The Radiotherapy Innovation Fund

An evaluation of the Prime Minister's £23 million Fund

July 2013

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[1] England & Wales registered charity no. 1089464; Scotland registered charity no. SC041666; Isle of Man registered charity no. 1103

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Executive summary

The Radiotherapy Innovation Fund marks a step change in the delivery of advanced radiotherapy in England. Without this Fund it is highly unlikely that centres across the country would be able to meet the minimum standards for Intensity Modulated Radiotherapy (IMRT) within the NHS England service specifications. In addition, the Prime Minister's personal pledge that all patients will have access to the most appropriate, safe, and cost effective radiotherapy that their doctor recommends would not be achieved.

In August 2012[2] 13.6% of patients receiving radiotherapy in England were given IMRT. By April 2013 this figure had risen to 22.3%[3]. This means that around 5,800 more patients a year across England will now have access to advanced radiotherapy treatment, which is more targeted at the patient's cancer and causes less damage to surrounding healthy tissue. This clearly demonstrates the immense value that the Fund has brought to radiotherapy services, and will continue to bring as the full benefit of the additional resources is realised over this year.

The expectation for all Trusts to achieve 24% IMRT by April was recognised by all as highly ambitious. While not all centres met this level, considerable progress has been made in a very short period of time. Much of the Fund was used to purchase software and equipment which carries with them a lead in time due to commissioning at the hospital site before safe clinical use, and so we expect to see further improvements as these are utilised.

The success of the Fund can be attributed to a number of key factors:

1. A personal commitment from the Prime Minister on radiotherapy.
2. Constructive collaboration between the Department of Health, Cancer Research UK, the Institute of Physics and Engineering in Medicine, the National Cancer Action Team, the Royal College of Radiologists and the Society and College of Radiographers to design a process which allowed money to be targeted on the basis of need and opportunity, and supported a case for additional funding over and above the original £15million commitment.
3. A pragmatic approach from the radiotherapy community, NHS Supply Chain and manufacturers to work to the very tight timescales and conditions placed on the Fund.
4. A dedicated professional approach by clinical radiotherapy teams to ensure software and equipment funded by Radiotherapy Innovation Fund was, and continues to be, implemented as a priority in a safe and effective manner.
5. Support provided by National Cancer Action Team and clinical members of the National Radiotherapy Implementation Group to run 46 challenge sessions across the country to help centres submit robust applications and ensure that the Fund achieved the best value for money and impact possible.

The ramp up in IMRT that has been seen would simply not have been achievable without the money which the Fund provided. Years of incentives and targets, but without additional ring-fenced funding, have failed where a relatively modest investment in the service has now shown success.

The Radiotherapy Innovation Fund was absolutely critical to fill a gap in the radiotherapy service that should not have existed. Significant challenges remain. The radiotherapy service will continue to need to introduce new innovative radiotherapy treatments, as they are evaluated and developed. Experts now believe that the goal for delivery of IMRT activity is likely to be around 50% for all

[2] Data for 4 centres was only available for November 2012 (prior to the implementation of the fund) and has been assumed to be representative of IMRT delivery at those centres at this point in time.

[3] Based on self-reported proportions of radically treated patients receiving inverse planned IMRT in these periods, and the number of radically treated radiotherapy patients in FY 2012/2013 at each of the centres in England.

radical radiotherapy patients[4]. The introduction of a tariff and changes to commissioning structures will go some way to support improvements. The funding and roll-out of advanced radiotherapy and innovation should be a priority for NHS England, to ensure patients have access to world class radiotherapy.

Given the impact that radiotherapy can have in curing cancer and reducing the premature mortality of patients who receive it, continuing commitment is vital to ensure that patients across the country are given access to the best possible radiotherapy service, regardless of where they live.

Recommendations

In reflecting on the success of this Fund, and the size of the challenge still to be met in radiotherapy, there is a real opportunity in the NHS in England to continue to build a world class radiotherapy service. To achieve this, a number of measures need to be taken:

Funding

- **NHS Trusts, with support from Government, must urgently find a solution to the current challenge in providing sufficient numbers of up to date linear accelerators.** Individual providers are responsible for maintaining and replacing high value equipment. Trusts need to prioritise their investments and ensure that they have sufficient equipment to provide high quality, safe and cost effective services for patients. They should also work with NHS Supply Chain on the procurement of radiotherapy equipment to make full use of the £300million capital equipment fund. The association between delivering advanced radiotherapy and the tariff, and the consequences of not providing these facilities, needs to be the responsibility of the highest management levels within Trusts.

- **Government should consider additional ring-fenced funding streams to further boost radiotherapy services in the future.** Radiotherapy is clinically cost effective. It accounts for 5% of the national spend on cancer, yet is second only to surgery in its effectiveness in treating cancer. The £23million investment through the Radiotherapy Innovation Fund is relatively modest, especially in comparison with funding provided to other areas of treatment and in promoting innovation in the NHS.

  Pound for pound, the number of people likely to benefit from this fund is highly competitive with other areas of investment. Given the success of this Fund, future one-off ring-fenced investments in radiotherapy should be considered.

Service delivery and commissioning

- **NHS England should provide support to ensure the roll-out of Image Guided Radiotherapy (IGRT).** While progress is being made, more effort is needed to ensure that all patients who might benefit are being offered this. The national support programme for IGRT and the introduction of a CQUIN for IGRT in 2013/14 will go some way to address this, but progress will need to be closely monitored. This will be crucial to making progress on the NRAG 2007 recommendation that all centres should be delivering 4D adaptive radiotherapy as standard.[5] A

[4] T. Cooper, M.V. Williams. Implementation of Intensity-modulated Radiotherapy: Lessons Learned and Implications for the Future. Clinical Oncology 24 (2012) 539-542

[5] National Radiotherapy Advisory Group, Radiotherapy: developing a world class service for England (2007)

progress report from the National IGRT programme will be published in summer 2013 with specific recommendations for further supporting work.

- **The Radiotherapy Clinical Reference Group should ensure specialised commissioning includes incentives to promote improvements in radiotherapy.** From April 2013 radiotherapy is being commissioned nationally as a specialised service. This is a positive step forward for the radiotherapy service. Until recently, local commissioning arrangements varied hugely across the country and were often not sufficiently flexible to reward complex or innovative radiotherapy practice. The service specification for radiotherapy should aim to promote best practice and, where appropriate, stretch the radiotherapy service to provide world-class treatment uniformly across the country.

  Providers will need to be given an appropriate level of support from commissioners to meet these specifications.

- **Implementation of the national tariff for radiotherapy should be monitored by NHS England to ensure that it is fit for purpose and is flexible enough to include new treatments as evidence supports their introduction to the service.** Historically, radiotherapy services have been commissioned using locally agreed tariffs via block contracts. This has resulted in different contract types and a variety of currencies and prices across the service. While it is accepted that there will be winners and losers across the country as the national tariff is introduced from April 2013, the impact of the tariff should be subject to close scrutiny. This should provide incentives for radiotherapy and promote innovation.

Innovation and workforce

- **Processes should be introduced to support innovation in radiotherapy. NHS England and the Clinical Reference Group should investigate an appropriate long term solution for ensuring innovative radiotherapy treatments are rolled out across the country as soon as possible.** The service specification for radiotherapy, and the additional support provided by the Radiotherapy Innovation Fund will help the roll-out of advanced radiotherapy. However, both of these mechanisms are focused around the minimum standards for advanced radiotherapy that each centre should be meeting now and not targets for the future.

  It is likely the £100million NHS England Specialised Service Commissioning Innovation Fund will be stretched across the whole of the NHS. Individual treatment requests are arduous and not appropriate for treatments that have proven clinical benefit in the significant proportion of patients who receive them. A long term solution is needed.

- **NHS England and Health Education England should take action to address current shortfalls in the radiotherapy workforce to ensure continued improvements in advanced radiotherapy. A plan should be put in place to ensure that the skills and resources required to meet future demand, and the introduction of innovations to radiotherapy services, can be achieved.** The ongoing introduction of new technologies requires additional time during the implementation phase, and all these new technologies demand additional workforce skills and require longer time to undertake compared with previous treatments. Additional workforce is required to support this effectively**.** Services should map skills requirements to patient pathways to ensure existing resources are used effectively and efficiently. Services should also ensure that new workforce resource is planned for to enable the right levels of advanced radiotherapy to be delivered to patients across England.

Data and monitoring

- **Progress in the delivery of advanced radiotherapy should continue to be monitored through the Radiotherapy Dataset (RTDS). The National Cancer Services Analysis Team (NATCANSAT) should undertake further work to ensure effective monitoring of each specific element of radiotherapy, and have clear criteria for unambiguous data entry as it is developed.** While the past three years have seen progress in the completeness of the radiotherapy dataset, coding issues mean that providers' self-reported activity is still at odds with that reported in the radiotherapy dataset. We recommend greater granularity within the coding of the RTDS to enable the data from centres to enable accurate monitoring of the levels of specific types of advanced radiotherapy across England. The RTDS should be used to populate the commissioning dashboard and enable monitoring against the service specification. Ensuring the RTDS is populated with the correct data will remove the requirement for centres to self-report for specific data sets.

- **The Radiotherapy Clinical Reference Group should develop appropriate metrics to measure both the quality and quantity of radiotherapy. The Group should regularly monitor progress in the delivery of advanced radiotherapy including IMRT, IGRT and SABR.** Historically the radiotherapy service has been rated by the number of fractions delivered and patient throughput. Priority should instead be given to quality measures such as the number of patients receiving advanced radiotherapy and the quality of the components of the process such as imaging and planning to deliver advanced radiotherapy.

  Delivery of advanced radiotherapy should be monitored against the national service specification, using the RTDS and commissioning dashboard, and compared to patterns of local delivery. The CRG should ensure that the appropriate percentage of patients and diagnoses have access to advanced radiotherapy, and if necessary re-direct patient flows to centres that can deliver such quality and capacity.

1 Background and introduction

Radiotherapy can cure cancer. Experts suggest that radiotherapy is second only to surgery in its effectiveness in treating cancer, and around 4 in 10 patients whose cancer is cured receive radiotherapy as part of their treatment[6]. Radiotherapy treatments have become significantly more sophisticated in the last decade and can deliver more targeted treatment. These advanced radiotherapy treatments can improve outcomes and reduce highly debilitating side effects. Advanced radiotherapy therefore plays an important role in contributing to Domains 1, 2 and 3 of the NHS outcomes framework (preventing premature mortality, enhancing quality of life and helping people recover from episodes of ill health).

In October 2012, the Prime Minister and Secretary of State for Health announced the establishment of a Cancer Radiotherapy Innovation Fund. Initially set at £15million, it was later boosted to £23million. The Fund was introduced to support the roll-out of advanced radiotherapy treatment across the NHS in England. The main aim of the Fund was to ensure that all radiotherapy centres could deliver a minimum of 24% of all radical treatments using **'inverse planned'** Intensity Modulated Radiotherapy (IMRT) by April 2013 or as soon as possible thereafter.

1.1 Why IMRT?

IMRT is a more targeted form of radiotherapy. It is used in some cases due to the limited ability of conventional radiotherapy to avoid vital organs and confine dose within the tumour region. IMRT shapes the radiation beams to closely fit the shape of the cancer and alters the radiotherapy dose accordingly. This means that the intended target volume receives the highest dose of radiotherapy and the surrounding area of healthy tissue gets lower doses. IMRT, along with other forms of external beam radiotherapy, is given using a linear accelerator machine (linac) which uses electricity to create the radiotherapy beams.

Inverse planned IMRT

Inverse planning is very complex and allows for the generation of a treatment plan that uses a large number of segments (beamlets) automatically. This is done by defining a number of objectives (for example, maximum dose allowed for a vital organ) that the plan must satisfy. These are then used to optimise the plan automatically to target the tumour and minimise the dose to surrounding healthy tissues. Calculated by a computer, an IMRT plan performs three trillion individual calculations. Inverse treatment plans can take longer to produce and can take up quite a lot of skilled resources.

A treatment plan is created for each patient receiving radiotherapy. The type of plan created is dependent on the type of tumour and what kind of radiotherapy is being delivered. IMRT treatment plans can be created using two methods: forward[7] and inverse planning. **Increasing the number of patients receiving inverse planned treatment was the focus of the Fund.** When IMRT is mentioned in isolation in this report, it is referring to inverse planned IMRT only.

[6] Department of Health (2012). *Radiotherapy services in England 2012*. https://www.gov.uk/government/publications/radiotherapy-services-in-england-2012

[7] Forward planning is an extension of conventional treatment planning used for relatively simpler cases. Using this method segment shapes and weights are defined manually by the treatment planner to produce a suitable dose distribution. The number of segments created using forward planning is considerably less than inverse planning.

A new guarantee for cancer patients
In announcing the Radiotherapy Innovation Fund, the Prime Minister also introduced a new guarantee for radiotherapy patients. This "extends the existing guarantee for drugs – that if they're safe, cost-effective and doctors say you need them, you will get them. From April 2013, for the first time ever, the Government is extending that guarantee to radiotherapy too. This has the potential to help thousands of people at one of the hardest times of their lives."

1.2 National commissioning of radiotherapy

As of April 2013, radiotherapy is commissioned at a national level as a specialised service by NHS England. A new service specification for radiotherapy sets national standards for the service. It is expected that this specification will be fully implemented in October 2013. The specification, drafted by the NHS England Radiotherapy Clinical Reference Group, states that the following advanced radiotherapy should be available to all patients who might benefit in England:

- **Intensity Modulated Radiotherapy (IMRT) –** uses complex physics to sculpt radiotherapy to give a high dose to the tumour while avoiding normal tissues. The accepted minimum standard is that 'inverse planned' IMRT should be used in almost a quarter of patients treated with curative radiotherapy especially with head and neck, prostate, lung, and bladder cancer. Less complex 'forward planned' IMRT is recommended for breast cancer patients. It is considered that at least 9% of all radical radiotherapy should be forward planned.
- **Image Guided Radiotherapy (IGRT)** – imaging is carried out during treatment to check for tumour movement or change during therapy guaranteeing accuracy and allowing smaller volumes to be treated. IGRT should as a minimum be used in radical treatment for tumours that move with breathing or bowel function such as lung, prostate and bladder; in effect all thoracic and abdomino-pelvic treatment sites.
- **Stereotactic Ablative Radiotherapy (SABR)** – this form of treatment is used to deliver a small number of very high dose treatments with curative intent where the treatment volume is small and defined. All patients with early lung cancer who are not suitable for surgery should receive SABR. SABR can be delivered by linear accelerators and other specially designed equipment.

