken throughout the course of radiotherapy treatment to accurately identify and localise the treatment area before or during the radiation delivery.
Individualised (adaptive) radiotherapy	A type of radiotherapy treatment that involves continually adjusting treatment to account for changes taking place within the patient's body. This can be done before or during treatment depending on technology available.
Intensity-Modulated Radiotherapy (IMRT)	IMRT uses multiple beams of X-rays of varying intensity directed towards the cancer, angled from various directions around the patient. The radiotherapy beams are shaped by multi-leaf collimators (MLCs) allowing for different doses of radiation to be given to different parts of the area needing treatment. controls the radiation enabling us to avoid or minimise exposure to surrounding healthy tissue while maximising dose to the cancer.
Late effects	Side effects from radiotherapy treatment that occur months and years after treatment has finished, these can be long term and ongoing.
Medical Physicists (Clinical Scientists)	Medical physicists registered to work in hospitals are clinical scientist. Their work is involved with the commissioning, calibration, safe operation and maintenance of systems used for looking at or measuring what is happening in the body, for example those using x-rays, ultrasound, light in various frequencies; laser Doppler blood flow measurement; magnetic resonance imaging and nuclear medicine.
Medical technology	Medical technologies are products, services or solutions used to save and improve people's lives from diagnosis to cure.
Molecular radiotherapy	Molecular radiotherapy (MRT) refers to the delivery of radiation to tissue (benign or malignant) via the interaction of a radiopharmaceutical drug with molecular sites or receptors.
MRI-guided radiotherapy	Technique that combines high resolution magnetic resonance imaging (MRI) to localise the treatment target guiding the radiotherapy beams to treat tumours more accurately than conventional radiotherapy. This type of radiotherapy is called magnetic resonance image guided radiotherapy (MRIgRT).
Particle Therapy	Particle therapy is a form of external beam radiotherapy using beams of energetic neutrons, protons, or other heavier positive ions for cancer treatment.

Patient reported outcome measures (PROMS)	A way to collect information, from patients themselves, about how well the health service is treating them. PROMs allow us to understand the difference that healthcare interventions make to people's quality of life.
Radiobiology	The study of the effects of ionizing radiation on living things, effects of radiation therapy on the body.
Radiotherapy fractions	Small doses of radiotherapy given over time or in a single dose.
Stereotactic ablative radiotherapy (SABR)	A type of radiotherapy where a few very high doses of radiation are delivered to relatively small, well-defined tumours.
Technology Horizon Scanning	A process aimed at looking ahead to identify and assess emerging health technologies that are new, emerging and that have the potential to affect health and health services.
Therapeutic Radiographers	Degree-trained or equivalent health care professionals, therapeutic radiographers provide expertly trained to safely plan and deliver radiotherapy treatment using a wide range of technical equipment.
Translational research	Research aimed at translating (converting) results in basic research into results that directly benefit humans in clinical care.

APPENDIX 1

5-year net survival charts

Background

Population-based net survival is a key metric for evaluating the overall effectiveness of health systems in providing cancer care.

In 2015, the second cycle of the CONCORD programme (CONCORD-2)[1] established the global surveillance of cancer survival trends by analysing data on 25.7 million patients diagnosed with one of 10 common cancers during 1995-2009 and followed up to 31 December 2009. Data were contributed by 279 cancer registries in 67 countries world-wide.

In 2018, the third cycle of the programme (CONCORD-3)[2] updated survival trends to 2014.

CONCORD-3 obtained individual tumour records for over 37 million patients diagnosed with one of 18 common cancers during 2000-2014 and followed-up to 31 December 2014. Data were provided by 322 population-based cancer registries in 71 countries world-wide. CONCORD-3 highlighted high and stable trends in age-standardised 5-year net survival for most solid tumours in North America, Oceania and several European countries.

CONCORD is the only programme to enable robust comparisons of population-based cancer survival in low- and high-income countries world-wide. Cancer registries submit data on anonymised individual tumour records according to a well-designed protocol and data specification. All datasets are subject to centralised and standardised quality control procedures. For each registry, life tables of background mortality are constructed and deployed to estimate net survival. Centralised analyses are performed using the latest statistical methods.

Summary

For most cancers, age-standardised 5-year net survival in the UK lagged behind six other high-income countries selected for this report. Survival in the UK is much lower for rectal, lung and cervical cancers, brain tumours and lymphoma. For oesophageal, breast and prostate cancers, 5-year survival in the UK does not differ from the other six countries.

In the UK, 5-year net survival for almost all cancers is higher in England than in Northern Ireland, Scotland and Wales.

Net survival estimates are corrected for background mortality (i.e. the risk that cancer patients will die from something other than their cancer). Background mortality differs between countries, as well as by age, sex and over time. The net survival estimates are also age-standardised (i.e., corrected for differences between countries and over time in the age profile of cancer patients). We will use the term "survival" in this report for brevity, but any extract of the results for the final report should make clear that the survival estimates are age- standardised net survival estimates, with a brief explanation in a footnote. Please note that survival is not a "rate": it is the estimated probability that a group of patients will survive for a certain time after diagnosis, such as one and five years, expressed in the range 0-100% for convenience. In this context, it is enough to use the word "survival."

[1] Allemani C, Weir HK, Carreira H, et al. Global surveillance of cancer survival 1995-2009: analysis of individual data for 25,676,887 patients from 279 population-based registries in 67 countries (CONCORD-2). Lancet 2015; 385: 977–1010. https://doi.org/10.1016/S0140-6736(14)62038-9

[2] Allemani C, Matsuda T, Di Carlo V, et al. Global surveillance of trends in cancer survival 2000–14 (CONCORD-3): analysis of individual records for 37,513,025 patients diagnosed with one of 18 cancers from 322 population-based registries in 71 countries. Lancet 2018; 391: 1023-75. https://doi.org/10.1016/S0140-6736(17)33326-3

Age-standardised five-year net survival by cancer type

The results below are presented for patients diagnosed during 2010-2014.

