Radiotherapy Board

Guidance on Improving Access to Radiotherapy: Increasing working hours

June 2015

Glossary of terms

Radiotherapy is the use of high energy radiation to predominantly treat cancer. It is a localized treatment that targets the tumour and can cure cancer by damaging the DNA of abnormal cells which have less ability than normal cells to repair and replace themselves.

External Beam Radiotherapy Treatment is the most common form of radiotherapy in current use. Treatment is delivered using a machine that generates an external source of radiation that is aimed at/delivered to a particular part of the body. (The term 'radiotherapy' in this document refers to this type of treatment.)

Fraction of radiotherapy is the term for the dose of radiotherapy delivered at each visit to the treatment machine. Radiotherapy is often divided into a number of small doses called fractions, which are usually given each day Monday to Friday over a number of weeks.

Hypo-fractionated Radiotherapy is a course of radiotherapy where a small number of fractions deliver a higher dose of radiation at each fraction than during conventional courses of radiotherapy.

Intensity Modulated Radiotherapy (IMRT) shapes the radiotherapy beams and allows different doses of radiotherapy to be given to different parts of the treatment area. This limits the dose of radiotherapy that can be given to healthy tissue, particularly healthy tissue that's more easily damaged by radiotherapy. As a result, immediate and long-term side effects are reduced.

Image Guided Radiotherapy (IGRT) is the use of images taken to ensure that radiotherapy is delivered precisely as planned and allow adjustments to the treatment if necessary. Before, and sometimes during, a course of radiotherapy, images are acquired to ensure the treatment accurately targets the area requiring treatment. This may involve taking x-ray images or moving the machine to get an image similar to a CT scan. The images are then compared to those taken during the radiotherapy planning process.

Linear Accelerator is a machine that uses electricity to form a stream of fast-moving subatomic particles which create high-energy radiation that can be used to deliver radiotherapy treatment. It is often referred to as a Linac.

Malthus provides a mathematical simulation of the requirement for radiotherapy by using local cancer incidence and evidence-based decision trees. Based on UK clinical practice and English data, it produces an answer in terms of fractions of radiotherapy that should be delivered per million population. It can be used as a decision making aid for planning and commissioning radiotherapy services at a local or regional level.

Quality Assurance (QA) In radiotherapy, this refers to all the checks and procedures that ensure that the delivery of radiation as a therapeutic intervention is safe and consistent.

Executive summary

- The rising incidence of cancer and the drive to diagnose patients earlier will continue to increase the number of patients being treated with radiotherapy.
- Increasing complexity of radiotherapy treatment is increasing the chances of cure from radiotherapy and reducing potential side effects but also increases the length of time required to plan and deliver individual patient treatments.
- These factors are creating the ongoing need to increase radiotherapy capacity.
- A number of centres have considered and indeed implemented increasing working hours to address this increasing demand.
- There are various options for extending the opening hours of current radiotherapy departments. This could be through:
    - longer hours from Monday to Friday or
    - operating the service at weekends.
- Whichever option is adopted, patients must receive a comprehensive, safe and high quality service and the overarching principle should be that from the patients' perspective it is 'business as usual' with patients' experiencing the same level of service regardless of the time or day of the week that they receive treatment.
- How the increase in the working hours is achieved depends on the additional capacity required.
- Most current evidence for patients being treated with radiotherapy is based on delivering treatment on five consecutive days with a two consecutive day break each week.
- Increasing the working hours on Monday to Friday is potentially the most straight forward and least disruptive option to implement and should be considered first.
- Scheduling over seven days is more efficient and effective than for six days due to a bottleneck effect created if one day of the week is effectively blocked.
- When increasing treatment delivery to six or seven days a week, consideration must be given to how linear accelerator quality assurance, maintenance and non-clinical activity will be scheduled.
- Careful consideration should be given to the groups of patients that can be safely and effectively treated outside 'normal working hours' and a risk-based approach should be adopted to define this.
- Once the patient group is defined, patients must be consulted to assess local willingness to attend for treatment at the proposed new treatment times.
- In addition to deciding the opening times of the radiotherapy department, the elements of the service to be offered outside 'normal working hours' must also be defined. This document discusses the options of delivering:
    - external beam radiotherapy treatment only,
    - external beam radiotherapy and some radiotherapy planning/imaging,
    - the same service elements as during 'normal working hours'.
- The combinations of additional working hours and the service elements to be offered will have direct implications on the workforce, equipment resources and the cost and efficiency of delivering the new service. This requires detailed modelling.
- Any change in service delivery must be underpinned by the correct workforce in terms of numbers, skill mix and experience being available at the right time.
- Consideration should be given to how changes to opening hours and days will impact on all professions. Staff must be consulted openly from the outset of planning such a change.
- Time will be required and should be factored in to allow for additional recruitment and training.
- Maintenance, Quality Assurance, upgrade of equipment and service developments all need significant hours of access to linear accelerators when patients are not being