The RTDS is the national standard dataset for radiotherapy and is collected from radiotherapy treatment machines. Delivery of IMRT is measurable from the standard dataset. However, the coding currently does not allow a unique measurement of inverse planned IMRT. For this evaluation we have therefore had to rely on self-reported data from radiotherapy centres.

1.3 The need for the Radiotherapy Innovation Fund

In 2009 the National Radiotherapy Implementation Group (NRIG), set up to advise and support the Department of Health in delivering a programme of work aimed at driving forward progress in radiotherapy in England, published guidance for commissioners on the use of IMRT. NRIG recommended that 33% of all radiotherapy should be delivered as IMRT, of which 24% should be the more complex 'inverse planned' IMRT. The aim of the Fund was to ensure all centres reached the 24% level.

Emerging evidence[8] in early 2012 indicated a wide variation in access to IMRT across radiotherapy centres in England. It was clear that some form of incentive was necessary to identify the range of causes and barriers to the delivery of IMRT, and associated IGRT, and to ensure more rapid progress

[8] Mayles WPM, Cooper T, Mackay R, Staffurth J, Williams M. Intensity-Modulated Radiotherapy Implementation in the UK. Clin Oncol. 2012; 24: 543-544.

towards higher quality and activity levels to make the service 'fit for practice' by the time national commissioning was introduced.

However, despite attempts to boost IMRT provision in recent years, at the end of 2012 levels in England fell well below acceptable standards, except in a handful of centres. In November 2012 the Department of Health report *Radiotherapy Services in England 2012* concluded that although 100% of machines are IMRT capable, and IMRT is now offered in 48 of 50 centres, delivery at some centres was still 'unacceptably low'. Only 4 out of 50 radiotherapy centres in England were delivering 'inverse planned' IMRT to at least 24% of their patients.

Figures obtained both from the RTDS and a self reported survey of IMRT delivery conducted by Professor Sir Mike Richards showed that levels of IMRT across England during 2011/12 were on average 6.8%. Centres indicated that the average IMRT level for England was anticipated to rise to 15% by April 2013.

Further self-reported figures in August 2012 showed an average of around 13.6% IMRT delivery across all centres in England. *Centre level data on IMRT provision at August 2012 are detailed in* ***Appendix 1***.

Levels of other types of advanced radiotherapy including IGRT and SABR also languish behind recommended standards. According to Department of Health figures, while all newly purchased machines are IGRT capable, only 40-50% of existing machines are utilising IGRT.

1.4 Incentives for advanced radiotherapy

Various incentives have been introduced over the past four years aimed at increasing IMRT levels. In addition to NRIG guidance for commissioners, a draft business case on IMRT was developed to help providers make the case for funding to support increased delivery at a local level. Prior to this, most radiotherapy services were purchased by local commissioners on a block contract. This prevented the necessary extra service investment required to support the implementation and delivery of IMRT, which needs specific equipment and workforce skills development, and increased time for treatment planning and checking. The NHS Operating Framework for 2011 included a requirement that all cancer networks should have at least one centre delivering IMRT by April 2012, and stated that:

"to improve outcomes for radiotherapy treatment for cancer patients, commissioners should develop local plans to ensure that access rates to radiotherapy and the use of advanced radiotherapy techniques such as Intensity Modulated Radiotherapy, are appropriate for their populations."

Central funding has also been provided for a number of training courses for planners and oncologists, supported by the professional bodies for radiotherapy. In 2011/12 an IMRT measure was included in locally agreed Commissioning for Quality and Innovation (CQUIN) goals. In 2012/13 an IGRT measure was included in locally agreed CQUIN goals. An IGRT roll-out programme was also supported during 2012/13 with guidance provided to departments by appointed IGRT leads and a training course. Alongside this, e-learning programmes were completed, commissioned and launched for advanced radiotherapy[9].

[9] http://www.e-lfh.org.uk/projects/radiotherap-e/index.html

1.5 Current barriers to advanced radiotherapy

In August 2012 Professor Sir Mike Richards, then the National Clinical Director for Cancer, wrote to all radiotherapy centres in England asking them to outline their current radiotherapy provision. Those centres not delivering 24% inverse planned IMRT were asked to identify the blockages to reaching optimal levels of IMRT and prepare local action plans to address these.

Responses varied between centres, but a few emerging themes were identified:

- No agreed tariff system incentive for advanced radiotherapy techniques to reimburse increased costs of delivery of IMRT or IGRT;
- Training needs, mainly in physics and oncology. In particular, gaps in the skills and availability of dosimetry staff to undertake IMRT;
- Vacant or frozen staff posts;
- Additional staff time needed for IMRT planning (as the process per patient is significantly longer than conventional planning);
- A need for additional workstations to compensate for additional time taken to plan advanced radiotherapy;
- The need for additional planning licenses;
- Limited linac capacity and/or the ability of older machines to deliver advanced radiotherapy;

For some centres the issue was that local commissioners wouldn't agree to support the additional costs required to allow IMRT delivery. Tariffs were not amended, therefore some centres were left unable to progress or had to cut back in another area to push forward with IMRT. Others were fortunate that the initial locally agreed tariff for radiotherapy was set so that it supported this.

One centre reported that a lack of confirmed income has meant that plans to grow infrastructure had to be put on hold.

2 Detail and aim of the Fund

On the 6th October 2012, the Prime Minister announced a £15million Radiotherapy Innovation Fund. This revenue fund was available for the remainder of 2012/13, primarily aimed at extending NHS capacity to deliver IMRT so that all appropriate cancer patients might benefit from April 2013.

2.1 Revenue vs. capital funding

The Fund was provided as a revenue fund through the Department of Health. Due to the time limited nature of this Fund the Department asked centres to ensure that requests did not pre-commit NHS England to future funding. As such the Fund was not intended to provide for additional linear accelerators or new staffing posts, as long term sustainability of advanced radiotherapy should be addressed as part of Trusts' routine business planning. Trusts were instead encouraged to buy technology or devices that enhanced the capability of existing equipment. An intensive support team led by the National Cancer Action Team held challenge visits with all centres not meeting the required levels of IMRT. These visits were used to challenge funding applications and assist local teams in developing business cases for additional equipment falling outside the scope of the Fund. *A list of potential items or use of revenue funding provided to centres is attached in* ***Appendix 5****.*

2.2 Implementing the Fund

The Fund was made available as part of a programme of work aimed at directly supporting the radiotherapy service. This programme comprised two key elements:

1 The £15 million Radiotherapy Innovation Fund.
2 A programme of visits to radiotherapy centres failing to meet 24% 'inverse planned' IMRT.

While the Fund was introduced with the intention of improving access to advanced radiotherapy as a whole, it was agreed that the priority in the first instance was to bring capacity for IMRT up to the agreed standard.

To support the Fund, central resources also provided funding for three bespoke training courses: one for clinical oncology staff; one for physics/dosimetrist staff, detailing introductory principles of IMRT; and a third course on IGRT, tailored to radiographers and physics IGRT leads from all English centres as part of the IGRT programme. These courses were led by the National Cancer Action team and professional bodies, and were delivered between January and June 2013. *Details and evaluation of these training courses are provided in* ***Appendix 6****.*

Alongside this, and also outside the remit of what was provided by the Fund, e-learning programmes were completed, commissioned and launched for advanced radiotherapy[10].

A core group chaired by Cancer Research UK and comprising members from the Department of Health, the National Cancer Action Team, the National Radiotherapy Implementation Group (NRIG), the Royal College of Radiologists, the Society and College of Radiographers and the Institute for Physics and Engineering in Medicine was established to oversee the allocation of the Fund. This group was supported by clinical expertise from NRIG members based at centres with good levels of IMRT delivery.

[10] http://www.e-lfh.org.uk/projects/radiotherap-e/index.html

It was agreed that each radiotherapy centre in England should have access to £150,000 of revenue funding, as long as it could set out how it could use it appropriately. However, to ensure that the Fund could respond to areas of the greatest need and greatest opportunity for improvements to IMRT, the remainder of the Fund was allocated against individual applications for additional funding. If a centre had already achieved the appropriate level of IMRT it was agreed that these centres could use the funding to support the adoption of other technical advances in radiotherapy including IGRT.

The methodology applied to distribute the Fund is detailed in ***Appendix 2 and 3****.*

2.3 Request for additional funding

As applications were received from the service and challenge visits held at 46 centres around the country during November and early December 2012, it became clear that the original £15million would be unlikely to match the demand for clinically appropriate service improvements.

A scoring and prioritisation process was introduced to allow the core group to rank requested items according to need and opportunity to boost IMRT delivery (please refer to *appendix 4*). However, at the end of this process, the core group was still faced with the prospect of rejecting around £8million of clinically appropriate, much needed, additional funding requests which could make a real difference to advanced radiotherapy provision.

In December 2012 a request was put to the Minister for Health to make additional funding available. On 18th December Health Minister Dan Poulter announced in Parliament that the Fund would be boosted from £15 to £23million. This additional funding meant that, in the majority of cases, the Fund was able to provide for most or all of the items requested by centres.
It is worth reflecting that although centres were invited to be ambitious with their funding requests, it was clear from the applications received that the majority of centres were conscious of the financially limited nature of the Fund. The resulting bids were therefore not an accurate picture of the scale of the need for additional funding across the service, but closely prioritised and focused on the challenge of delivering IMRT.

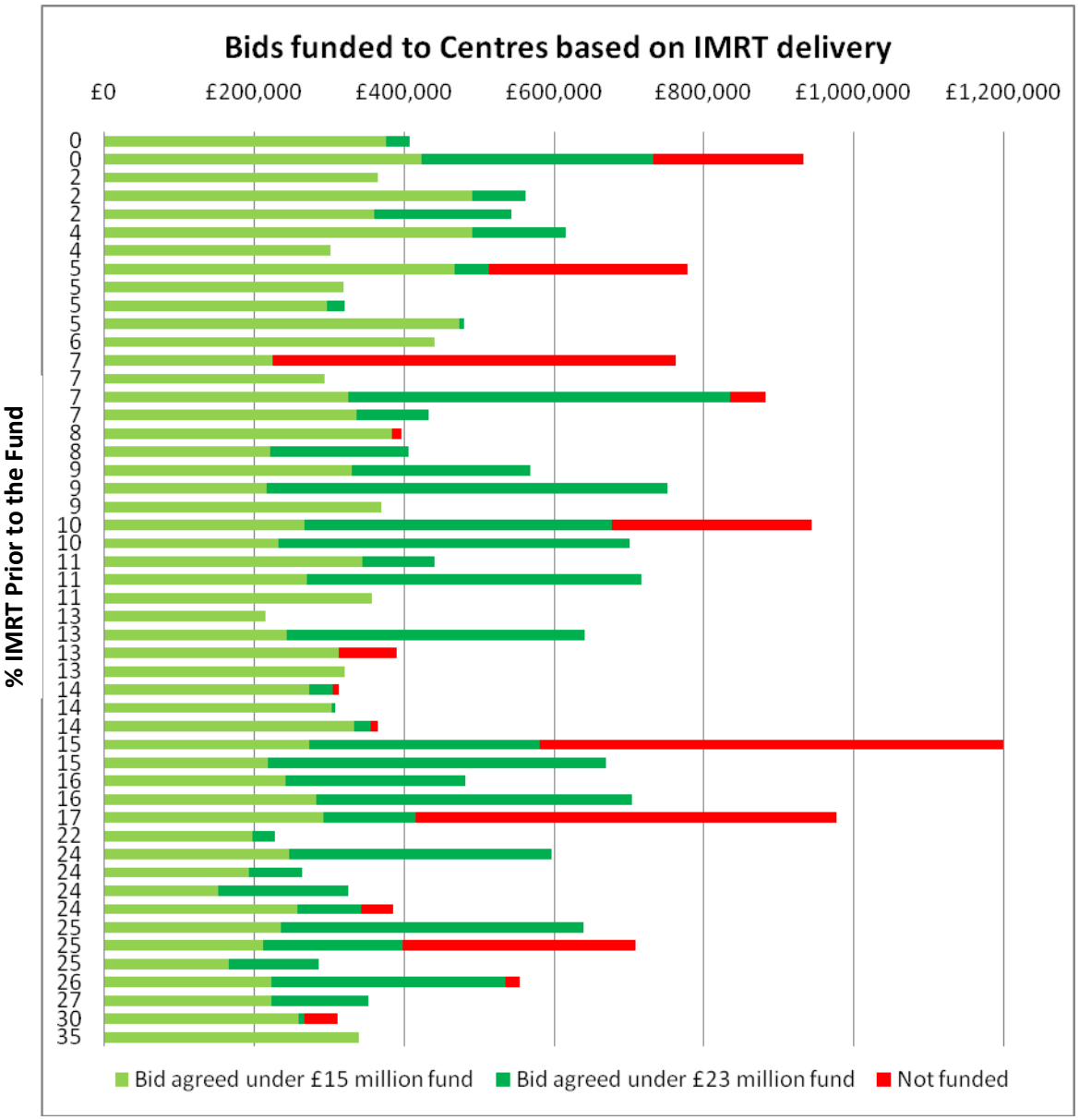
3 How the Fund was allocated

3.1 Distribution by level of IMRT

Figure 1 shows allocations for 50 radiotherapy centres according to the level (%) of inverse planned IMRT they were delivering at the outset of the programme. One London based centre submitted a bid of over £4million (this was due to the centre bidding for linac replacement, which was outside the scope of the Fund). The next highest bid was for just under £1m. For the purposes of the calculations below, the £4million bid from the single London centre is considered an outlier.