Oesophagus

In 2010–14, 5-year survival ranged between 16% in the UK and 24% in Australia. In the UK, survival ranged between 13% in Scotland and 21% in Northern Ireland.

Rectum

Five-year survival was lower in the UK than in any other selected country. 5-year survival ranged between 62% in the UK and 72% in Australia. Survival among the UK nations did not vary widely (range 59%-64%).

Lung

Both one-year and five-year survival were lower in the UK than in the other selected countries. One-year net survival ranged between 37% in the UK and 48% in Sweden; estimates were similar among UK nations (range 35%-37%).

Five-year survival ranged between 13% in the UK and 21% in Canada. No difference was found between the UK nations.

Breast

Five-year survival was high, in the range 86% (UK) to 90% (Australia) in all seven countries. Among the UK nations, five-year survival was lower than 85% only in Northern Ireland (83%) and Wales (82%).

Cervix

Five-year survival was in the range 64% (UK) to 73% (Norway). No difference was observed between the UK nations (range 62%-64%).

Prostate

Five-year survival was high, in the range 89% (UK) to 94% (Australia). Among the UK nations, five-year survival ranged between 85% in Scotland and 89% in England.

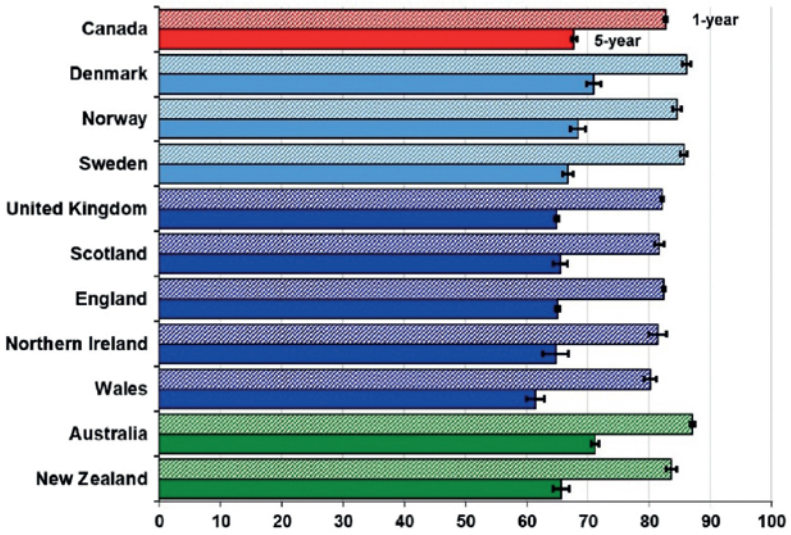
Brain

Five-year survival ranged between 23% in New Zealand and 39% in Denmark and Norway. In the UK, five-year survival was in the range 26% (England) to 31% (Wales).

Lymphoma

Five-year survival ranged between 65% in the UK and 71% in Australia and Denmark. Survival in the UK varied between 61% in Wales and 66% in Scotland.

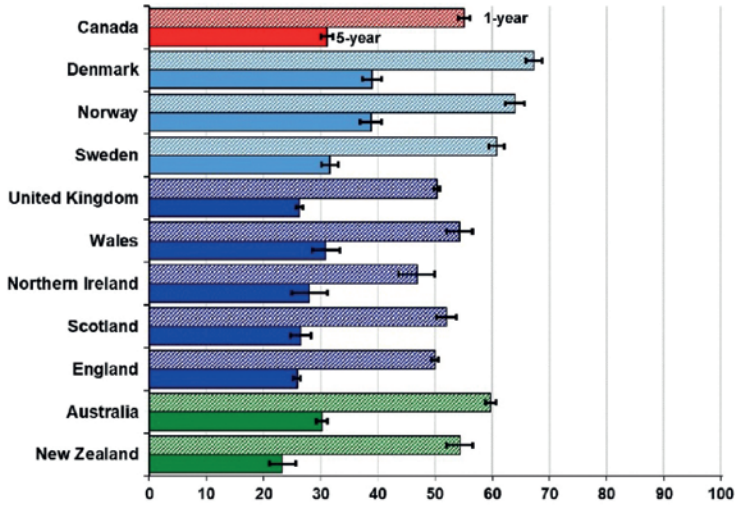
Lymphoid adults: age-standardised 1-year (pattern) and 5-year (solid) net survival (%)



Allemani et al. Lancet 2018; 391: 1023-75. https://doi.org/10.1016/S0140-6736(17)33326-3

CONCORD Global surveillance of cancer survival

Brain adults: age-standardised 1-year (pattern) and 5-year (solid) net survival (%)



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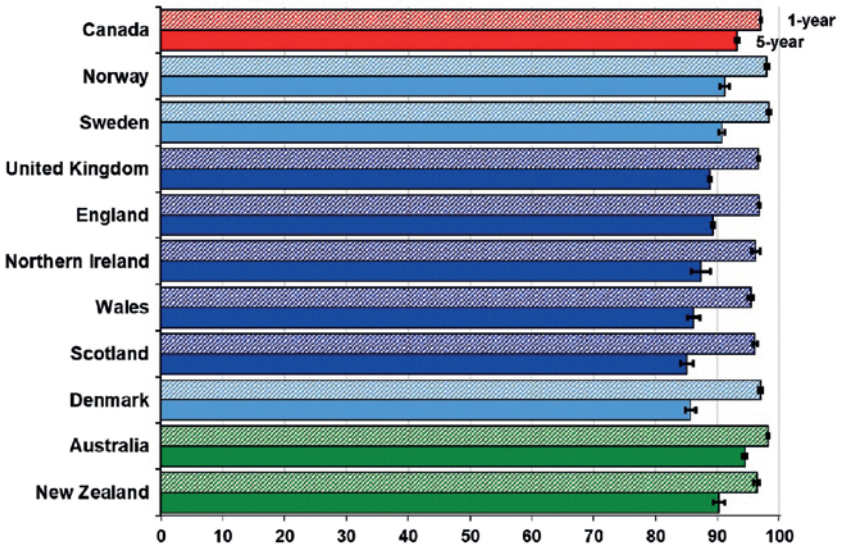
CONCORD Global surveillance of cancer survival