treated. To ensure a safe, resilient infrastructure to deliver a modern radiotherapy service, this must be integrated into any plans for extending radiotherapy service hours. Ideally, this should be supported by a service efficiency machine, as this would provide resilience in terms of clinical linear accelerator capacity during extended hours working and facilitate the completion of the essential non-clinical activity.

- Availability of manufacturer support and parts is currently limited outside the ‘normal working day’. This could have significant impact on continuity of the service ‘outside normal working hours’. This needs risk assessment and, in the future, potential national commitment to enable manufacturers to provide an extended service.
- To ensure a robust contingency plan can be implemented in the event of a linear accelerator breaking down, it is recommended that the machines are not run at maximum capacity.
- Service Leads should remain mindful of how engagement with clinical trials, research, development and audit can be maintained when planning to increase working hours as these are essential to delivering an optimal modern radiotherapy service.

1 Introduction

Radiotherapy is a highly effective treatment and contributes to the cure of 50% of patients with cancer. It can be used alone or in combination with surgery and systemic therapy (chemotherapy, hormone or biological therapy). Radiotherapy is also an effective palliative treatment in patients who have symptoms owing to the local effects of their cancer.

Radiotherapy aims to eradicate tumour cells and minimize the effect of radiation on the surrounding tissue; therefore each patient's radiotherapy requires individual planning, preparation and delivery. Depending on the type and site of the tumour, patients could attend for just one single treatment or up to thirty seven daily treatments. Traditionally the normal working hours for radiotherapy services have been Monday to Friday, 9am to 5pm. As the requirement for additional capacity to treat more patients with more complex treatments continues to increase, this working pattern is being challenged.

It is anticipated that this need for additional capacity will continue. The incidence of cancer is predicted to increase by around 2% per annum over the next 10 years[1] with a consequent increase in the radiotherapy workload. Survival rates for patients with cancer in the UK still lag behind Europe and the rest of the developed world.[2] To address this, plans are in place to expand cancer screening.[3] These aggressive public health campaigns and screening programmes will facilitate earlier diagnosis of cancer. This will increase the number of patients receiving radiotherapy with the aim of cure which in turn increases the number of fractions of radiotherapy required, as patients receiving curative (also known as radical) radiotherapy are usually treated with daily radiotherapy over weeks, rather than the shorter courses of treatment currently used for palliation.

The details of this have been widely documented in:

Department of Health Improving Outcomes: A strategy for cancer, 2013 [3]
The Malthus programme, 2012[4]
Department of Health, National Radiotherapy Implementation Group. Radiotherapy Services in England, 2012[1]
Cancer in Scotland: Radiotherapy Activity Planning for Scotland 2011-2015[5]
Vision for Radiotherapy 2014-2024[6]

In 2007, the Department of Health's National Radiotherapy Advisory Group[7] predicted a significant increase in demand for radiotherapy by 2016. They estimated that the number of radiotherapy fractions required would increase from 30,000 to 54,000 fractions per million population per annum. In more recent years, the National Cancer Action Team funded the development of the Malthus programme (a radiotherapy capacity and demand modelling tool)[4] and this has refined this prediction to 47,600 fractions per million population per annum by 2016. Currently the national average figure is reported to be 35,700 fractions per million per annum (Radiotherapy Data Set (RTDS) micro site).[8] While the rate of increase to date suggests that the activity levels will fall short of the predicted level by 2016, it does provide evidence that the demand for radiotherapy continues to grow. It is, however, not just the number of fractions that is increasing the pressure on capacity. Other factors, such as the incremental use of Image Guided Radiotherapy (IGRT), are increasing the complexity of the radiotherapy delivered.