Figure 1 demonstrates that the amount of funding requested by centres varied greatly, and bore little relation to the amount of IMRT they were delivering at the time. It is also useful in demonstrating the success of the Fund, in delivering most centres with the funding that had been requested.

Figure 1



A strict prioritisation process was put in place to assess bids, as follows (please refer to ***Appendix 4*** for more details):

- Bids from Trusts with the lowest reported IMRT activity levels and robust proposals for delivering from April 2013 were prioritised first.
- Bids from Trusts making sound proposals to deliver above the 24% level.
- Bids that support increased capability to deliver using Image Guided Radiotherapy (IGRT).
- Bids from Trusts making robust proposals for other advanced techniques that would directly benefit patients.

Figure 1 above demonstrates that, from the original £15million Fund, bids from Trusts with the lowest reported IMRT levels were prioritised first. However, consideration was also given to whether these lower performing Trusts were in a position to make best use of all requested new equipment, particularly in terms of existing staff capacity or expertise within the Trust. This is why better performing Trusts (those delivering between 7-17% IMRT) tended to do better out of the second round of funding, once the additional £8million had been announced.

In general lower performing centres submitted higher funding requests, as seen in Table 1.

Table 1

	Average bid size	Lowest request	Highest requested
0<12%	£544,553	£292,969	£943,188
12<24% (with outlier)	£787,593	£214,700	£4,630,749
12<24% (without outlier)	£467,330	£214,700	£976,632
24%+	£443,575	£264,000	£709,200

n.b. total bid > £4m

3.2 Regional spread of IMRT delivery and bid requests.

Table 2 outlines the distribution of funding by region. No clear correlation can be seen between average IMRT delivery and the size of the bids.

Table 2

Region	Lowest IMRT (%)	Highest IMRT (%)	**Average IMRT (%) at the outset of the programme**	Lowest request	Highest request	**Average bid size**
South West	0.0	19.6	**4.2**	£301,236	£932,896	**£473,491**
South East	1.3	10.0	**5.7**	£292,969	£701,480	**£536,673**
South Central	2.0	20.6	**9.0**	£364,359	£882,160	**£550,918**
Yorkshire and Humber	2.2	15.8	**9.8**	£479,890	£715,900	**£632,997**
East Midlands	1.8	17.5	**10.2**	£308,001	£976,632	**£603,100**
North West	1.2	25.3	**10.7**	£319,735	£943,188	**£655,524**
North East	13	19.1	**16.1**	£214,700	£227,098	**£220,899**
East of England	1.7	38.4	**16.7**	£286,394	£709,200	**£455,999**
West Midlands	11.2	35.2	**18.7**	£320,380	£439,735	**£363,980**
London (with outlier)	9.1	26.9	**19.8**	£264,000	£4,630,749	**£903,913**
London (without outlier)	9.1	26.9	**20.9**	£264,000	£669,600	**£397,642**

3.3 Items requested from the Fund

Figure 2 outlines how the Fund was spent. Linac upgrades, advanced treatment planning and IMRT Quality Assurance (QA) made up around three quarters of funded bids. While making up a small proportion of the overall Fund, training and temporary agency staff/additional payments on a temporary basis for staffing were requested by most centres. This supported additional commissioning and training only.

Figure 2

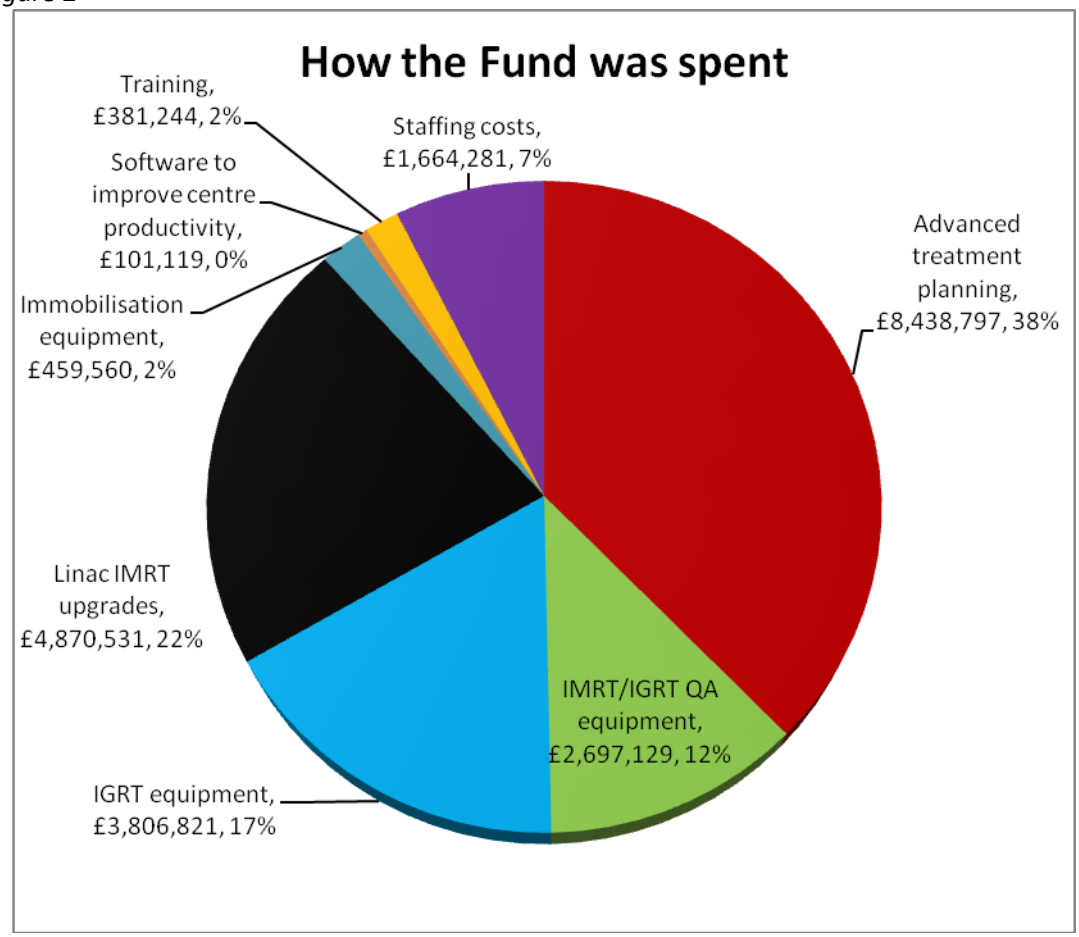


Table 3 outlines regional average spend on different types of equipment. IMRT delivery in a specific region does not appear to correlate to a particular average spend on pieces of equipment. This suggests that centres within each region have approached the challenge of delivering advanced radiotherapy differently because of different local challenges.

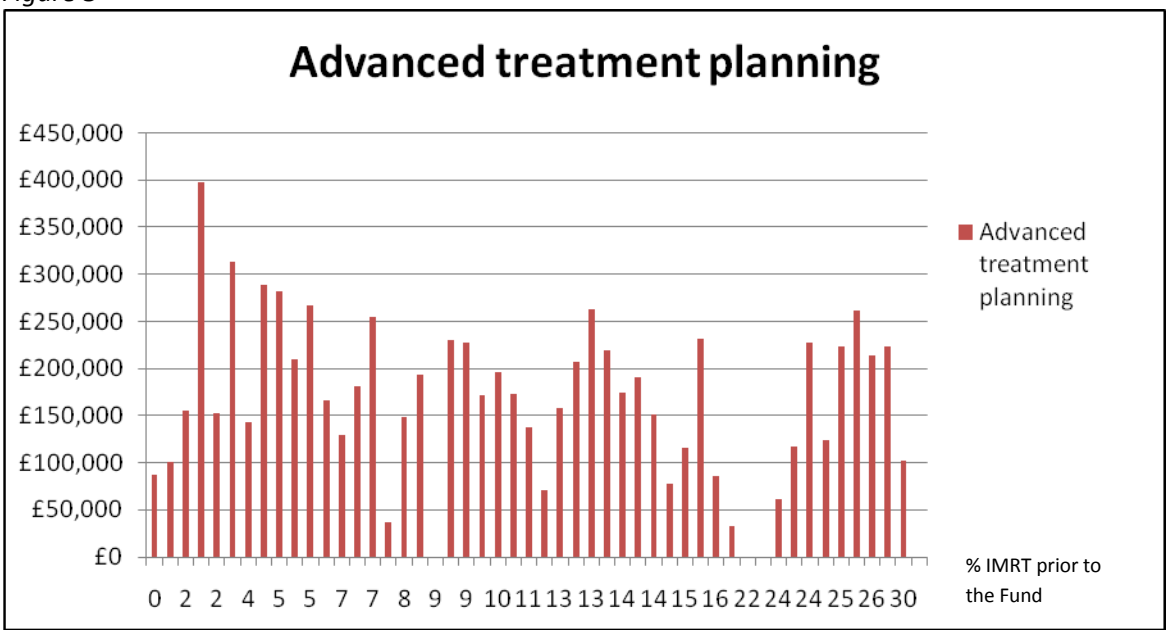
Table 3

Region	Average IMRT in August (%)	Advanced treatment planning	IMRT/IGRT QA	IGRT equipment	Linac upgrades	Training	Staffing
South West	4.2	£149,563	£98,509	£215,167	£171,521	£22,100	£75,502
South East	5.7	£230,288	£36,578	£445,332	£101,790	£41,400	£33,925
South Central	9.0	£193,929	£61,190	£225,166	£229,920	£25,125	£46,270
Yorkshire and Humber	9.8	£162,913	£62,500	£420,000	£321,650	£7,000	£89,100
East Midlands	10.2	£186,245	£52,740	£247,631	£201,975	£5,250	£31,717
North West	10.7	£142,955	£38,067	£371,318	£92,497	£7,162	£84,414
North East	16.1	£157,700	£14,729	£0	£198,000	£20,640	£48,000
East of England	16.7	£218,963	£110,746	£10,000	£60,480	£16,958	£50,154
West Midlands	18.7	£154,014	£108,941	£339,600	£185,790	£6,800	£5,000
London	19.8	£156,728	£68,368	£83,339	£209,095	£19,575	£33,232

Advanced treatment planning

Requests for advanced treatment planning systems were fairly consistent across all centres. These systems on the whole were requested to improve productivity, increasing available planning capacity and maintaining quality, even for centres meeting the minimum standard for IMRT. Requests for additional planning workstations by all centres should result in an increase in the delivery of IMRT in all centres, even the ones currently delivering at 24% or above. Figure 3 shows the amount of funding provided for advanced treatment planning for each centre.

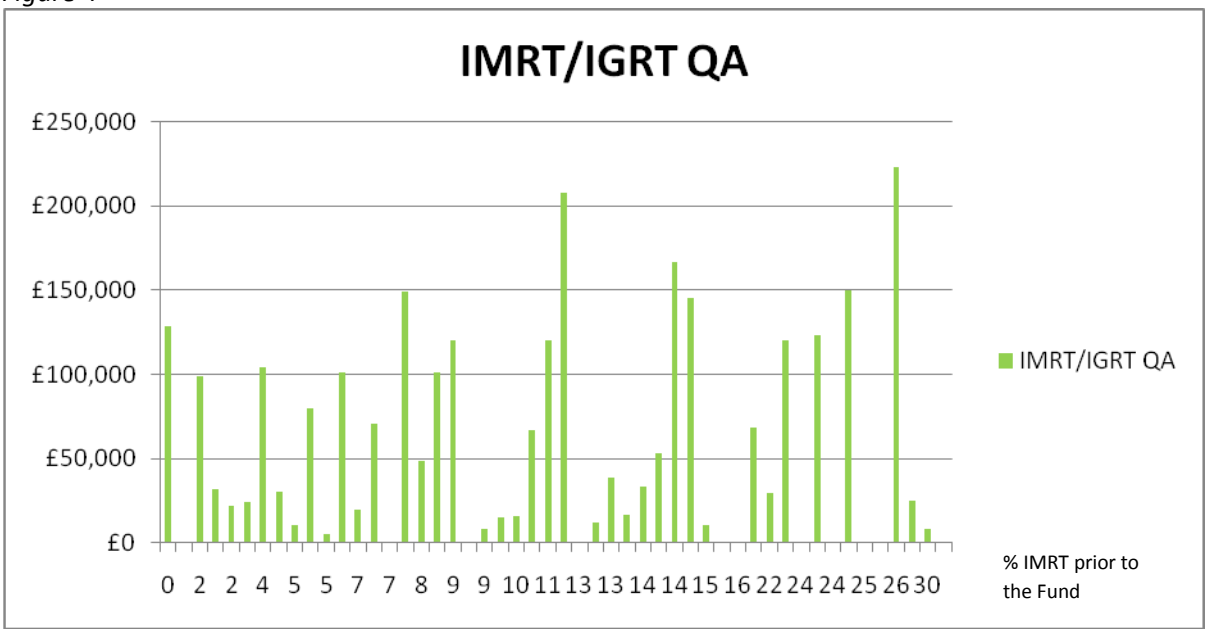
Figure 3



Quality Assurance (QA) equipment

Fewer centres requested QA equipment. Those that did varied greatly in the amount of IMRT they delivered. 30 centres requested less than £50,000 of IMRT/IGRT QA equipment. Figure 4 shows the amount of funding provided for IMRT/IGRT QA for each centre.