Prostate: age-standardised 1-year (pattern) and 5-year (solid) net survival (%)



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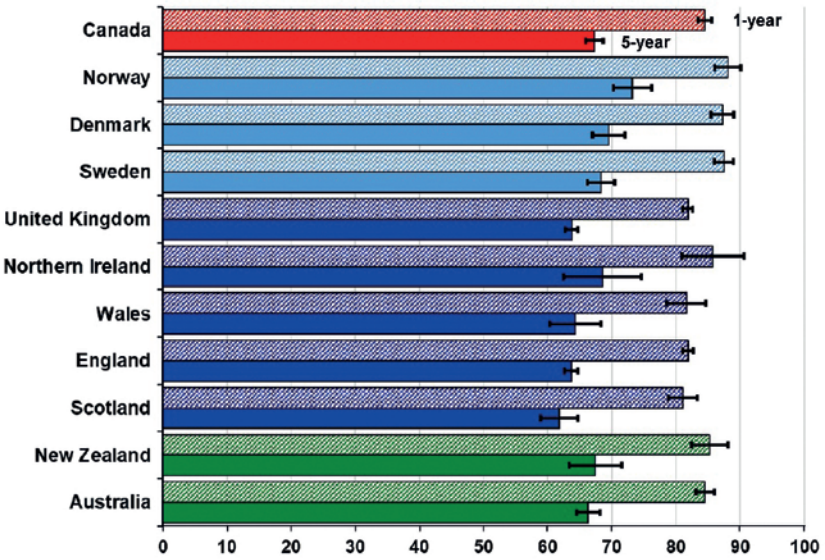
CONCORD Global surveillance of cancer survival

Cervix: age-standardised 1-year (pattern) and 5-year (solid) net survival (%)



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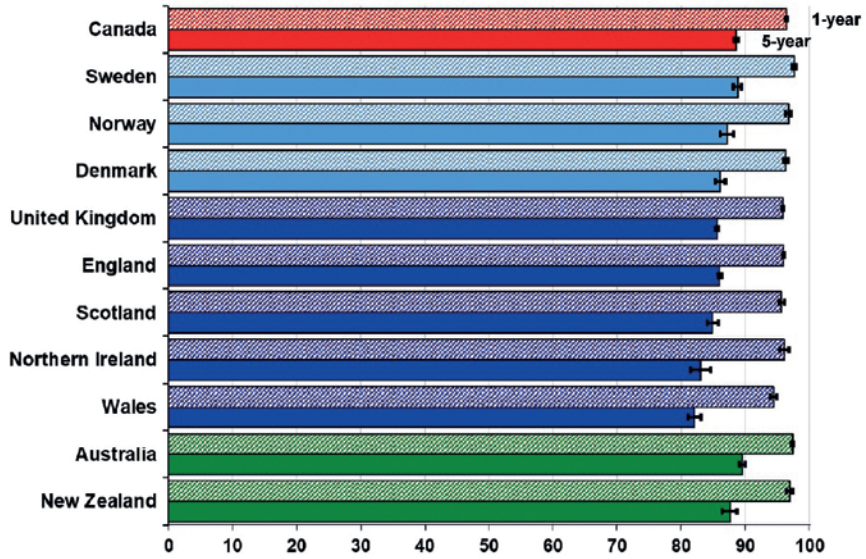
CONCORD Global surveillance of cancer survival

Breast: age-standardised 1-year (pattern) and 5-year (solid) net survival (%)



Allemani et al. Lancet 2018; 391: 1023-75. https://doi.org/10.1016/S0140-6736(17)33326-3

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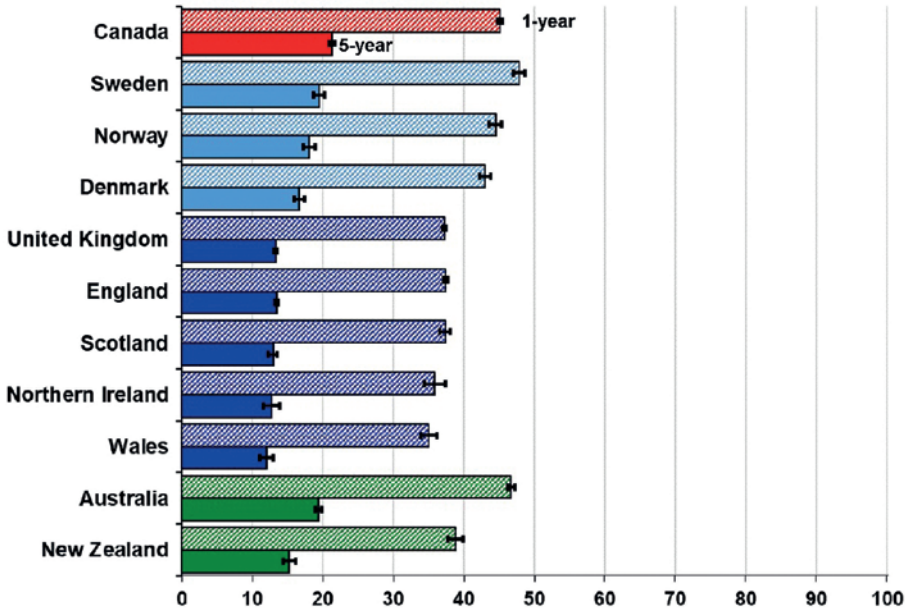
Lung: age-standardised 1-year (pattern) and 5-year (solid) net survival (%)