In 2012, the Prime Minister pledged that all patients in England would have access to advanced radiotherapy techniques, including Intensity Modulated Radiotherapy (IMRT) and IGRT.[9] In 2014, the Vision for Radiotherapy document[6] endorsed that patients should have access to innovative, sophisticated techniques and technologies to achieve optimal treatment outcomes. In addition to the demand for more fractions of radiotherapy to be

delivered, the increased complexity of technical radiotherapy planning and treatment delivery is increasing the workload of radiotherapy services accelerating the need for additional radiotherapy capacity. Indeed as this demand grows, a number of radiotherapy departments across the country have already begun to extend their working hours.

There is evidence that hypo-fractionated radiotherapy improves patient outcomes in some situations but this is only for a minority of patients. The majority of cancers are likely to continue to be treated with longer courses of radiotherapy until clinical trial evidence indicates otherwise. The use of hypo-fractionated radiotherapy is unlikely to imminently offset the increased demand on radiotherapy treatment machines due to increasing numbers of patients requiring radiotherapy and increased use of IMRT and IGRT.

This document has been produced by the Radiotherapy Board[1] and reviews the issues that need to be considered when increasing provision of radiotherapy by extending the working hours of radiotherapy departments. It outlines potential options and the associated practicalities to be addressed when expanding radiotherapy capacity through increasing radiotherapy departments' working hours and/or days.

Increasing capacity has many implications. Patients rightly expect and should experience the same level of service regardless of what hour or day of the week they are treated. Any increase in radiotherapy capacity must include the infrastructure changes that are required to ensure that a safe and equitable service is provided for the patients being treated.

The aim of this document is to support and inform those who lead and manage radiotherapy services and are responsible for working with commissioners to meet the demand for radiotherapy. For the purposes of this document, 'Service Leads' refers to the heads of medical/radiotherapy physics and heads of radiotherapy (radiographer and clinical oncologist).

This document is distinct from, but should be read in conjunction with, the 2013 IPEM/SCoR/RCR document that refers to the development of satellite provision; *Guidance on the management and governance of additional radiotherapy capacity* [10] and also the IPEM position statement; *The Impact of Extended Clinical Hours on a Radiotherapy Physics service*.[11]

This document refers to the preparation and delivery of external beam radiotherapy only.

NB: for the purpose of this report, when 'normal working hours' for radiotherapy centres are referred to this is in accordance with the NATCANSAT website definition ie 9.00am – 5.00pm, (or 09.00-17.00hrs) Monday to Friday, excluding Bank holidays

[1] The Radiotherapy Board was established in 2013 by The Royal College of Radiologists (RCR), the Society and College of Radiographers (SCoR), and the Institute of Physics and Engineering in Medicine (IPEM) to provide guidance, oversight and support for the continuing development of high-quality radiotherapy services for cancer patients in the UK.

2 Considerations when increasing the radiotherapy department's working hours

The need for satellite radiotherapy provision has been well documented to address capacity and travel times for radiotherapy patients.[1,10] In addition to this, Service Leads within existing radiotherapy departments are looking at ways to increase their own radiotherapy capacity. Although relatively few centres currently deliver radiotherapy at weekends (except for emergencies), it is recognised that over 50% of centres have already increased their working day beyond 'normal working hours' to meet service demand within existing resources.[11]

This section outlines some of the key considerations when developing the case for extending working hours within existing resource.