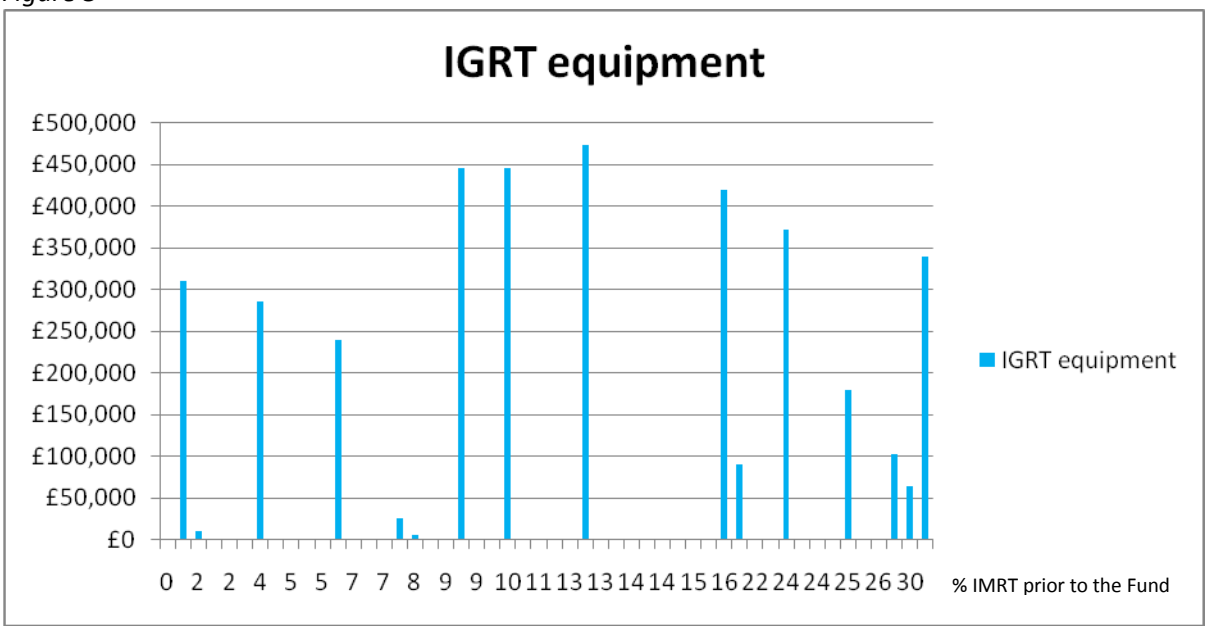
Figure 4



IGRT equipment

Centres with established plans to deliver the required amount of IMRT were approved for funding for IGRT equipment. Centres delivering less than 24% that demonstrated they would be able to deliver the amount of inverse planned IMRT while also improving IGRT provisions were granted funding. IGRT equipment tended to be funded out of the additional £8million provided to the Fund. Figure 5 shows the amount of funding provided for IGRT equipment for each centre.

Figure 5

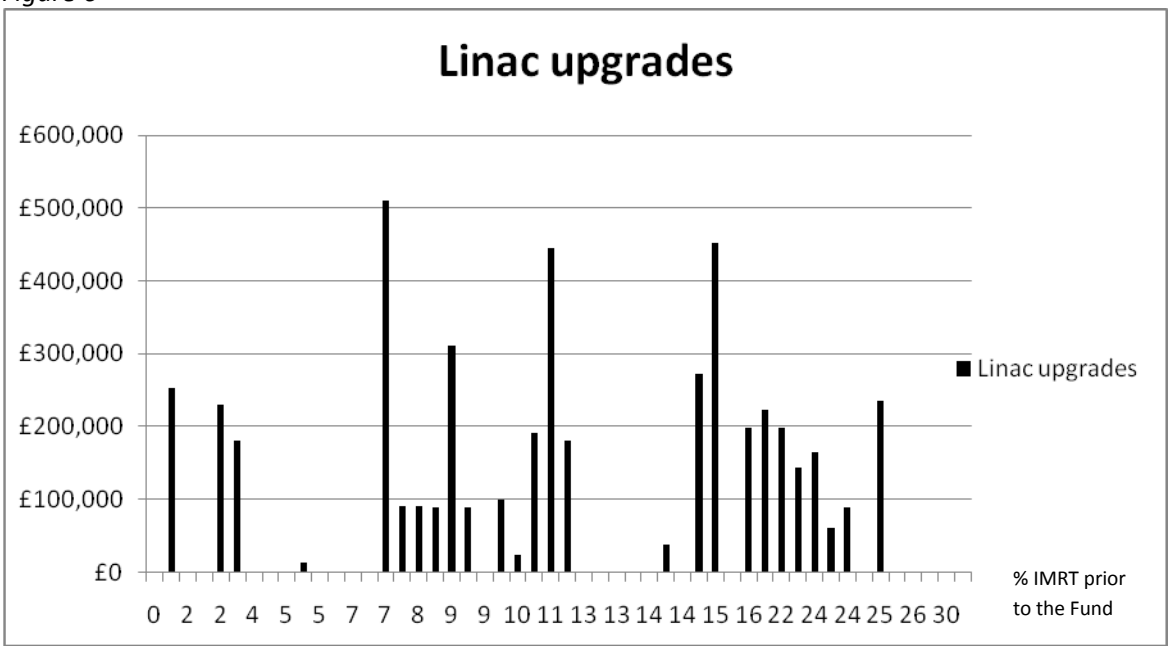


Linac upgrades

Linac upgrades in general were less frequently requested than other major pieces of equipment, mostly as the Fund could only deliver revenue and not capital costs. Most upgrades requested were for rotational IMRT aimed at speeding up the delivery of IMRT. Figure 6 shows the amount of funding provided for linac upgrade for each centre.

Some centres requested upgrades that extended the life of their existing machines. However, this is a temporary solution and further capital plans within the Trusts need to be put in place to ensure that advanced radiotherapy is delivered effectively in the future.

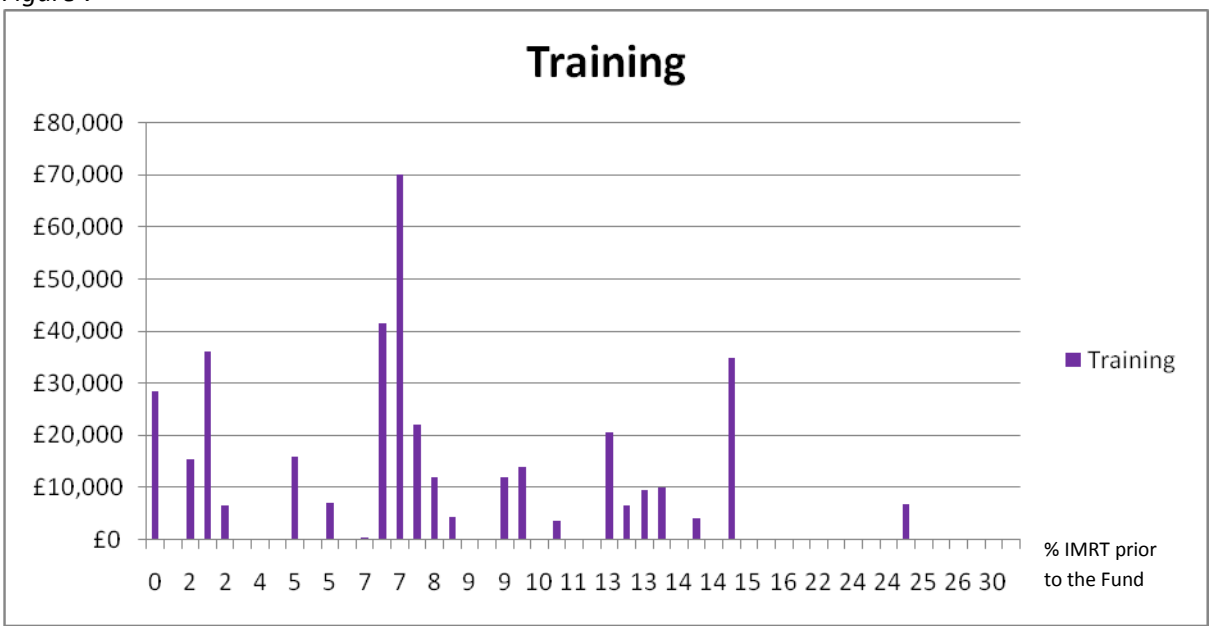
Figure 6



Training costs

Training requests for specific local training within the centres were in addition to the IMRT and IGRT courses funded by Department of Health, led by the NCAT and professional bodies (*Appendix 6*). The vast majority of training requests came from centres that were delivering less than 15% IMRT. It is possible that centres already beginning to deliver IMRT at a low level required further training of a number of their staff in order to ramp up delivery effectively and efficiently. Figure 7 shows the amount of funding provided for training for each centre.

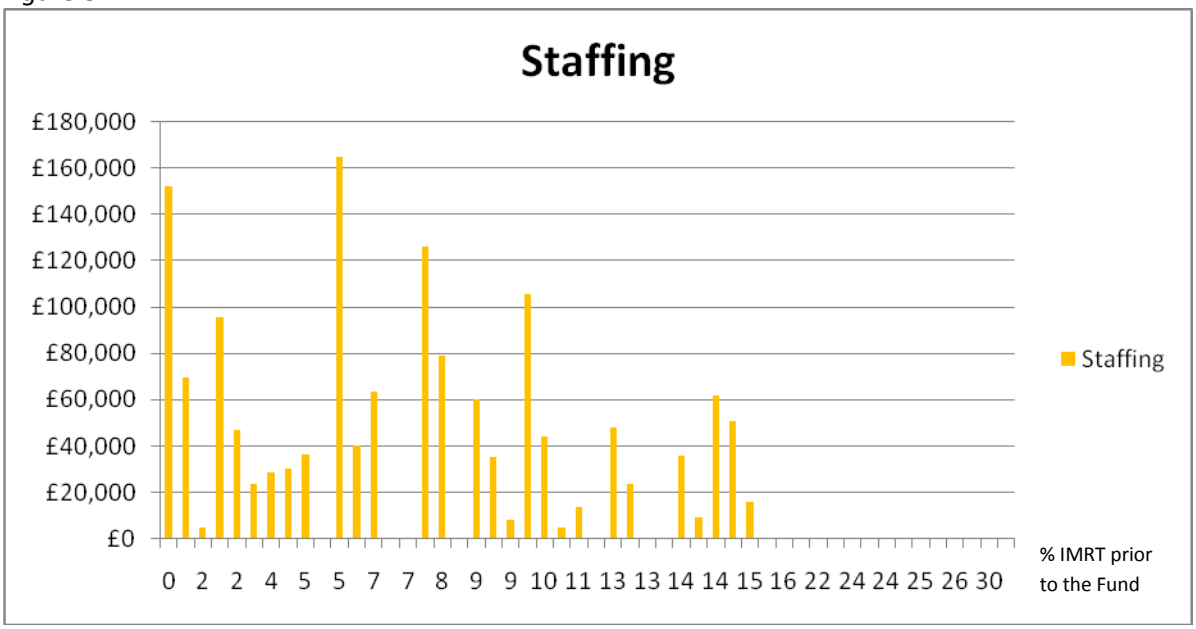
Figure 7



Staffing costs

Requests for additional short term staffing costs came exclusively from centres delivering below 24% IMRT. Typically, staff time was used so that centres could commission equipment. This suggests that existing workforce did not have the capacity to adopt new technologies without being funded to work additional hours; the Fund offered this short term solution. Many of the centres indicated a need for an overall increase in staff posts, but the Fund was unable to support this due to its time-limited nature. The additional hours of overtime payment for staff time provided by the Fund should give lower performing centres the ability to overcome these "equipment commissioning" barriers and deliver higher levels of IMRT. However, some centres will require a permanent increase in staff posts to enable increased capacity for IMRT treatment planning on a long term basis. Figure 8 shows the amount of funding provided for staffing costs for each centre.

Figure 8



4 Impact of the Fund

Since the introduction of the Radiotherapy Innovation Fund in October 2012 there has been a step change in the provision of the IMRT component of advanced radiotherapy across England. In August 2012,[11] 13.6% of patients receiving radiotherapy in England were given IMRT. By April 2013 this figure had risen to 22.3%[12].

4.1 Number of patients likely to benefit

The Department of Health estimated that if centres can increase their capability to 24% IMRT, a further 8,000 patients would benefit[13]. The self-reported figures we are reporting indicate that, with the increase to 22.3% in April 2013, around 5,800 more patients across England a year will now have access to advanced radiotherapy treatment.

While not all centres reached the target levels of IMRT by April 2013, the majority of centres are well on their way to achieving this and the number of centres exceeding 24% IMRT has grown. Experts now consider that centres should be going beyond the 24% target, with the optimal level of IMRT delivery more likely to be around 50% of radical patients[14]. This means that there is potentially scope for thousands more patients to benefit annually from advanced radiotherapy.

4.2 Increase in IMRT delivery

Over a very short period of time, this programme of work and the associated Fund has achieved an uplift of nearly 9 % inverse planned IMRT delivery across England. This has exceeded previous expectations of the centres, which were that the average provision of IMRT would hit 14% on average by April 2013[15], way below the 22.3% achieved. This clearly demonstrates the value the Fund has brought in achieving a substantial increase in inverse planned IMRT delivery. In addition, the delivery of IMRT overall (inverse and forward planned) has significantly increased since the launch of the Fund, as shown by RTDS data detailed in ***Appendix 1***.

Position as of April 2013

A self-reported position was obtained from individual centres. This showed average delivery in April of 22.3% inverse planned IMRT across all centres. 22 centres out of 50 are now delivering at or

Case study from Royal Berkshire Cancer Centre

In October when the Radiotherapy Innovation Fund was announced, Berkshire Cancer Centre (BCC) was treating 8% of radical courses using inverse planned IMRT. While the Fund was a very welcome boost to resources, the allocation of funding was not announced until late December 2012, which presented challenges in relation to the purchase and commissioning of equipment. However, the additional physics capacity that has been achieved has enabled BCC to be in a position, where, at the end of April it was treating 17% of radical courses using inverse planned IMRT with an estimated trajectory of treating 24% of patients by the end June 2013.

[11] Data for 4 centres was only available for November 2012 (prior to the implementation of the fund) and has been assumed to be representative of IMRT delivery at those centres at this point in time.

[12] Based on self-reported proportions of radically treated patients receiving inverse planned IMRT in these periods, and the number of radically treated radiotherapy patients in FY 2012/2013 at each of the centres in England.