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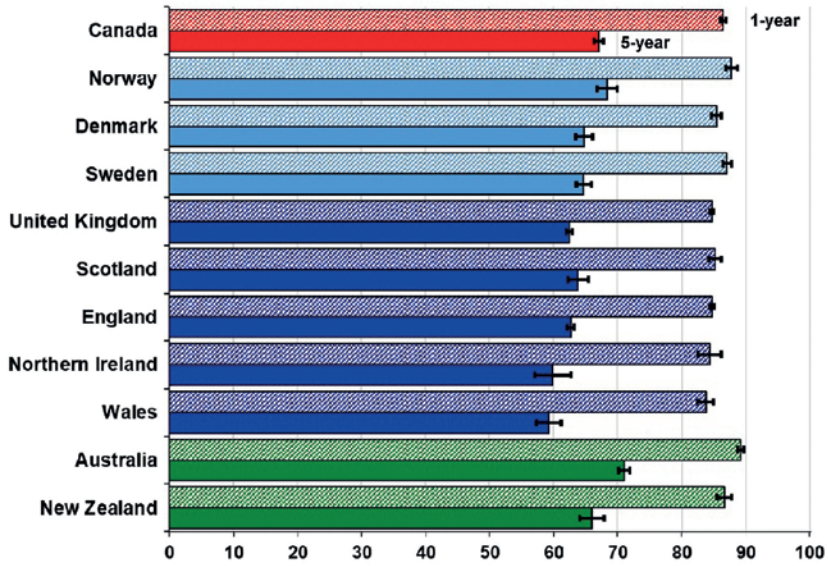
CONCORD Global surveillance of cancer survival

Rectum: age-standardised 1-year (pattern) and 5-year (solid) net survival (%)



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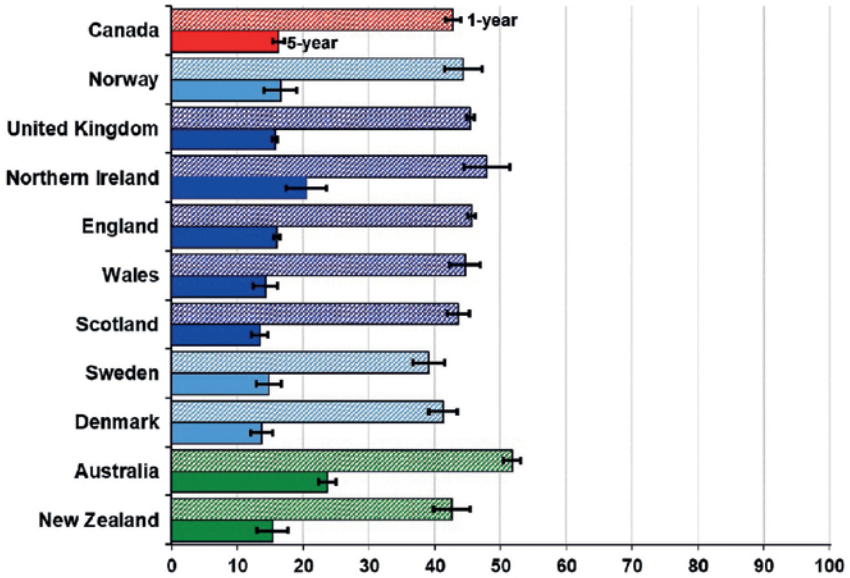
Oesophagus: age-standardised 1-year (pattern) and 5-year (solid) net survival (%)



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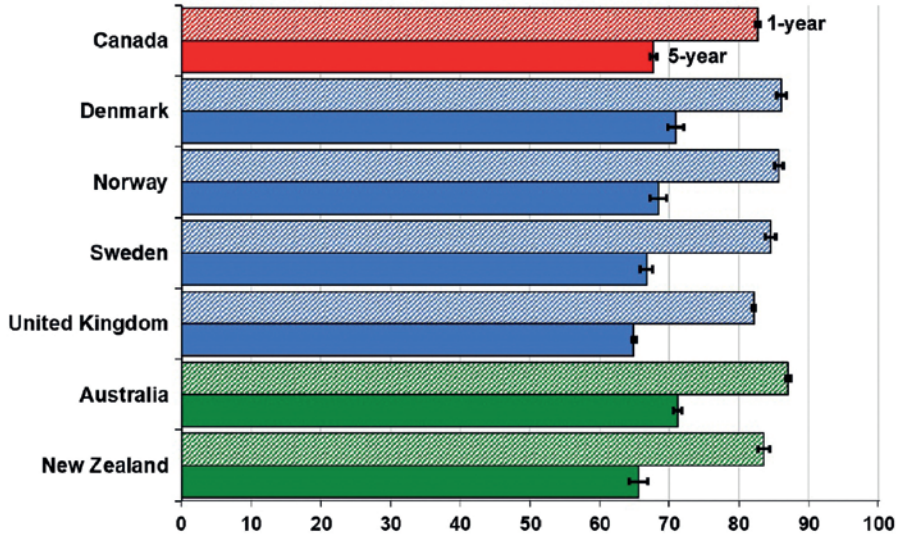
CONCORD Global surveillance of cancer survival

Lymphoid adults: age-standardised 1-year (pattern) and 5-year (solid) net survival (%)