2.1 Will patients be willing to attend outside 'normal working hours'?

In 2012, the National Cancer Action Team commissioned Quality Health to lead a national radiotherapy patient survey[12] to explore whether patients in England might be willing to attend for treatment outside 'normal working hours' and at weekends. The survey yielded a 76% response rate (4854/6615 patients) with all but one radiotherapy centre in England participating. The results of this survey showed a *general willingness* by patients to be flexible in attending for radiotherapy treatment outside 'normal working hours'. This is the first time such evidence on a national scale has been available and supports the case for extending radiotherapy service working hours. The survey did, however, find that patient age, distance to travel, gender, ethnicity, living in London and availability of a car influenced willingness to attend for treatment outside 'normal working hours'. Centres planning to extend their working hours must confirm that their local patients are willing to attend outside 'normal working hours' to ensure the viability of extending the radiotherapy service into the evenings and/or weekend working.

2.2 Which groups of patients should be included for treatment 'out of hours'?

An ideal scenario might be to offer radiotherapy to *all* patient groups through increased working hours to improve patient choice. The practicalities of achieving the same level of service for all patients, especially those requiring regular input from medical and nursing staff, dieticians, speech therapists etc, for every hour that a department is open as specified in the Radiotherapy Service Contract Specifications in England[13] creates a major challenge in terms of resources, logistics and finance. A more cost-effective approach may be to consider groups of patients who have a lower risk of requiring support from medical, nursing and allied health professionals when they attend for their radiotherapy treatment and offer these patients the option of treatment outside normal working hours.

Defining appropriate groups of patients is the foundation on which the operational models suggested in this document will be developed. The selection of patient groups should reflect local requirements and service configuration. This selection should be informed by a comprehensive risk assessment for the patient groups who are being considered.

It is mandatory that Service Leads should ensure that the level of support for individual patients is not compromised if patients are attending for radiotherapy outside 'normal working hours'.

2.3 What are the options for increasing the working hours of radiotherapy services?

There are many potential options for increasing working hours and days and these will be influenced by demand, local patient willingness to attend for treatment and resource availability. In addition to the hours of work, the level of service required needs careful consideration. Whether the department delivers treatment only or treatment along with some radiotherapy planning pre-treatment activity or runs a full service needs to be considered. This is addressed in section 5.

For the purpose of this document, the three core scenarios below have been considered as a framework to highlight some of the challenges that might be faced:

1) Extending the working day, eg working Monday-Friday 8am – 9pm
2) Six day working, ie Monday to Saturday inclusive
3) Seven day working, ie Monday to Sunday inclusive

It is important to consider how Quality Assurance (QA) and maintenance will be integrated into linear accelerators' schedules, as these are essential to the safe running of the radiotherapy department. While the availability of a service-efficient Linac would have clear benefits, the absence of such a facility has implications when clinical hours need to be increased. Some routine or commonly occurring clinical scenarios for each of the possible models for increasing working hours are set out in Table 1.

Table 1. Implications of different options for increasing a radiotherapy department's opening hours on its ability to carry out maintenance and quality assurance

Task to be undertaken	Extending the working day only	6 day working	7 day working
2 (or 3) day planned maintenance or QA	Work continues to be undertaken within service hours or at the weekend where appropriately resourced	Undertaken around Sunday ie Sat & Sun (+/- Fri or Mon) or Sun & Mon (+/-Sat or Tues)	2 (3) day break in treatment delivery, could be any 2 (or 3) consecutive days
1 day planned maintenance or QA	No change - weekend or 1 day break in clinical service	Possibly no change. Sunday or one day break in clinical service	Any one day break in the clinical service
Patient QA	May lose option of doing this in the evening	Would lose option of doing this on Saturday. Would have to be done during clinical time, Sunday or late evening	Would lose option of doing this at weekends – would have to be done during clinical time or late evening
Addressing unexpected interruptions to service	Evenings (if not all machines work into the evenings) or weekend where appropriately resourced	Sunday	Late evening

The cost-effectiveness of each of these would need to be worked through locally.