[13] https://www.gov.uk/government/news/eight-thousand-patients-to-benefit-from-advanced-cancer-treatment

[14] T. Cooper, M.V. Williams. Implementation of Intensity-modulated Radiotherapy: Lessons Learned and Implications for the Future. Clinical Oncology 24 (2012) 539-542

[15] Department of Health (2012). *Radiotherapy services in England 2012*. https://www.gov.uk/government/publications/radiotherapy-services-in-england-2012

above 24% inverse planned IMRT. A breakdown of self-reported IMRT delivery by centre can be seen in ***Appendix 1***.

Table 4 shows the average increase in IMRT delivery between August 2012 and April 2013 by region (ordered by average delivery of IMRT in April 2013, from lowest to highest).

Table 4

Region	Average funding allocated	Total funding allocated	Average IMRT (%) at the outset of the programme	Average IMRT (%) April 2013
South West	£444,920	£3,114,439	**4.2**	**14.0**
South East	£536,673	£1,610,019	**5.7**	**15.2**
South Central	£539,125	£3,234,751	**9.0**	**18.9**
East Midlands	£483,986	£3,387,902	**10.2**	**19.0**
Yorkshire and Humber	£632,997	£1,898,990	**9.8**	**21.0**
North West	£454,302	£1,817,209	**10.7**	**23.0**
West Midlands	£363,980	£1,455,919	**18.7**	**24.3**
East of England	£397,581	£2,783,069	**16.7**	**25.9**
London	£309,133	£2,783,069	**19.8**	**28.4**
North East	£220,899	£441,798	**16.1**	**30.8**

While data from the Radiotherapy Dataset (RTDS) will be used to report progress going forward, we are not able to report data from the April collection of the RTDS in this evaluation. This is because some centres are reporting Quality Assurance for forward planned treatments within the IMRT code as well as inverse planned IMRT. The former was not the focus of the Fund and so would provide an artificially high level of inverse planned IMRT for some providers. The centres' self-reported levels of inverse IMRT as of April are the most up to date indication of current levels available. These data have been rigorously reviewed and checked.

There are obvious limitations to self-reported data and while ***Appendix 1*** gives an outline of centre performance, it is still possible that there are some inaccuracies in the data. We therefore have recommended that there should be more granularity in the coding and reporting of advanced radiotherapy in the RTDS to allow for more rigorous monitoring of inverse planned IMRT.

Post-April 2013

A letter sent from the Department of Health to Health Minister Anna Soubry in late 2012 stated that *'With the funding announced by the Prime Minister and based on centres plans, from April 2013, 35 centres will be delivering at or very close to 24%. By the end of 2013, 44 centres will be delivering at 24% with the remaining 6 reaching 24% early in 2014.'*

While this report outlines that these predictions have not been met, with 22 meeting the 24% target by April, many of the benefits have not yet been seen due to lead in time to use some of the resources provided by the Fund. Much progress has been made, with a further 17 centres delivering at 15% and over. Hopefully this upward trend will mean all centres are delivering 24% before the start of 2014.

Case Study from Royal Cornwall Hospital

Royal Cornwall Hospital Trust (RCHT) received its first IMRT capable linear accelerator in August 2012 and therefore could not offer IMRT to patients prior to this time. The process of the Fund largely overlapped the centre's efforts to bring the machine online and incorporate IMRT into their workflow. The Fund assisted with this as it allowed RCHT to pay for two temporary band 7 radiographers to enable additional training of existing staff on the linac capable of IMRT, which enabled the department to extend the working day on the linac and therefore increase the capacity for IMRT. In the first months of 2013 the RCHT exceeded its expected delivery of IMRT resulting in 17% delivery in April.

The provision of additional equipment and software through the Fund had not further enhanced the volume of IMRT by June 2013. This is primarily as commissioning of the equipment, which is underway must be completed before clinical use and considerable additional staffing resources are required to support the planning of IMRT patients.

RCHT has identified two significant challenges. Firstly that the centre only has a single IMRT capable linac with no realistic backup plan should this one fail. Secondly the Trust lacks sufficient consultant capacity (and support including radiographers) to support, plan and deliver increasing volumes of IMRT alongside overall delivery of its cancer services. The Trust has recently approved a significant three phase investment in additional staffing. The first tranche of this investment is being advertised immediately.

Prior to the Fund, the RCHT's estimated date for 24% IMRT was December 2013. However, once the equipment has been fully commissioned, it is expected that this date will be brought forward to the autumn of 2013 or earlier.

5 Additional benefits from the Fund

There have been a number of additional benefits to this programme of work that will likely contribute to further improvement of the radiotherapy service in the longer term.

5.1 Galvanising the radiotherapy community

One of the requirements of application for the Fund was that all centres either not meeting or not well on their way to meeting the required 24% IMRT should have a 'challenge visit' from an NCAT led intensive support team. These sessions were confidential discussions between clinical members identified by the Fund's core group plus additional expertise in physics, led by the NCAT Associate Director for Radiotherapy, and a team from each centre which was representative of the specialities across the radiotherapy department. In total 46 visits were held in November and early December 2012.

These sessions were aimed at ensuring that funding requests were clinically justified and appropriate. They also provided an opportunity to discuss local barriers, check reported and 'ramp-up' figures, and ask often challenging questions where progress in developing advanced radiotherapy had been slow to date. The clinical teams were also tasked with directly challenging funding requests, asking centres to justify equipment requests and explain why these could not be provided for within local commissioning or other arrangements with their Trust.

These sessions differed from other mentoring opportunities offered by NCAT for several reasons:

1. **Senior level engagement:** The financial imperative of the Fund meant that these sessions were well attended by senior NHS Trust board level radiotherapy staff. On a number of occasions centre representatives were joined by members of the Trust executive and finance teams with whom it has traditionally been difficult for departments to engage.
2. **Challenge to existing practice**: As they followed a self-reported survey of IMRT provision, the visits provided an opportunity for an honest conversation about progress in introducing advanced radiotherapy and possible cultural or organisational barriers which would need addressing in concert with additional equipment or staff training.
3. **Asking centres to submit a 'ramp up' plan for IMRT:** This helped focus the minds of centres on the size of the challenge facing them and consider why, when increases in actual numbers were small month-on-month, this was not happening already.
4. **Highlighting inaccuracies in reporting:** Challenge visits provided an opportunity to compare self-reported activity to that captured in the RTDS, explore reasons for differences and reiterate the importance of accurate data collection.

These sessions are thought to be largely responsible for the significant ramp up in IMRT provision across the country in line with self-reported predictions, even before additional purchased equipment or training had hit the ground.

5.2 Improving senior Trust-level engagement

Failure of Trusts to commit to long term plans, and the difficulty of getting purchasing approval for large capital items were cited amongst the barriers to IMRT delivery in response to Professor Sir Mike Richards' August 2012 survey of the service. A lack of engagement by senior Trust figures was thought to be a significant contributory factor.

The core group recognised the Fund as an opportunity to directly address this. Letters sent from Professor Sir Mike Richards on behalf of the Department of Health, announcing the Fund and outlining plans for its distribution were sent directly to Trust Chief Executives. This letter also asked Trusts to identify the appropriate clinical teams at each centre and encourage them to attend the one-day training events held in support of the Fund. All funding requests required senior Trust level sign off before submission. This engagement served to underline the priority of radiotherapy within their organisations. This was particularly important in non cancer specialist Trusts. Chief Executives received a letter on 21st December 2012 confirming the funding allocation awarded to their centre.

5.3 Procurement through NHS Supply Chain

NHS Supply Chain, working as an agent on behalf of the NHS Business Service Authority and the Department of Health, engaged in this programme of work to ensure the maximum benefit was realised from the Fund. This was achieved by aggregating national demand, effectively ensuring the buying power of 50 centres was levered to each individual centre while retaining local choice.

Of the £15 million that was procured via NHS Supply Chain, over £2 million (13%) in savings was delivered back to the NHS. In real terms, this meant that centres were able to procure additional equipment from the Fund, to enhance their ability to deliver to the 24% level. NHS Supply Chain worked with every centre and across the key stakeholders to ensure the processing of orders was kept on time, and facilitated the required engagement with suppliers to ensure delivery to timescales was supported.

NHS Trusts were assured that by having National Framework Agreements already in place there was a compliant route to procure under EU Public Procurement regulations, minimising the risk of challenge on this Fund and greatly reducing the procurement timescale.

While the maximum benefit was derived from the Fund within the time restrictions in place, a key learning was the ability to forward commit to suppliers to ensure the ongoing sustainability of savings available to the NHS. NHS Trusts should work with NHS Supply Chain to make full use of the £300 million capital equipment fund. A national programme of asset management for radiotherapy equipment could be considered to facilitate commitment deals in the market to drive sustainable savings for NHS procurement of capital equipment.

6 Remaining challenges for the NHS in provision of advanced radiotherapy

Significant challenges remain if the service is to meet the Prime Minister's ambition that all patients will get access to all clinically appropriate, cost effective, radiotherapy which their doctor recommends.

6.1 Boosting advanced radiotherapy capacity

The Department of Health has recognised that while the National Radiotherapy Implementation Group (NRIG) recommended that 24% of patients should receive IMRT as part of their treatment, this is the minimum standard and the true rate for delivery of IMRT is likely to reach approximately 50% of radical radiotherapy patients over the next few years.

It is also worth remembering that IMRT is only one component of advanced radiotherapy. NRIG and now the NHS England Radiotherapy Clinical Reference Group both recognise that a significant number of patients should also be getting access to 4D adaptive radiotherapy including Image Guided Radiotherapy (IGRT) and Stereotactic Ablative Radiotherapy (SABR). Although exact figures on delivery of these treatments in England are not available at this time, it is thought that delivery lags well behind recommended levels.

NRIG recommendations state that all patients who are getting IMRT should be offered some form of IGRT. This would ensure that the available technologies are used to deliver appropriate radiotherapy doses to complex shaped tumour targets within the body (to maximise cure rates), minimise the doses to normal tissues, and ensure that changes of the tumour target with time are measured and patient factors such as daily variation in positioning and internal organ motion (such as breathing) are taken into account. Commissioning guidance from NHS England recommends that all patients with non-resectable lung cancer should be offered SABR.

A concerted effort will be needed to ensure that these technologies are rolled out across the country over the coming months ensuring equity of access and high quality treatments for patients. There is concern that ongoing capacity issues within the service, both in terms of adequate workforce within centres to meet the increasing demands of more complex planning and treatment as well as lack of capital equipment, may prevent some centres from meeting these targets.

In addition, in April 2012 the Secretary of State for Health announced that the Department of Health had set aside up to £250 million of public capital to be invested by the NHS in building Proton Beam Therapy facilities at The Christie Hospital in Manchester and University College London Hospital to treat up to 1500 patients every year in this country. The first facility will become operational from the end of 2017. While this is welcome progress, introducing proton therapy into the UK will put additional pressure on an already stretched radiotherapy workforce. The Department of Health has recommended that detailed workforce planning for the whole radiotherapy workforce (clinical oncologists, therapeutic radiographers and medical physicists) will be required to ensure there is sufficient workforce to meet current and future service needs. This needs to be addressed as a matter of urgency.

6.2 Change of currency for IMRT – fractions (i.e. number of treatments) to patients

The currency for measuring the delivery of advanced radiotherapy has recently changed from the total number of treatments delivered with IMRT per patient (i.e. number of fractions) to the number of patients receiving IMRT. This change was made to provide a more consistent measure to

accurately assess the treatment patients are receiving. It was assumed, perhaps erroneously, that the percentage of fractions directly equates to the same percentage of patients treated. However, this is not the case in all centres. For example, Nottingham University Hospitals NHS Trust exceeded 24% significantly by treating 31% of radical fractions with inverse planned IMRT in quarter 4 of 2012/13. However, this equated to only 22% of the number of patients treated radically.

Whilst services were informed of the change of currency through Radiotherapy Innovation Fund meetings and letters, this process happened at the same time as services were striving to achieve the fraction target for the CQUIN. It is therefore possible that many more services have achieved the original currency target of 24% fractions than are now able to comply with the corresponding 24% of patients.

Further work remains to ensure that the IMRT code in the RTDS reflects all patients treated with inverse planned IMRT and does not include forward planned IMRT QA data.

6.3 Additional challenges in radiotherapy

In addition to the above challenges radiotherapy centres identified a number of issues which could not be addressed by the Fund, either because these require systemic changes or because they lie outside the scope of the Fund. These were highlighted by centres in their applications to the Fund.

Many of these issues, which impact on the ability to deliver advanced radiotherapy, are well known and were reflected in the recent Department of Health report *Radiotherapy Services in England 2012*. The size of the challenge and possible impact are outlined below.

6.3.1 More patients need to be treated with radiotherapy

The Department of Health reported that by 2016 a 67% increase in current activity will be needed.[16,17] Although experts recommend that half of all cancer patients should have radiotherapy as part of their treatment, in England it is thought that this level remains at around 40%. This could be attributed to a variety of factors. For example, a lack of advanced radiotherapy capacity could be deterring clinicians from recommending patients for radiotherapy. Improving advanced radiotherapy and further promoting the benefits of radiotherapy services to clinicians and patients is likely to drive take up of this important, and highly cost effective, treatment.