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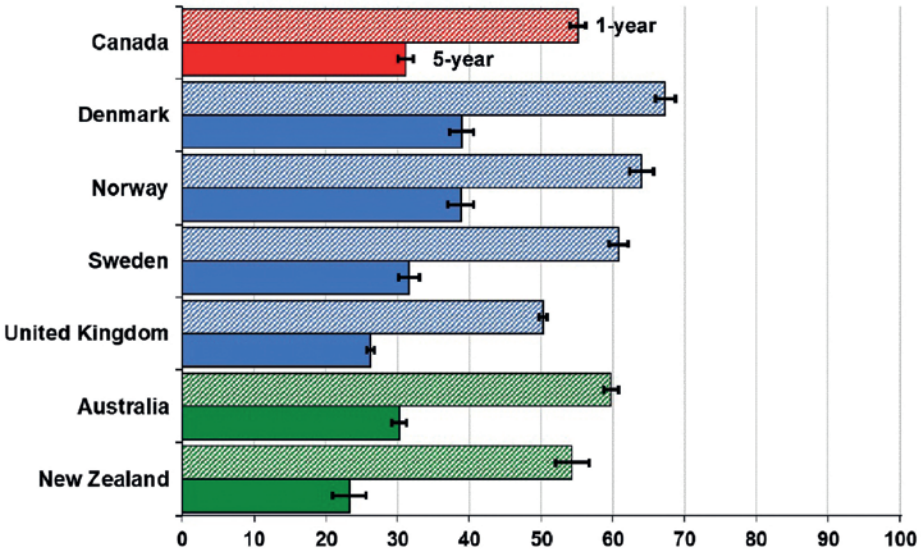
CONCORD Global surveillance of cancer survival

Brain adults: age-standardised 1-year (pattern) and 5-year (solid) net survival (%)



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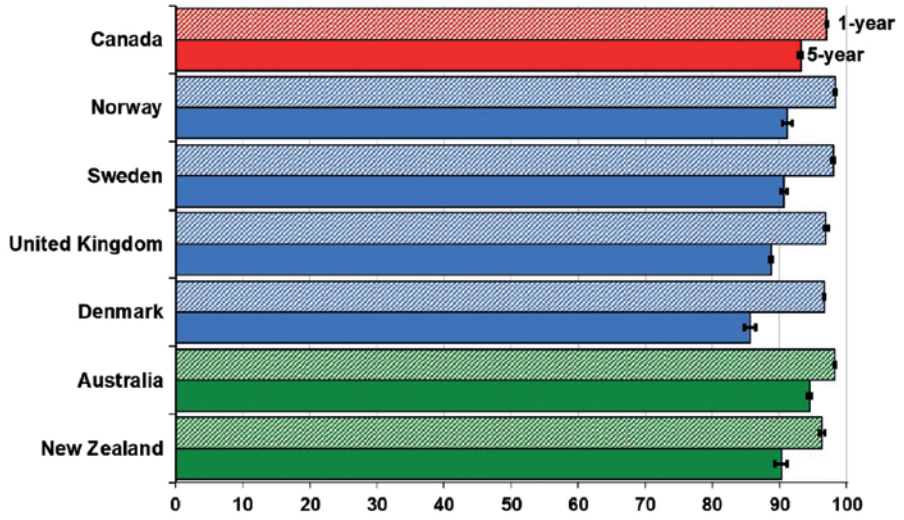
Prostate: age-standardised 1-year (pattern) and 5-year (solid) net survival (%)



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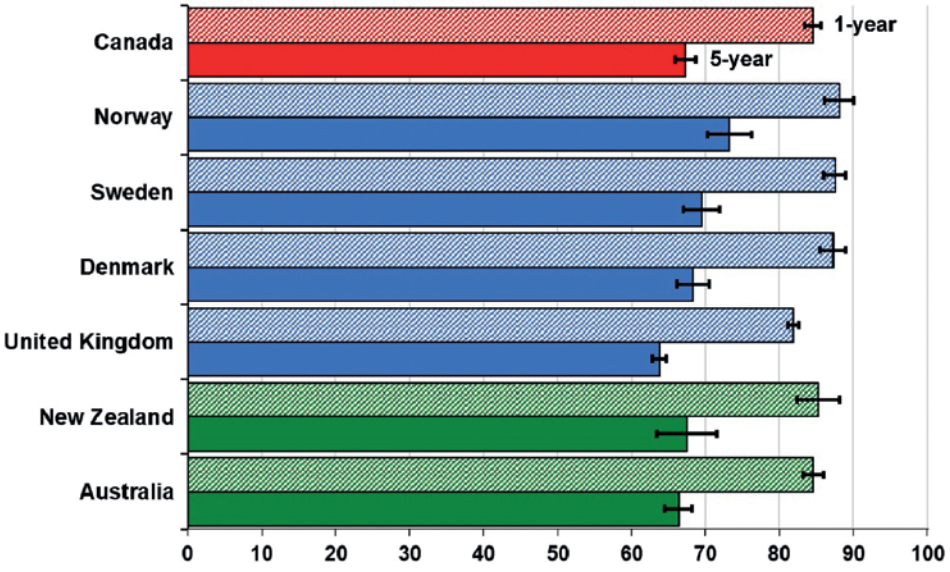
CONCORD Global surveillance of cancer survival

Cervix: age-standardised 1-year (pattern) and 5-year (solid) net survival (%)