2.4 Scheduling treatment

Where patients are being treated with curative intent, the majority of evidence for radiotherapy is based on treating patients once a day for five consecutive days with two consecutive days' break each week. Any change to treat patients seven days a week with no breaks may have potential benefits but it may also increase the side effects of treatment. While seven day working could potentially present an opportunity for research into radiotherapy fractionation, a move to treating seven days a week continuously should only be introduced into routine practice on the basis of robust clinical trial evidence. For the purpose of this document, it is assumed that patients will be treated with radiotherapy on five out of seven days and have two consecutive days break.

All radiotherapy is scheduled using integrated electronic booking systems eg MOSAIQ® and ARIA®, which are traditionally designed to book treatment five days a week Monday to Friday. Extending the working day Monday to Friday should therefore present minimal difficulties in terms of scheduling. However introducing Saturday and/or Sunday working may present more of a challenge when maintaining current dose fractionation schedules (ie treating five consecutive days in seven). This may require engagement with the software manufacturers.

2.5 Checklist for considering which patients may be treated outside 'normal' working hours

When considering increasing radiotherapy capacity through increasing working hours outside the 'normal working day', the following scheduling issues must be addressed:

- Which patients can attend outside the 'normal' working hours/day?
- Can/should new patients start their radiotherapy outside 'normal' working hours/days?
- How will patients be scheduled through the week to achieve five days treatment with a two day gap while avoiding peaks in the number of patients starting on specific days?
- Are there are additional restrictions to which patients can be treated outside 'normal working hours', eg patients with additional co-morbidities or mobility problems?

Scheduling of treatment over a six day working week rather than a seven day working week is more challenging. This will introduce a 'bottleneck effect' because the consecutive two day break each week during a course of radiotherapy would have to be worked around a Sunday, ie patients would have a break on Monday or Saturday in addition to the Sunday.

3 Practicalities of increasing working hours and days

3.1 Workforce

For each of the disciplines in the radiotherapy team, the workforce required to support working outside 'normal working hours' will depend on the needs of the patients being treated at that time. The overarching principle behind workforce planning should be that an adequate number of staff with the right skill mix is available. This will ensure that the quality and safety of service and level of support for any individual patient is not compromised if the patient is attending for radiotherapy outside 'normal working hours'.

Workforce staffing levels recommended by individual professional bodies (SCoR and IPEM) should be considered to help develop staffing models.

The workforce model must include sufficient scientific and technical staffing with the appropriate level of experience to ensure that the extensive non-clinical activity is adequately delivered in parallel with the extended treatment hours.

Extending the working hours and days of the service will impact on existing working arrangements for all staff groups involved in delivering or supporting patients receiving radiotherapy. This could possibly provide an opportunity to review the skill mix of the staff providing the service. Despite this, for any robust and permanent increase in working hours in any radiotherapy department, extra staff will have to be recruited. Relying on overtime is neither a sustainable nor cost-effective option for this type of service redesign. The precise implications depend upon the staff group. For some staff, time shifting (ie standard working hours with 'shifted' hours across the day/week) may produce more flexibility resulting in a positive impact on work/life balance.

Service Leads need to be mindful of the legal position and of the contracted hours of staff and ensure that increasing the department's working hours does not lead to staff working in breach of legislation, including the European Working Time Directive, or to employers breaching their contractual obligations to staff. Engagement with staff should begin as early as possible in the planning process to extend the radiotherapy department's working hours to ensure that staff are supportive of any change and to avoid delays owing to contractual difficulties. It is also essential that any additional staff are recruited in a timely manner to ensure that they are trained and able to fulfil their roles when the service increases its working hours.

3.1.1 Radiographers

This is the largest professional group in terms of numbers that will be affected by increasing working hours. In addition to the number of radiographers, skill mix is critical. To increase the working hours of a radiotherapy service, careful and timely planning of change is essential to ensure continuation of safe service for patients at all times. Engagement of staff and, where required, their union representatives as early as possible will help smooth the transition to longer departmental opening hours and help maintain staff morale and job satisfaction.