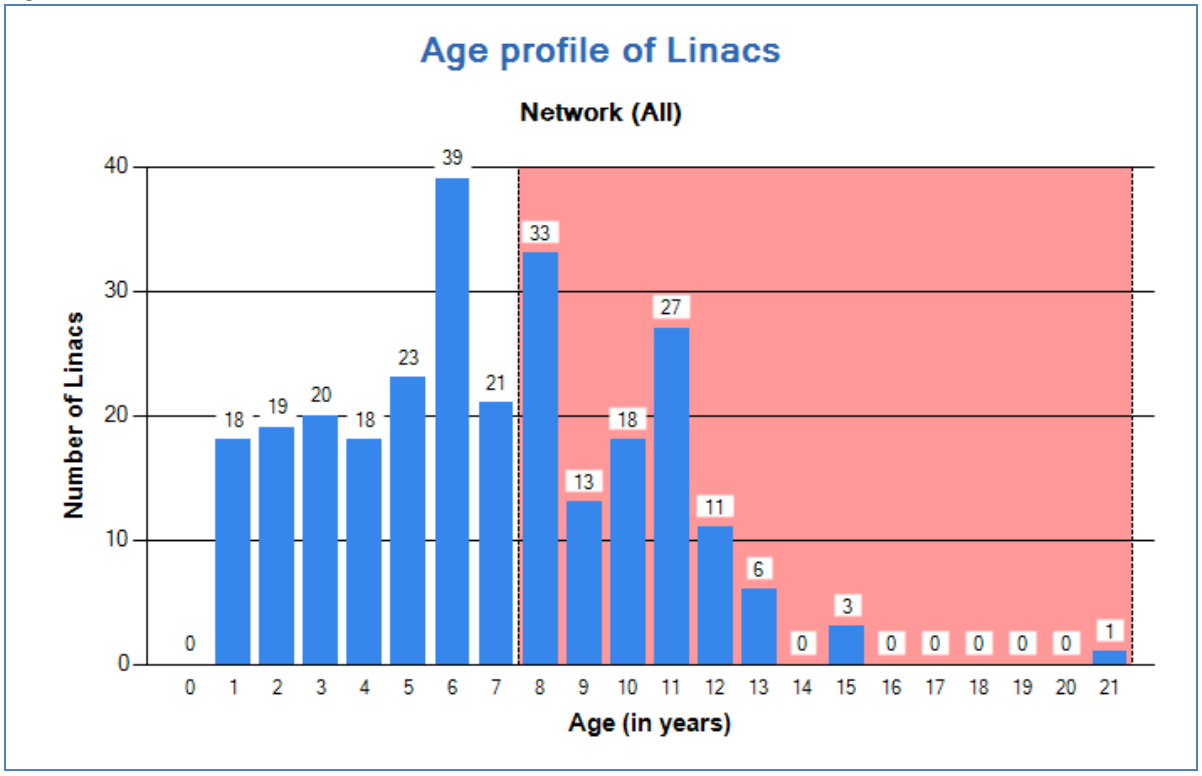
6.3.2 There are not enough linear accelerators and many are out of date

As seen in Figure 9, there are currently 270 linacs in operation in England. The Department of Health reported that increases in demand mean that this figure will need to be 412 by 2016[18]. To ensure appropriate radiotherapy capability and the latest techniques are available, existing machines need to be replaced at 10 years. Of the current linacs, 48 are over 10 years old and should be replaced. An additional 64 will be over 10 years old by 2016. In total, the NHS therefore needs an additional 254 new linacs over the next three years. Responsibility for replacing and investing in new machines lies at the Trust level.

[16] Population growth and ageing are driving an increase demand for radiotherapy of 2.3% per year.
[17] 33,000 attendances per million population (pmp) in 2010/11 versus the Malthus target of 55,000 pmp in 2016.
[18] Department of Health (2012). *Radiotherapy services in England 2012*. https://www.gov.uk/government/publications/radiotherapy-services-in-england-2012

The Department of Health has established a £300 million fund to encourage the NHS to update the existing medical technology infrastructure, operated by NHS Supply Chain. The NHS Operating Framework 2012/13 published in November 2011 included a 'comply or explain' provision aimed at NHS Trusts. However, the scale of the current shortfall suggests that, to ensure that the service is adequately resourced to meet patient need over the next four years, this is no longer a practical solution and additional support may be required.

Figure 9[19]



Responses to Professor Richards' survey in August 2012 highlighted a number of centres where the age of linacs was inhibiting progress in advanced radiotherapy. Not only are there challenges in making a business case for upgrading a machine that has only a few years of useful service left, but older machine treatment times are slower. They therefore take up treatment slots which impactd on throughput and consequently waiting times for patients, deterring the service from introducing newer techniques. It is the responsibility of Trusts to provide equipment to deliver safe and effective radiotherapy to match the national service specification. The following initiatives may help:

a. The CQUIN for IGRT for the year 2013/2014;
b. The new national tariff for advanced radiotherapy as the driver to clearly cover the higher complexity and costs of IMRT and IGRT;
c. NHS Supply Chain will have a mechanism to ensure best prices are available and access to £300 million equipment fund.

6.3.3 Staffing and training remain key issues

Increasing demand on the radiotherapy service means that increases in staff numbers are needed in all areas of the radiotherapy workforce. All centres will need to review and, where necessary, remodel the workforce structure to capitalise on technological advancement and make effective use of the skilled workforce across the service. Mapping of workforce requirements (numbers, skills and

[19] Radiotherapy Clinical Information Group Quarterly Report to Cancer Programme Board 2012 – 2013 Q3

skills mix) for the radiotherapy service should be undertaken in order to make plans to ensure sufficient workforce levels to meet increasing radiotherapy demand.

Many services reported a lack of clinical oncology planning time as a significant barrier to the delivery of IMRT. In addition, several centres reported that recruitment freezes and Trust pressure not to replace vacant positions were undermining attempts to introduce more complex radiotherapy techniques. Increased use of technological innovation and changes to traditional models or ways of working can help support efficiency and effectiveness.

Clinical oncology: There is a planned increase in clinical oncologist numbers of 7.5% per annum to 2016. When Professor Richards' survey in 2012 asked about barriers to IMRT delivery, 49% identified clinical oncology staffing as a problem. Issues are associated with the complexity of job planning with other service pressures. This includes a failure to include specific time allocation for radiotherapy treatment planning within job plans and quality meetings. The Royal College of Radiologists has made specific recommendations on this issue.

Therapeutic radiographers: The vacancy rate against established therapeutic radiography posts has increased from 5% in 2010 to 6.4% in 2012 (this is down from 11.9% in 2006). Attrition from training programmes is very high and has continued to range from 33-37% in the last three years (and was 35% in 2005). The Society and College of Radiographers has recently published an NCAT commissioned report on this issue which contains key recommendations to be taken forward[20]. It will be essential that stakeholders address the recommendations in order to improve retention. Only 5 of 50 centres have implemented the '4-tier' radiotherapy workforce model for therapeutic radiographers recommended in the 2007 NRAG report, indicating further scope for skills mix across radiotherapy centres. Some centres commented during the challenge meetings that the skills of radiographers could be utilised to undertake the necessary patient planning for IMRT, thus boosting available resource in treatment planning. The Fund supported those centres in making this skills mix change, through the temporary backfill of radiographers moving from the treatment to the dosimetric planning section. The Department of Health report *Radiotherapy Services in England 2012* suggested a 39% increase in the radiography workforce from 2011-2016 to meet the anticipated activity levels. This does not include the additional staffing required for the Proton Beam service.

Radiotherapy physics: The vacancy rate against established radiotherapy physics posts within the NHS in England was found to be 7.5% in 2012. This figure has remained consistent at around 6-8% since 2008. The figure is higher amongst associated supporting staff groups (clinical technologists and dosimetrists). Radiotherapy physics practitioners (or dosimetrists) work in compliment to the radiotherapy physics and radiographer workforce and therefore are key to enabling physics resources to be directed towards the implementation and roll-out of advanced radiotherapy. A two-year pilot dosimetry practitioner training programme run within the London region delivered 10 practitioners at the end of the programme in 2012. Although, this programme has now ended, further funding has been approved to train five more radiotherapy practitioners within the London region. However, the workforce would benefit from national roll-out of the scheme. The Department of Health report *Radiotherapy Services in England 2012* suggested that a 31% increase is required in the physics workforce between 2011-2016 to meet the anticipated activity levels. This does not include the additional staffing required for the Proton Beam service.

[20] https://www.sor.org/learning/document-library/improving-retention-radiotherapy-workforce-role-practice-placements-student-attrition-pre

7 Conclusion and recommendations

The Radiotherapy Innovation Fund has been a significant boost to radiotherapy services, with the average proportion of IMRT being delivered across all centres in England increasing to 22.3% by April 2013. This means that around 5,800 more patients a year across England will now have access to advanced radiotherapy treatment.

While in the strictest sense the Fund has not met its target of increasing IMRT provision to the recommended 24% by 1st April 2013 in all centres, good progress has been made over a very short period of time and will continue to do so over the coming year. It was to be expected that the impact of some of the revenue will take time to show effect because of the complex task of delivering and installing software and hardware, and the commissioning of both for clinical use within the local centre.

The success of the Fund can be accredited to the pragmatic approach taken by both the service to turn funding requests around at very short notice, the Department of Health to process these requests and identify the need and opportunity for the £8million uplift to the Fund.

However, this money was absolutely critical to fill a gap in the radiotherapy service which should not have existed. Radiotherapy is a cutting edge treatment. As research uncovers new and improved ways of delivering radiotherapy in a more targeted and effective way, these treatments will need to be introduced into the service. It is absolutely vital the service is sufficiently prepared and resourced to enable this.

Although the introduction of a national tariff for radiotherapy and changes to commissioning structures will go some way to aid this, the funding and roll-out of advanced radiotherapy and innovation in the radiotherapy service should be a priority for NHS England. Radiotherapy plays an important role in addressing Domains 1-3 of the NHS outcomes framework (reducing premature mortality, improving the quality of life of survivors and helping people recover from ill health). We therefore need continuing commitment to ensure that patients across the country are given access to the best possible radiotherapy service, regardless of where they live. This is especially important in the light of recent changes to the traditional models of provider support through the National Cancer Action Team and the National Radiotherapy Implementation Group which no longer exist. It is important that the Radiotheray Clinical Reference Group ensure that providers continue to be supported and encouraged to develop at this important time.

7.1 Recommendations

In reflecting on the success of this Fund, and the size of the challenge still to be met in radiotherapy, there is a real opportunity in the NHS in England to continue to build a world class radiotherapy service. To achieve this, a number of measures need to be taken:

Funding

- **NHS Trusts, with support from Government, must urgently find a solution to the current challenge in providing sufficient numbers of up to date linear accelerators.** Individual providers are responsible for maintaining and replacing high value equipment. Trusts need to prioritise their investments and ensure that they have sufficient equipment to provide high quality, safe and cost effective services for patients. They should also work with NHS Supply Chain on the procurement of radiotherapy equipment to make full use of the £300 million

capital equipment fund. The association between delivering advanced radiotherapy and the tariff, and the consequences of not providing these facilities, needs to be the responsibility of the highest management levels within Trusts.

- **Government should consider additional ring-fenced funding streams to further boost radiotherapy services in the future.** Radiotherapy is clinically cost effective. It accounts for 5% of the national spend on cancer, yet is second only to surgery in its effectiveness in treating cancer. The £23 million investment through the Radiotherapy Innovation Fund is relatively modest, especially in comparison with funding provided to other areas of treatment and in promoting innovation in the NHS.

  Pound for pound, the number of people likely to benefit from this fund is highly competitive with other areas of investment. Given the success of this fund, future one-off ring-fenced investments in radiotherapy should be considered.

Service delivery and commissioning

- **NHS England should provide support to ensure the roll-out of Image Guided Radiotherapy (IGRT).** While progress is being made, more effort is needed to ensure that all patients who might benefit are being offered this. The national support programme for IGRT and the introduction of a CQUIN for IGRT in 2013/14 will go some way to address this, but progress will need to be closely monitored. This will be crucial to making progress on the NRAG 2007 recommendation that all centres should be delivering 4D adaptive radiotherapy as standard. A progress report from the National IGRT programme will be published in summer 2013 with specific recommendations for further supporting work.

- **The Radiotherapy Clinical Reference Group should ensure specialised commissioning includes incentives to promote improvements in radiotherapy.** From April 2013 radiotherapy is being commissioned nationally as a specialised service. This is a positive step forward for the radiotherapy service. Until recently, local commissioning arrangements varied hugely across the country and were often not sufficiently flexible to reward complex or innovative radiotherapy practice. The service specification for radiotherapy should aim to promote best practice and, where appropriate, stretch the radiotherapy service to provide world-class treatment uniformly across the country.

  Providers will need to be given an appropriate level of support from commissioners to meet these specifications.

- **Implementation of the national tariff for radiotherapy should be monitored by NHS England to ensure that it is fit for purpose and is flexible enough to include new treatments as evidence supports their introduction to the service.** Historically, radiotherapy services have been commissioned using locally agreed tariffs via block contracts. This has resulted in different contract types and a variety of currencies and prices across the service. While it is accepted that there will be winners and losers across the country as the national tariff is introduced from April 2013 the impact of the tariff should be subject to close scrutiny. This should provide incentives for radiotherapy and promote innovation.

Innovation and workforce

- **Processes should be introduced to support innovation in radiotherapy. NHS England and the Clinical Reference Group should investigate an appropriate long term solution for ensuring**

innovative radiotherapy treatments are rolled out across the country as soon as possible. The service specification for radiotherapy, and the additional support provided by the Radiotherapy Innovation Fund will help the roll-out of advanced radiotherapy. However, both of these mechanisms are focused around the minimum standards for advanced radiotherapy that each centre should be meeting now and not targets for the future.

It is likely the £100million NHS England Specialised Service Commissioning Innovation Fund will be stretched across the whole of the NHS. Individual treatment requests are arduous and not appropriate for treatments that have proven clinical benefit in the significant proportion of patients who receive them. A long term solution is needed.

- **NHS England and Health Education England should take action to address current shortfalls in the radiotherapy workforce to ensure continued improvements in advanced radiotherapy. A plan should be put in place to ensure that the skills and resources required to meet future demand, and the introduction of innovations to radiotherapy services, can be achieved.** The ongoing introduction of new technologies requires additional time during the implementation phase, and all these new technologies demand additional workforce skills and require longer time to undertake compared with previous treatments. Additional workforce is required to support this effectively**.** Services should map skills requirements against patient pathways to ensure existing resources are used effectively and efficiently. Services should also ensure that new workforce resource is planned for in order to enable the right levels of advanced radiotherapy to be delivered to patients across England.