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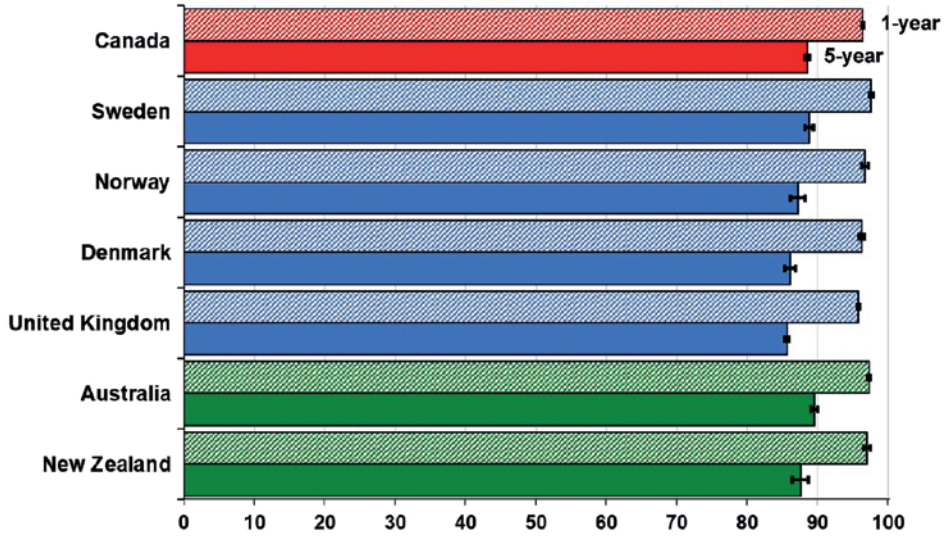
CONCORD Global surveillance of cancer survival

Breast: age-standardised 1-year (pattern) and 5-year (solid) net survival (%)



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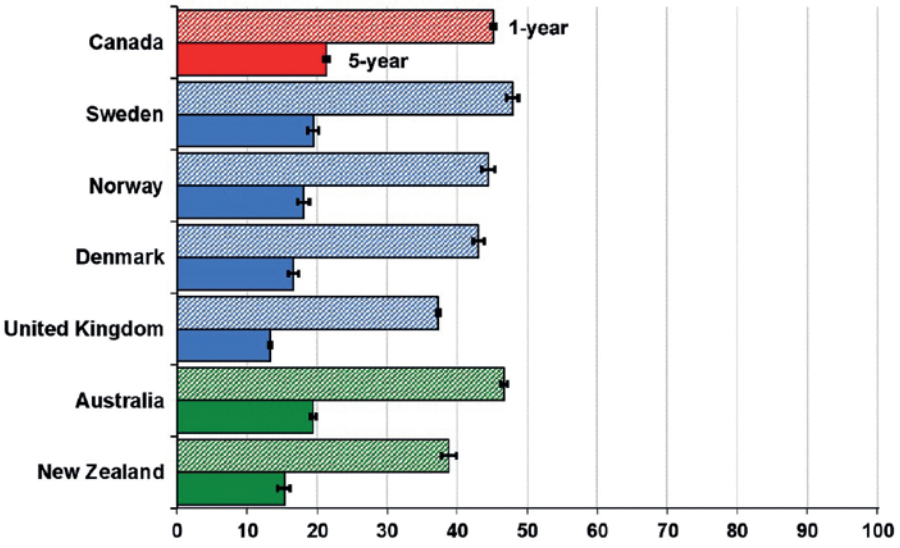
CONCORD Global surveillance of cancer survival

Lung: age-standardised 1-year (pattern) and 5-year (solid) net survival (%)



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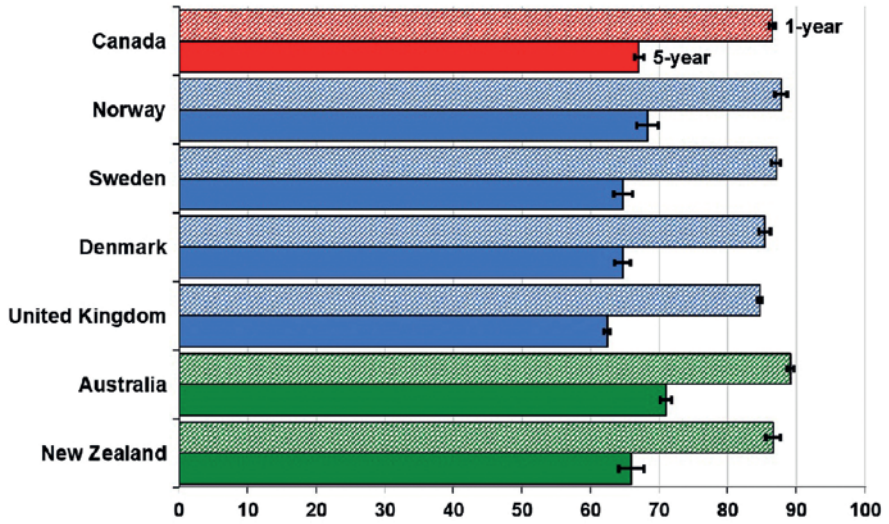
CONCORD Global surveillance of cancer survival

Rectum: age-standardised 1-year (pattern) and 5-year (solid) net survival (%)



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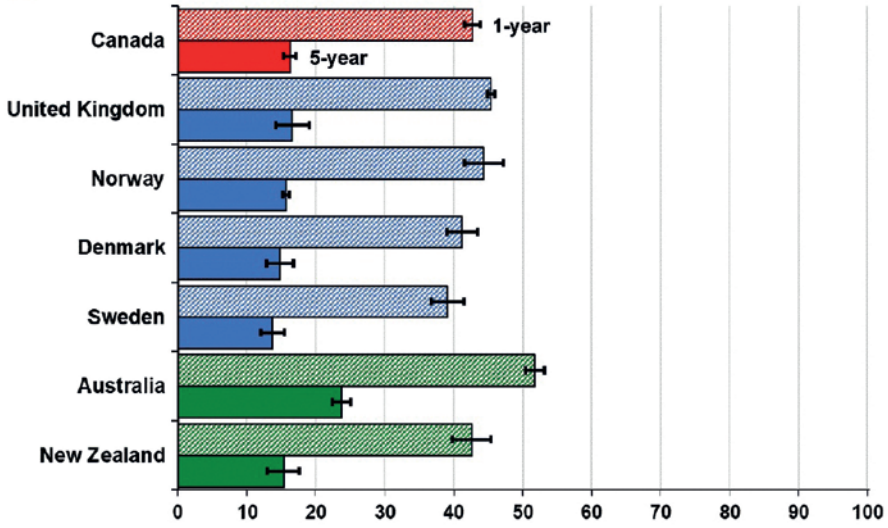
CONCORD Global surveillance of cancer survival