3.1.2 Clinical Scientists and Technologists (medical physics workforce)

Providing adequate numbers of appropriately skilled scientific and technical staff to support the planned clinical service throughout the working day is essential. There must be sufficient staff to provide a safe service, including planning and preparing treatments, maintaining equipment and software. Staff with the appropriate level of experience must be available to discuss and resolve problems relating to equipment, technical or clinical issues

safely and efficiently during the hours of clinical service. Staffing levels must also allow for maintenance, quality assurance, upgrades and developments to be undertaken outside the hours of the clinical service. Achieving this, as the radiotherapy department increases its working hours, may be more challenging for these smaller professional groups, especially in departments with fewer Linacs.

3.1.3 Medical workforce

It is essential to have appropriate support from medical staff for radiotherapy being delivered outside normal working hours. The introduction of acute oncology services has been largely absorbed by medical staff in oncology departments without any extra resources and this has left many clinical oncology services with no capacity to take on extra work within the current workforce. It is equally essential that, when considering the groups of patients who will be treated outside normal working hours, there is a robust and appropriate level of medical support available for patients. The extent of support required will also depend on which elements of the radiotherapy service are being delivered outside normal working hours. If radiotherapy planning (simulation) and first fractions/treatments are being undertaken outside normal working hours, a higher level of tumour site specialist support will be required than if the service is confined to subsequent radiotherapy fractions.

3.1.4 Nursing and other staff required to support the service

Nursing support has become an essential part of the radiotherapy service. Additional support that may be needed from nursing staff should be included in plans to extend radiotherapy working hours.

The availability of other services and staff that must be considered when extending working hours beyond the normal working day and deciding which groups of patients are suitable to attend include:

- Allied health professionals, including speech therapists, dietitians and physiotherapists
- Pharmacy services
- Departmental administrators and radiographer helpers
- Ancillary and catering provision
- Patient transport services.

The financial implications of providing an appropriate workforce for increased working hours will be critical in determining how the service can be run cost-effectively.

Nationally, sufficient training places will need to be identified to ensure adequate staff numbers to deliver an extended hours clinical service.

The importance of continuity and communication within the workforce is paramount in delivering successful change.

3.2 Maintenance of radiotherapy equipment

To achieve a safe, operational radiotherapy service at all times, the infrastructure requires input from scientific and technical staff with support from equipment manufacturers.

3.2.1 Planned maintenance and Quality Assurance

A survey of UK radiotherapy centres undertaken in January 2014, indicated that the average (mean) number of linear accelerators in each radiotherapy centre was 5.1 and that

the average number of hours spent in each department undertaking activities on the department's linear accelerators outside direct patient treatment delivery (eg QA, maintenance) per department is approximately 3000 hours per annum. The number of hours required for these activities will vary from department to department because the time required for QA and maintenance on a specific linear accelerator is dependent on the clinical use of the machine. Factors influencing this include the complexity of the machine, the number of radiation beam energies available, imaging on-treatment (verification) devices in use on the machine, frequency of individual tests and the QA equipment used. It is therefore not appropriate to be more specific about the time required for maintenance and QA.

Time for non-clinical but essential activity, including linear accelerator maintenance and QA must be scheduled into any operational model to extend radiotherapy treatment hours to ensure a safe, reliable, sustainable and modern clinical service. More detailed consideration of all the factors can be found in the IPEM position statement.[11] In summary, when planning to increase the hours of treatment delivery, consideration should be given to:

- Provision of sufficient equipment to allow infrastructure maintenance, QA and service development.
- Ensuring time is scheduled for validation of radiation outputs on a daily, weekly and monthly basis to maintain a safe service. It is also essential that time is available for regular inter comparisons to the National Physical Laboratory, dosimetry audits, reference audits (usually organised by IPEM) and quality assurance audits for clinical trials.
- Whether a service efficiency linear accelerator and/or a spare linear accelerator (decant) bunker can be justified to maintain the clinical service as outlined in the NRAG report.[7] This will depend on the total time required for linear accelerator maintenance, quality assurance, installation and commissioning of replacement linear accelerators, and other activities essential to maintain a safe and modern radiotherapy service.
- Whether specific treatment techniques can be limited to a small number of linear accelerators thus reducing the extent of QA required on specific Linear Accelerators.
- How patients' QA for specific complex treatments can be scheduled in patient pathways to ensure no delays in the start of treatment.[11]