Data and monitoring

- **Progress in the delivery of advanced radiotherapy should continue to be monitored through the Radiotherapy Dataset (RTDS). The National Cancer Services Analysis Team (NATCANSAT) should undertake further work to ensure effective monitoring of each specific element of radiotherapy, and have clear criteria for unambiguous data entry as it is developed.** While the past three years have seen progress in the completeness of the radiotherapy dataset, coding issues mean that providers' self-reported activity is still at odds with that reported in the RTDS. We recommend greater granularity within the coding of the RTDS to enable the data from centres to enable accurate monitoring of the levels of specific types of advanced radiotherapy across England. The RTDS should be used to populate the commissioning dashboard and enable monitoring against the service specification. Ensuring the RTDS is populated with the correct data will remove the requirement for centres to self-report for specific data sets.

- **The Radiotherapy Clinical Reference Group should develop appropriate metrics to measure both the quality and quantity of radiotherapy. The Group should regularly monitor progress in the delivery of advanced radiotherapy including IMRT, IGRT and SABR.** Historically the radiotherapy service has been rated by the number of fractions delivered and patient throughput. Priority should instead be given to quality measures such as the number of patients receiving advanced radiotherapy and the quality of the components of the process such as imaging and planning to deliver advanced radiotherapy.

  Delivery of advanced radiotherapy should be monitored against the national service specification, using the RTDS and commissioning dashboard, and compared to patterns of local delivery. The CRG should ensure that the appropriate percentage of patients and diagnoses have access to advanced radiotherapy, and if necessary re-direct patient flows to centres that can deliver such quality and capacity.

Appendix 1: Radiotherapy Centres IMRT delivery and radically treated patient numbers

RTDS data for IMRT delivery in April was not available for this evaluation. Table 5 compares self-reported inverse planned IMRT delivery by centre in August 2012 and April 2013. For 4 centres, data was also not available for August 2012 and so data for November 2012 had to be used. This was still prior to the implementation of the Fund. Table 5 is arranged by IMRT delivery as of April 2013, ordered lowest to highest.

The reason that the RTDS data for April was not available was because the RTDS data code for inverse planned IMRT also includes some patients who receive forward planned IMRT but who require specific individual Quality Assurance. The forward planned patients are not relevant to the delivery of the Fund, which focused on increasing inverse planned IMRT. It seems from the RTDS data code, that some centres are undertaking a lot of forward planned IMRT requiring patient specific individual QA. Therefore providing RTDS data would not provide an accurate picture of inverse planned IMRT delivery. For example, one Trust was showing it delivers 73% under the RTDS IMRT code data – when this was checked with staff at the Trust – the actual figure reached for inverse planned IMRT treatment alone was significantly lower at 17%.

There are obvious limitations to self-reported data and Table 5 gives an outline of centres' performance. It is still possible that there are some inaccuracies in the data.

To calculate the overall proportions and numbers of patients receiving IMRT in England for the two periods, the number of radically treated patients at each of the centres for the financial year 2012/2013 was used. The numbers were provided by NATCANSAT (www.natcansat.nhs.uk) from the RTDS, and include radically treated breast cancer patients. Radically treated patients were defined as those that had 15 or more attendances. Due to low numbers, these figures have not been included here to protect patient confidentiality.

Table 5 - (Red = 0-3%, Amber = 4-14%, Yellow = 15-23%, Green = 24-32%, Blue = 33% and above).
*denote those Trusts that supplied self-reported data in November 2012.

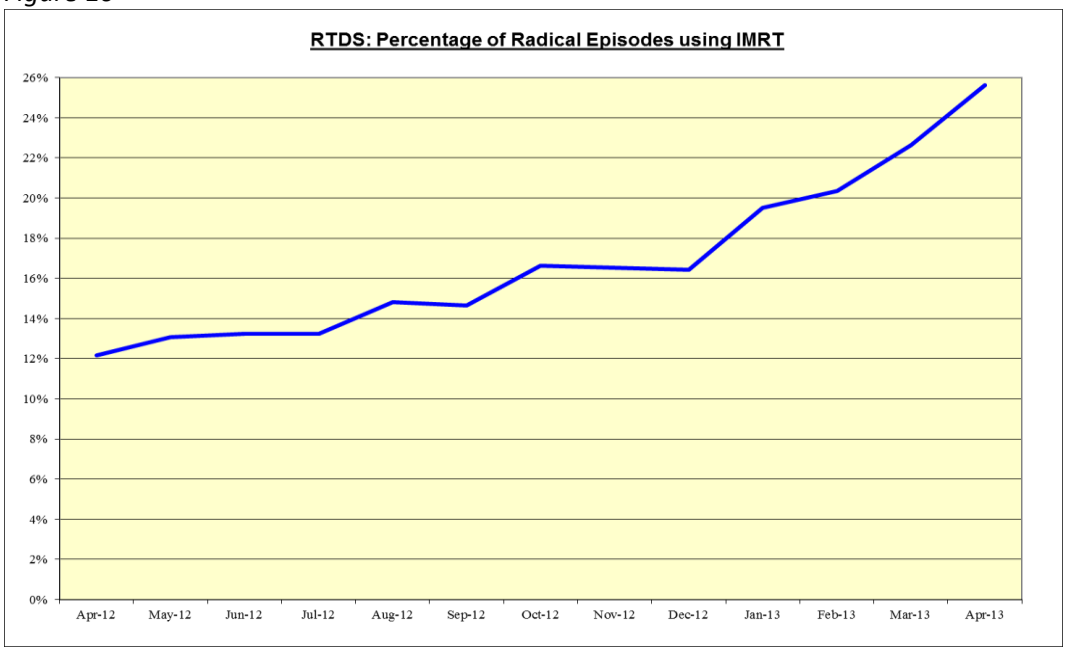
Self reported delivery of inverse planned IMRT for radically treated patients		
Centre Name	**August 2012 Survey**	**April 2013 Survey**
North Middlesex University Hospital NHS Trust	1.7	1.5
Colchester Hospital University NHS Foundation Trust	1.9	2.0
Taunton and Somerset NHS Trust	0.0	3.7
United Lincolnshire Hospitals NHS Trust	2.3	7.0
Southampton University Hospitals NHS Trust	2.0	7.0
North Cumbria Acute Hospitals NHS Trust	1.2	7.9
Royal United Hospital Bath NHS Trust	6.2	10.0
Derby Hospitals NHS Foundation Trust	5.0	10.9
University Hospitals Coventry and Warwickshire NHS Trust	1.8	13.0
Brighton and Sussex University Hopsitals NHS Trust	1.3	13.4
Poole Hospital NHS Foundation Trust	0.0	13.5
South Devon Healthcare NHS Foundation Trust	1.1	15.0
Portsmouth Hospitals NHS Trust	2.3	15.9
Royal Devon And Exeter NHS Foundation Trust	2.4	16.5
Maidstone and Tunbridge Wells NHS Trust	10.0*	17.0

Royal Berkshire NHS Foundation Trust	13.1	17.0
Royal Cornwall Hospitals NHS Trust	0.0	17.0
Royal Wolverhampton Hospitals NHS Trust	11.2*	17.6
Plymouth Hospitals NHS Trust	9.1	18.0
University Hospital Birmingham NHS Foundation Trust	16.7*	19.0
Gloucestershire Hospitals NHS Foundation Trust	14.1	19.0
Leeds Teaching Hospitals NHS Trust	15.8	19.0
Sheffield Teaching Hospitals NHS Foundation Trust	2.2	19.0
Northampton General Hospital NHS Trust	4.9	20.0
Oxford Radcliffe Hospitals NHS Trust	5.2	20.7
Imperial College Healthcare NHS Trust	14.3	21.9
University Hospitals Bristol NHS Foundation Trust	19.6	22.0
Royal Marsden NHS Foundation Trust	26.9	22.2
Christie Hospital NHS Trust	25.3	24.0
Nottingham University Hospitals NHS Trust	17.5	24.0
University College London Hospitals NHS Foundation Trust	26.6	24.0
Lancashire Teaching Hospitals NHS Foundation Trust	5.1	24.3
Hull and East Yorkshire Hospitals NHS Trust	11.3	25.0
University Hospital of North Staffordshire NHS Trust	35.2	25.0
Norfolk and Norwich University Hospital NHS Trust	15.2	25.0
East and North Hertfordshire NHS Trust	10.7	25.9
University Hospitals of Leicester NHS Trust	15.1	27.0
Newcastle Upon Tyne Hospitals NHS Trust	19.1	27.2
Royal Surrey County NHS Foundation Trust	20.6*	28.0
Barking, Havering and Redbridge Hospitals NHS Trust	19.0	29.0
Barts Health NHS Trust	24.5	31.9
Guy's and St Thomas' NHS Foundation Trust	26.0	32.0
Royal Free Hampstead NHS Trust	9.1	33.0
South Tees Hospitals NHS Trust	13.0	34.3
Clatterbridge Cancer Centre NHS Foundation Trust	11.3	35.7
Shrewsbury and Telford Hospital NHS Trust	14.2	35.7
Southend University Hospital NHS Foundation Trust	18.3	37.0
Ipswich Hospital NHS Trust	29.8	38.6
Cambridge University Hospitals NHS Foundation Trust	26.2	40.0
Peterborough and Stamford Hospitals NHS Foundation Trust	38.4	56.4
Overall proportion of radically treated patients receiving inverse planned IMRT in England	**13.6**	**22.3**

Overall increase in IMRT

Figure 10 shows RTDS data on the overall rapid ramp up of IMRT for radical patients since RIF. It includes both inverse planned IMRT patients **and** those forward planned IMRT patients requiring individualised QA. Therefore the overall figure on the chart for April (nearly 26%) is slightly higher than the self-reported inverse planned IMRT patients alone. The data demonstrates the effectiveness of the fund.

Figure 10



Appendix 2: Methodology

1. Allocating the Fund

The Radiotherapy Innovation Fund was a single one-off revenue fund with a requirement that this Fund was used in 2012/13. To ensure equity across the service, and that centres were not disadvantaged by excellence, it was agreed that the £15million fund should be divided equally into a fixed and a variable element.

Fixed element:
Each centre was allocated a fixed £150k from the Fund. Centres not delivering 24% inverse planned IMRT were asked to submit action plans setting out how this funding would help them deliver appropriate rates from April 2013.

Those already delivering at 24% or above were asked to set out how they intend to use this funding to either improve pathways, reliably sustain and increase inverse planned IMRT activity levels or to deliver (or prepare to deliver) other advanced techniques and show how this will benefit patients.

Variable element:
Trusts were also invited to submit bids for additional funding from a pot of £7.5million on top of the fixed amount. It was agreed that these bids would be prioritised as follows:

- Bids from Trusts with the lowest reported IMRT activity levels and robust proposals for delivering from April 2013 will be prioritised first.
- Bids from Trusts making sound proposals to deliver above the 24% level.
- Bids that support increased capability to deliver using image guided radiotherapy (IGRT).
- Bids from Trusts making robust proposals for other advanced techniques that will directly benefit patients.

In submitting bids for funding, Trusts were asked to prioritise requests so that allocations could be distributed as fairly as possible and to those proposals likely to have the greatest impact on increasing access to advanced radiotherapy.

Centres were invited to submit applications for a fixed share of the fund together with bids for a variable amount. The guide for submitting applications is attached in *Appendix 3*.

2. Challenge sessions and expert scoring

All centres not delivering 24% inverse planned IMRT were required to attend a challenge session with an NCAT led team of clinical experts, including radiotherapy physics and radiotherapy management expertise with a clinical oncologist where needed drawn from the NRIG membership.

Centre visits were held at 16 central locations between 5th November and 5th December 2012.

The aim of these visits was to provide advice and support for centres to ensure they were getting the most out of the Innovation Fund and guide them in submitting a successful application; they also provided an opportunity for teams to verify current IMRT provision and ensure appropriate prioritisation of applications and challenge funding requests.

Centres were asked to submit initial funding applications ahead of the site visit, and review and resubmit these based on the feedback at the visit.

After each session, expert reviewers were asked to provide feedback on the visit and score each centre according to need, clinical relevance and likelihood that the items requested would deliver an increase to IMRT activity. Review teams were also asked to comment and score resubmitted bids.

This information was used to inform decisions at the funding review meeting in December 2012.

*Details of the approval process is outlined in **Appendix 4**.*

3. Funding approval and request for additional funding

In December 2012, the core group met to agree funding based on applications. Applications were prioritised based on process outlined above.

At this meeting, it was clearly demonstrated that a number of valid funding requests would fall outside the £15milion allocated to the Fund, and rigorous prioritisation would be needed. It was therefore agreed that a request for additional funding would be submitted to Ministers.

In December 2012 the Health Minister, Dan Poutler, announced that an additional £8million of funding was being made available, bringing the total value of the Fund to £22.8million.

4. Procurement and management of payments

Trusts were notified of the success of their application in writing by the Department of Health. Following the issue of letters to Trusts confirming amounts allocated, each centre was asked to sign either a MOU detailing how the Fund was intended to be spent. Centres were asked to provide receipts for expenditure to the Department of Health by 31st March 2013.

5. Training courses

In addition to the £15million innovation fund, resource was also identified to support the development of three training courses. Further details and analysis of these courses are attached in *Appendix 6*.

- An IMRT foundation course

All centres were invited to identify clinical teams to attend a bespoke one-day foundation course on IMRT. Centres identifying lack of appropriate training as a blockage to the delivery of IMRT were particularly encouraged to take up this opportunity.

- IMRT physics and dosimetrists workshop courses

Two specific one day meetings were established primarily to support medical physicists and dosimetrists to use innovative methods to support increased IMRT activity, workflow and planning solutions.

- IGRT training for radiographers

A one day course has been designed to complement the NCAT funded national support programme for IGRT being rolled out by the SCoR.

Appendix 3: Action Plan and funding request

Action Plan for IMRT Implementation

1. Current IMRT activity

To include both forward planned and inverse planned IMRT figures.

2. Barriers/opportunities to delivering advanced radiotherapy

For centres delivering below 24% this should comprise a brief summary of key barriers in your centre. For those currently delivering 24%, or on track to deliver 24% by April 2013, this should be a short summary of the opportunity presented by the Radiotherapy Innovation Fund to develop advanced radiotherapy capability in your centre.