Oesophagus: age-standardised 1-year (pattern) and 5-year (solid) net survival (%)



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APPENDIX 2

Patient Survey Findings

In August 2023 Radiotherapy UK asked radiotherapy patients and their family or friends to respond to a short survey about what they think world-class radiotherapy in the UK should include. No identifiable information was collected. A total of 279 respondents answered two questions.

The first question asked about three priorities of a world-class radiotherapy service. 279 respondents replied.

What should a world class Radiotherapy service inlucde? What do you think are the three most important things from the list below?

Access to the best treatment that will give the best result	**93.1%**
Getting treatment as soon as possible	**85.6%**
Skilled and experienced staff	**73.1%**
Treatment that happens close to home	**35.8%**
Taking part in research and clinical trial	**15.4%**

The second question was an open question asking for further thoughts and comments. 201 people replied, with many writing detailed answers outlining their own experiences of radiotherapy and what they believed where key elements of a world class service. The most common themes that were raised in this section are highlighted below.

34% of respondents emphasised the importance of clear and honest communications with patient and a good hospital experience.

"Apart from all of the above, careful thought into physical settings, space and patient dignity should be considered."

"Realistic information about long term effects of radiotherapy so that consent can be informed."

"More explanation to the patient beforehand e.g. videos of exactly what to expect, and advice from previous patients about how to prepare for each session."

"Giving the patient all the pros and cons of treatment. Giving them the information on how to treat yourself at home."

22% of patients highlighted the need for better after-care support.

"I felt very alone getting my radiotherapy, a better after care service ensuring patients are coping with it mentally & physically would have helped me tremendously."

"More support/care for patients with long term or late side effects. A better understanding of long-term side effects for all medical professionals e.g. GP surgeries."

"I'm 2 years down the line and I've got permanent scarring (which doesn't bother me) nerve pain, inflammation, swelling, pain, swallowing difficulties, dry mouth, restricted eating. I'm part of a group who have found each other from all across the world who are united by this diagnosis and treatment.... Aftercare clinics would be a great addition."

16% of respondents thought a world-class service should deliver access to the latest, targeted technology, sooner:

"Radiotherapy has been miraculous to me throughout my ordeal with cancer and I feel it should be more available as a treatment."

"More of the latest technology, sooner, and dispersed and available across each region of the UK."

"The most up to date radiotherapy treatment should be offered to ALL patients, no matter what the postcode is."

15% noted the importance of receiving care close to home.

"I think you need treatment close to home, especially treatment where you need a full bladder, also how uncomfortable it becomes sitting."

"We need more radiotherapy centres and in areas where people have to travel, we need provision of transport and/or accommodation."

APPENDIX 3

Patient Survey Findings

RAPID-RT: Using routinely collected 'real-world' patient data to provide evidence of the impact of changing radiotherapy practice as an embedded part of standard-of-care.

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What are we doing?

- RAPID-RT is a programme of research aiming to demonstrate how Real-World Data (RWD) can be used to prospectively evaluate and iteratively optimise changes in radiotherapy practice.
- The clinical exemplar of the approach is the introduction and optimisation of heart sparing radiotherapy as a new standard-of-care for Non-Small Cell Lung Cancer patients treated with curative intent.

Why are we doing it, why is it important?

- Randomised clinical trials (RCTs) provide a gold standard of evidence of the efficacy of new radiotherapy interventions, but have limitations: Patient groups (the elderly, frail, those with comorbidities, from ethnic minorities or deprived backgrounds) are known to be under-represented in trial participants limiting generalisability; RCTs are expensive and hard to set up and as such there are many changes in practice (e.g. evolutions in technique, new technologies) that are not evaluated in trials, and for which there is little data about their impact on patient outcomes.
- Real-World Data (RWD) is collected about all patients as a part of their normal cancer care. Our vision is to use RWD to provide evidence of the impact of changes in radiotherapy on patient outcomes as an embedded part of routine practice.
- By using multiple learning cycles, it is possible to iteratively refine changes in care, based on real-time patient outcomes, to optimise the new technique to deliver the best outcomes in the population of patients served by a radiotherapy centre (Figure 1).
- This approach is often called 'rapid-learning'. The aim is that:
    - The evidence is inclusive and representative of all patients served by a radiotherapy centre – we learn from every patient.
    - Treatments are tuned to deliver the best outcomes for the local patient population.
    - No additional data is collected and so evidence can be generated without additional burden on staff.
    - Will allow all changes in radiotherapy practice to be monitored and evaluated as an embedded part of standard-of-care.