3.2.2 Linear Accelerator breakdowns/unexpected interruption to service

Resilience within a radiotherapy service requires sufficient capacity and resources to avoid delays or cancellations of patients' treatment due to equipment/software malfunction or failure. While a service efficiency machine would enhance such resilience, it is acknowledged that this may not be possible. Any plan to increase the treatment delivery hours in a radiotherapy department should be risk-assessed to ensure that all of the relevant staff are available during treatment hours to deal with unexpected problems. Radiotherapy should be delivered within defined protocols containing adequate contingency planning, to ensure there is no compromise to patient care or the outcome of treatment in the event of equipment failure or of a patient developing clinical problems.

3.2.3 Equipment manufacturers

The availability of parts and equipment support from manufacturers outside normal working hours needs to be considered when developing plans to extend linear accelerator working hours. Manufacturers currently only provide support and undertake maintenance within the working week, except when special arrangements are made with individual Trusts. If

opening hours extend beyond this, manufacturers currently do not have the resources in place to support this. Providing such a service would require a major commitment from the manufacturers. They would need to train additional staff to extend service hours. For manufacturers to undertake this, assurance on the future of extended opening hours would be required from the national radiotherapy community.

It has been reported that a lead-in time of approximately two to three years would be needed for manufacturers to recruit and train the necessary personnel.[11] An increase in the cost of maintenance in the order of 70% could be anticipated to deliver a seven day service. Service Leads would need to ensure that there were sufficient trained engineers/Information Technology (IT) support staff within their Trust's workforce to work with the manufacturers to minimise down time after an equipment failure.[11]

3.2.4 Replacements and upgrades

A modern high quality radiotherapy service is dependent on equipment and software being regularly upgraded. Upgrades to hardware and software require time for the upgrade itself, for quality assurance and for staff training following the upgrade to ensure continued delivery of safe radiotherapy. An extensive upgrade (eg for a Record and Verify system) will therefore require a period of non-clinical time to ensure that a safe upgrade is completed.

3.2.5 Service and technical development

Optimum standards of radiotherapy are delivered when service development is an integral element of professionals working within the radiotherapy service. Clinical trials and research and development work are all essential to maintain a high quality radiotherapy service in order to continuously improve radiotherapy treatment and improve outcomes for patients. Increasing opening hours in radiotherapy departments must not compromise access to equipment for these crucial activities. Traditionally a large part of this work has been carried out by medical physics staff outside normal working hours. This will now need to be factored into the working hours of any extended service.

3.2.6 Hospital maintenance

Estates departments require access to treatment rooms and associated plant rooms in order to carry out maintenance work. IT departments also have maintenance requirements for the IT infrastructure. This cannot be carried out while patients are being treated. When extending the hours of radiotherapy delivery, this essential work must be scheduled appropriately into the linear accelerator's schedule.

4 Is it cost-effective to increase working hours?

Identifying and comparing the costs of different service models is critical to ensure that a safe and sustainable service is delivered in the most cost-effective way. Apart from the key issues of workforce availability and equipment maintenance/replacement costs, other considerations may include:

- any contractual costs associated with increasing departmental opening times, eg. in Public Finance Initiative builds,
- the cost of maintaining the same quality of service for the patient group being treated, eg. pharmacy, hotel services, transport etc,
- cost implications of staff working unsocial hours,
- potential impact of increased use on the lifespan of equipment parts, eg. treatment machines/parts and supporting/ancillary equipment,
- whether radiotherapy on call would become part of the service during weekends and offset costs.