3. Implementation Plan for overcoming barriers: [for centres delivering below 24% IMRT]

To include an outline of requirements for development of radiotherapy capacity, including additional software, equipment, and staff support as necessary. This might include, but should not be limited to:

a. Protocol development

Where protocols are not currently in place, centres should outline how they plan to develop protocols for the introduction or expansion of IMRT and pre-treatment QA/verification for each appropriate treatment site.

b. Training required

Centres should identify training needs and discuss how these will be addressed. This should include in-house peer-to-peer training and external training courses where necessary.

c. Capacity issues to be addressed

To include the need for additional or software, the need to commission existing equipment or additional short-term staff capacity. Where capital equipment is required please describe what action has been / is being taken locally to secure the equipment etc.

d. Other issues

Please outline any other issues.

e. Schedule of ramp-up of IMRT treatments

A schedule of IMRT treatments per month should be developed for each relevant cancer site based on additional equipment and staff resources outlined in funding request. Trusts delivering below 9% forward planned IMRT for breast should include this in the table.

	Period	Site, e.g. Prostate	Site,	Site -	**Inverse Planned**		Forward Planned
					Total	**%**	
2012	November						
	December						

2013	January						
	February						
	March						
	April						

Progress against these figures will be measured through the Radiotherapy Data Set (RTDS).

4. Radiotherapy Innovation Plan Funding Request

Are there any risks or dependencies that could limit your ability to use the available funding to deliver enhanced capability? How will those risks be managed?

5. Radiotherapy Innovation Plan Funding Request

Please set out your proposals for use of, or bids for, funding in the table below.

Where you are already delivering at the appropriate rate of IMRT, please describe your proposal for use of £150k of funding in the first column below and complete columns two and three. If you are then bidding for additional funding, please be sure to prioritise your bid.

Where you will use this funding to develop capability to deliver appropriate levels of IMRT, please refer to the list of potential items in appendix 3.

Proposal	**Assessment of likely impact**	**Estimated cost** (Includes VAT)
Please give manufacturers details as appropriate	*Brief overview of how this will improve delivery of advanced radiotherapy.* *Refer to IMRT action plan as appropriate.* *Where not IMRT related, please describe the anticipated benefit to patients*	*For items on the list of potential items that can be sourced via NHS Supply Chain please use indicated best price*

6. Comments

Please add any additional comments you wish either to support the bid or for discussion during the assessment of bids.

Please return this form to IMRTinnovationfund@cancer.org.uk, by **9th November 2012**

Appendix 4: Approving funding

1. **Clinical visit teams recommendations.**

   Visit teams have been asked to score each revised bid from centres according to the following criteria:

- **<u>Quality of the final revised bid</u>**: **overall, given the items requested, how would you rate this bid on how well it describes and addresses the barriers identified by the centres and therefore the likelihood that it will deliver improvements to radiotherapy treatments for patients?**

This scoring should show the overall credibility of the bid. Firstly does the bid describe the problems that the service has, and is this description consistent with the dialogue at the confirm and challenge meeting. Also, does the bid address the problems described in the bid, or are there still items that exist in the description that the bid fails to address. Overall therefore, is there confidence that the submission, if approved deals with the blocks within the service to IMRT.

- **<u>Progress to date</u>: given the effort each centre has made to date to implement IMRT, how would you rate your confidence in this bid and that investment will see a marked improvement in service delivery given their progress to date?**

This scoring should reflect the progress the centre has made on their own. This is a more subjective area, as some centres will have blocks outside their own control (commissioning, funding for equipment etc) and as such they may have tried but not been supported.

- **<u>Impact of the first 150K</u>: given your local knowledge about the centre and the challenges they face from the bid and discussion with them, how would you rate this bid on the likelihood that the first 150K of funding will significantly improve IMRT delivery?**

This scoring measures the extent to which the first £150k alone will improve IMRT provision. As all centres will receive £150k, this score supports area 4 in looking at funding beyond £150k.

- **<u>Impact of further funding</u>: given your local knowledge about the centre and the challenges they face from the bid and discussion with them, how would you rate this bid on the likelihood that additional funding over 150K will significantly improve IMRT delivery, or outcomes for patients?**

This scoring measures the impact of additional funding. Clearly it may not all be provided, but this area measures whether funding beyond £150k will have a significant impact on further IMRT delivery. The exact amount of additional funding will be determined separately; but this score will in effect create a hierarchy of organisations where funding will achieve greatest good.

Each area is to be scored between **zero and 4** where **zero is very poor, 1 is poor, 2 is average, 3 is good and 4 is very good**.

These scores will be used to prioritise applications for approval at the funding meeting, weighted by the amount of IMRT currently delivered by each centre. Centres most in need of additional funding (those delivering the least IMRT) will be prioritised first, with decisions about the amount of additional funding they received based on the quality of their bid and their ability to deliver against it.

Clinical visit leads have also been asked to make recommendations to the funding committee on what should be provided for within each bid.
These decisions should be based on their assessment of the quality of the application, the centres ability to deliver and the likely impact on patients and indicated as below.

Green: items which are **critical to delivering 24% IMRT** and will **directly lead to improved outcomes for patients** over the next 6-18 months.

Amber: items which are **likely to improve outcomes for patients** but which should **not be included in this round of funding allocation, given the limited budget of this fund**.
Red: items which, in your opinion, would either **not make a significant clinical impact** or are **not an appropriate addition to the department at this time**.

Clinical visit leads have also been asked to **provide commentary for your recommendations and scores**.

2. Clinical core group pre-meet

The RIF core group clinical leads met on 10th December 2012 to consider applications and make recommendations to the funding committee. Centres delivering the least IMRT were to be considered first.

Recommendations on funding will be made based on need and opportunity. Funding recommendations will be considered alongside the score achieved by each centre, with a focus on the quality of the revised bid and the impact of further funding.

The clinical leads will also identify areas for discussion at the funding meeting on the 13th December. Where agreement cannot be reached on a recommendation, this will be flagged for discussion on the 13th December.

3. Funding committee meeting 13th December

This meeting provided an opportunity to review the recommendations from the core group clinical leads and discuss areas of risk, proposals for part funding and challenges such as likely impact on regional spread of IMRT provision. The core group signed off approval for £150K to be distributed to all centres. Applications for funding above £150K were also approved at this meeting.

Appendix 5: Possible items for inclusion in funding requests

Example	*Benefit*	*Other considerations*
1. Help with Contouring		
CT artefact reduction software	Artefact reduction software aids delineation of prostate patients with artificial hips and H&N patients with significant dental work.	Requires commissioning by the physics team to ensure the accuracy of HU to density calibration. Staff training will be required in the software prior to clinical use.
Auto-contouring software	Significant time is required for appropriate outlining of H&N patients prior to IMRT planning. Auto-contouring software reduces the time required for contouring of normal tissues required for IMRT plans.	Auto-contouring packages may require significant time for set-up and commissioning. For example manual outlines may be required for the generation of a suitable outline library. Staff training in the software will be required prior to clinical use.
Multi-modality image contouring software	Contouring of tumour and organs-at-risk can be simplified by the use of multi-modality imaging, for example CT and MR scans for prostate and H&N patients. Software to facilitate simplified workflow for contouring of multi-modality image sets may reduce overall contouring time.	Staff training will be required prior to clinical use. Whether integrated in to the treatment planning system or a separate 3rd party system, software will require thorough testing and commissioning.
2. Help with treatment planning		
Treatment planning IMRT/IMAT/VMAT/RapidArc /Tomotherapy software licenses	IMRT/IMAT/VMAT/RapidArc/Tomotherapy are complex treatments that are computationally intensive at the treatment planning stage. Sufficient treatment planning capacity is crucial to achieve high throughput of IMRT treatments. New software to increase the throughput of IMRT/IMAT/VMAT/RapidArc/Tomotherapy plans are available on some planning platforms.	Additional licenses are likely to require little or no additional commissioning. VMAT provides faster delivery compared to IMRT treatments. If IMAT/VMAT/RapidArc/Tomotherapy is not currently used then significant commissioning may be required prior to clinical use as well as staff training. Software may have minimum hardware requirements that also need to be considered.
Remote treatment planning licenses (and/or software)	Remote access to treatment planning can increase clinician availability, reducing potential bottle-necks in the planning process.	Staff training in the software may be required prior to clinical use.
Adaptive re-planning software licenses	Use of IGRT with advanced radiotherapy techniques leads to re-planning for up to 25% of patients. Software to	Re-planning software is likely to require significant commissioning by the physics team. Staff training

	improve workflow of re-planning reduces the additional resource needed for adaptive radiotherapy.	will be required prior to clinical use. Significant clinical protocol development required from MDT.
3. Help with commissioning/training		
External commissioning of equipment	The use of an external commissioning service reduces the need for additional physics resource. Specific equipment can be commissioned effectively and efficiently without affecting the routine clinical service.	Access to the linac is likely to be required to enable external commissioning of equipment. Requirements of the equipment commissioning need to be clearly specified.
Non-recurrent short term funding of staff	Commissioning of equipment or techniques can be achieved through short term funding of staff either in temporary positions, or through the use of overtime payments.	Access to linacs and dosimetry equipment is likely to be required to enable commissioning of equipment.
External training courses	External training courses enhance the ability of local staff to increase IMRT capacity.	
Applications training (e.g. from manufacturers)	Applications training for specific equipment can significantly reduce the time needed to install equipment within a department.	
Short term educational visits to other centres	Visiting other centres already performing significant proportions of IMRT treatments can lead to insights in to the action plan required to increase capacity, and longer term to revise patient QA schedules.	
4. Help with patient verification / QC checks		
Independent MU software	Independent MU software reduces the need for pre-treatment patient specific verification. This reduces the need for linac time and lessening the workload on the physics team.	Commissioning of independent MU software may require additional measurements as input, and a significant commissioning process. Staff training will be required.
Pre-treatment patient specific verification equipment (2D/3D arrays etc)	Specifically designed 2D and 3D arrays for pre-treatment patient specific verification provides a streamlined and optimized workflow. Additional devices of the same type within a department requires little commissioning and staff training prior to clinical use.	Staff training will be required for devices new to the department to enable commissioning and clinical use.
QA software for deformable image registration software		Commissioning and performance testing of the software will be required as well as staff training.
5. Help with IMRT treatment		
IMAT/VMAT/RapidArc/Tomotherapy	IMAT/VMAT/RapidArc provides faster treatment times than	Significant commissioning prior to clinical use may

licenses/upgrades for the linac	traditional IMRT treatments with equivalent plan quality. More recent developments have further improved the efficiency and reliability of treatment through dose rate control and improvements.	be required. Hardware upgrades may be required in conjunction with software upgrades.
IGRT retrofit/upgrade	IGRT combined with IMRT treatments provides an increased assurance in the treatment of advanced radiotherapy techniques.	Retrofitting/upgrading requires linac downtime for several weeks. Radiographer training in IGRT may be required prior to clinical use.
R&V licenses (for pathway monitoring/ efficiency)	R&V systems can be used to monitor patient processes in the pathway and enable efficiency gains if used appropriately.	Staff training in the software to enable new ways of working may be required.
Portal dosimetry software	Portal dosimetry software enables efficient in-vivo patient measurements. The software may also be used for pre-treatment patient specific verification using the EPID device on the linac.	Significant commissioning and staff training may be required prior to clinical use.
Data Storage & Archive management	The use of IGRT with IMRT treatments increases the data storage and archive requirements of a radiotherapy centre. Efficient data storage and archive management reduces additional staff and time resource to manage additional IMRT/IGRT capacity.	Implementation of a managed data storage and management system may require detailed discussions and agreement with Trust IT departments. Some ongoing physics resource is likely to be needed to maintain the system.

Appendix 6: NCAT training programmes

In additional to the centre bids, NCAT ran a series of training courses aimed at raising awareness and improving practical skills needed to deliver advanced radiotherapy.

IGRT event

A learning event was held on 22 May 2013 for Lead IGRT radiographers and physicists from radiotherapy centres in England. All 50 Providers were represented at the event by their Lead IGRT radiographer and physicist, 104 radiotherapy staff attended and 12 radiotherapy vendors at the event provided equipment for hands-on teaching demonstrations by clinical experts. The event provided an opportunity to update delegates on progress with the national IGRT funded programme, which ended 31st May 2013, and offered a series of workshops to enable hands on learning in-relation to complex IGRT cases for all delegates across a range of vendors technologies. This focused on image acquisition analysis and adaptive radiotherapy.

A report is being published in the summer, by the professional bodies, which will include further feedback from the full year long IGRT support programme. This report will provide further recommendations for NHS providers highlighting gaps between practice and National Radiotherapy IGRT guidelines. The report will be shared with the Radiotherapy Clinical Reference Group once published in July 2013.

IMRT events

Three events were hosted across England for professionals planning IMRT. Each study day was aimed at providing basic core knowledge about the IMRT planning process and included an

- introduction to IMRT planning
- evaluation of a IMRT treatment plan
- generic planning points for prostate and head and neck patients
- hands-on experience with relevant treatment planning system

Over 200 clinical physics staff attended the events held at weekends, and feedback was extremely positive. A team of clinical experts provided presentations and workshops, with support from radiotherapy vendors who loaned planning equipment for the event.

IMRT for Clinical Oncologists

9 regional events were hosted for Clinical Oncologists from February to March 2013. These events were organised by the Royal College of Radiologists, and Clinical Oncologists from each NHS radiotherapy provider were invited to attend one event. 244 Clinical Oncologists attended one of the 9 events.

These programmes were aimed at providing support to undertake IMRT planning and provided an opportunity for joint learning about the principles of IMRT and then some focused site specific sessions where delegates could choose to learn about the specifics of IMRT planning specific to the patients treated within their own clinical practice. This offered opportunity for very detailed focused learning from experts.

Site specific workshops:

1. Prostate, pelvis, anus
2. Thorax – lung, oesophagus
3. Head and neck
4. Sarcoma, CNS