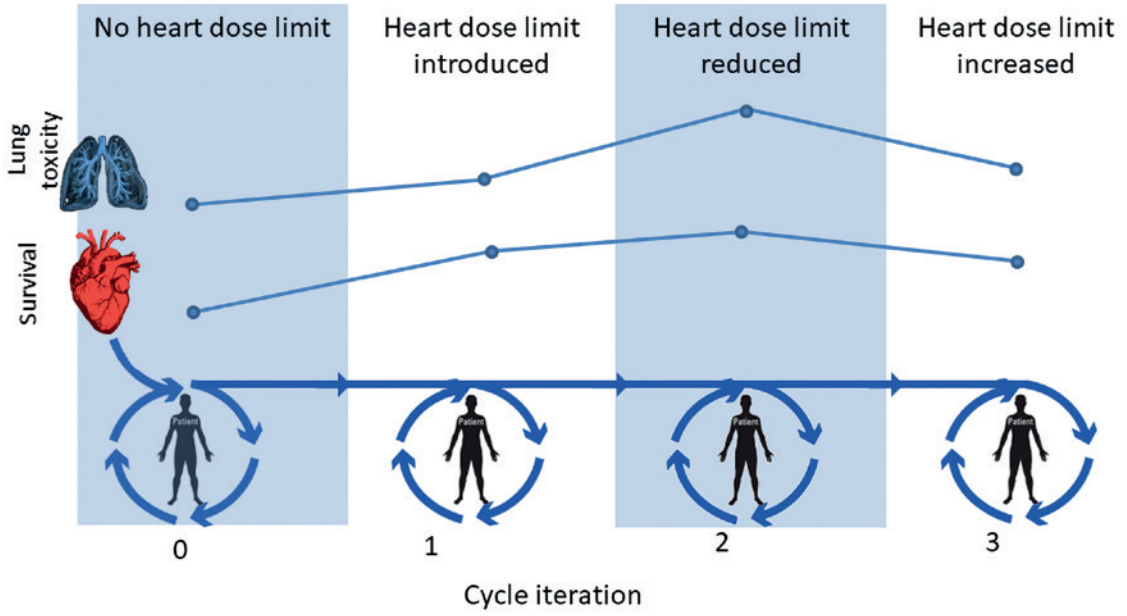

Figure 1: An illustration of how 'rapid-learning' will iterate towards an optimal heart dose-limit. Starting with no limit, baseline survival and lung toxicity is assessed. A heart dose-limit is introduced (cycle 1), resulting in increased survival with slightly increased lung toxicity. In cycle 2, the dose-limit is decreased further, resulting in unacceptable lung toxicity. In cycle 3 the dose-limits are raised to reduce toxicity. This aims for quick convergence on the balance of risks considered clinically optimal.

What have we demonstrated to date?

- Heart sparing radiotherapy was introduced at The Christie NHS Foundation Trust as a new standard of care in April 2023. The new technique introduced a new organ at risk, a region composed of several cardiac substructures, with a mandatory dose limit (initially 19.5Gy).
- The RAPID-RT study recruits patients treated with the new standard of care and compares their outcomes to that of patients treated before the new technique was introduced.
    - The primary outcomes are overall survival, radiation pneumonitis and radiation oesophagitis. Using the iterative cycles shown in Figure 1, the aim is to refine the initial dose limit to balance the expected benefit in overall survival with possible changes in other toxicities to deliver best outcomes for patients treated at The Christie.
- The RAPID-RT study opened in April 2023, the same time as the new technique was introduced.
    - It uses an informed opt-out process. Patients are provided with information on the study by a health care professional and a brief patient information sheet with options to watch video/listen to an audio description. Opt-out is verbal or via a dedicated e-mail address. There are no consent forms. Opt-out status is captured in the patient electronic record.
    - Data is automatically extracted from the patient electronic record, anonymised and pushed to a study database. The database is updated daily.
- To date (December 2023 – 7.5 months) ~280 patients were treated with new technique and recruited to study. There has been 1 opt-out.
- Changes in outcome are reported monthly to The Christie lung team. The decision to refine the dose limit further will be a clinical decision supported by evidence from the RAPID-RT study.

What we are hoping to achieve?

- Clinically we hope the RAPID-RT study will demonstrate that introducing a new dose limit for the top of the heart improves the overall survival of NSCLC patients without causing unacceptable increases in other toxicities. We should be able to report on the efficacy of the first dose limit in summer 2024.
- More widely, we will collect and report information on the processes followed when implementing the RAPID-RT clinical study, including potential barriers to implementation, the ease of translation to other disease sites and changes in radiotherapy practice, the legal and ethical issues, and the health economics of the approach. The aim is to provide comprehensive evidence other institutes can use to support the prospective use of RWD to assess the impact of changes in radiotherapy practice on patient outcomes.
- The long-term aim is to see all changes in radiotherapy and oncology practice evaluated and optimised using routinely collected RWD as an embedded aspect of normal care.
    - In this first instance we would like to see uptake of the rapid-learning process more widely at The Christie following the completion of RAPID-RT (outside of the research setting as an aspect of standard service provision).
    - Following this, roll-out to other academic and non-academic radiotherapy centres.

What needs to happen to replicate this nationally?

- Agreed upon minimum datasets per cancer site:
    - Unified structured data collection processes (e.g. via similar electronic record form design).
    - Unified data collection time-points (baseline and throughout follow-up).
    - Data collection may be possible through the use of the Secure Data Environments NHS England are developing if symptom burden and acute/long-term toxicity burden can be inferred from primary/secondary care data.
- Common governance processes across radiotherapy centres for the use of patients' data for i) research (such as RAPID-RT) but ii) for routine evaluation of changes in care as a part of normal service provision (i.e. not using research governance processes – can we generalise the Quality Improvement frameworks used at different trusts?).
    - Should this be dictated/recommended centrally – e.g. from NHS England?
    - Can rapid-learning approaches such as RAPID-RT be integrated into existing Quality Improvement processes.
- Agreed upon minimum infrastructure standards.
- Development of a culture of working with patient data for patient benefit to move away from 'guarding' patient data. This aligns with the recent 'Data Saves Lives' policy.

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