5 Scope of service to be offered during increased working hours

Probably the first decision to be made when developing a model to increase a radiotherapy department's working hours is to determine what work will be undertaken outside the 'normal working day'. The three main options are:

- Some External Beam Radiotherapy treatment only
- Some External Beam Radiotherapy treatment and limited radiotherapy planning
- All External Beam treatments and all aspects of radiotherapy planning

In addition, the following core principles need to be adhered to for all the above:

- Patients must be willing to attend during proposed clinical hours
- Increasing the treatment hours on a machine will reduce flexibility to deal with unexpected events, therefore sufficient flexibility for contingency must also be factored in
- There must be appropriate support (clinical and technical) available throughout the department's working hours
- The availability of out-of-hours manufacturer support should be factored in when assessing the risks.

Some of the pros and cons of these options are highlighted in Table 2:

Table 2. Pros and cons of services offered during increased working hours

	Pros	Cons
External Beam Radiotherapy treatment only	Least complex option though not all machines should be used for extended hours in order to mitigate risk Most inexpensive model because less technical and medical physics staff required Staffing and skills required are easier to predict	Less time for QA/development work Need confidence that linear accelerators and software are reliable Contingency policies must be in place for clinical and technical issues that may arise Infrastructure support likely to be reduced which may affect continuity of service if there is a machine or IT breakdown Need to ensure that the pre- treatment capacity matches the treatment capacity available on the linear accelerators Need to ensure sufficient staff of correct skill mix are available at all times
External Beam Radiotherapy treatment and limited radiotherapy planning	Helps the pre-treatment process keep pace with Linear Accelerator capacity Could provide additional capacity for specialised procedures, eg scanning with contrast	The need to use staff with specialist skills outside normal working hours must not be at the expense of the availability of such skills during normal working hours Specialised procedures could need additional medical support Need to ensure that capacity in treatment planning requiring clinicians, dosimetrists and clinical scientists matches the capacity in treatment. Probably the most challenging scenario to ensure appropriate staffing and skill mix available at required times within the department
External Beam treatment and all aspects of radiotherapy planning	If fully staffed, • will ensure that all aspects of radiotherapy service and technical support are available during the department's working hours • will enable all elements of the service to match the Linear Accelerator's capacity • could provide more choice for patients	Requires the full range of staff and skills to be available Would require provision of additional experienced staff in all disciplines Most impact on all staff groups Most costly option Would require the provision of transport, pharmacy, dietetics etc in addition to the core staff

6 Checklist for producing a model of extended hours working

What clinical service is required?

- What capacity is required?
- Will local patients be willing to attend?
- Which patients will be treated?
- Is there sufficient capacity in radiotherapy planning and preparation to support the increased treatment capacity?

What is the proposed model of extended hours working?

- Extending the working day, eg working Monday-Friday 8am – 9pm
- Six day working - Monday to Saturday inclusive
- Seven day working - Monday to Sunday inclusive

Which elements of the service should be delivered?

- External Beam Radiotherapy treatment only
- External Beam Radiotherapy treatment and limited radiotherapy planning
- External Beam treatment and all aspects of radiotherapy planning.

What resources are required to deliver the service?

- What staff groups, grade and experience (skill mix) are required to complement existing staff?
- How many extra staff will be required?
- How is it proposed to schedule QA/maintenance and development work?
- Is technical and scientific support required for breakdown / planned maintenance?
- What manufacturer response time is required outside normal hours?
- Is in-vivo dosimetry required?
- When would individual patient QA be scheduled?
- Are Mould Room services required?
- What other support services (eg administration, ancillary, transport, pharmacy) are required?

Is the proposed service level safe?

- Can the required level of service be maintained?
- What are the risks posed by equipment breakdown?
- How can continuity of treatment be guaranteed?
- Does the proposed model allow sufficient contingency arrangements to ensure that there is no detriment to patients in the event of a breakdown, particularly if patients need continuous fraction delivery?
- Does the proposed model have an associated financial risk?
- Is there a potential risk to the recruitment, retention, training and morale of staff?

Monitoring

- Define the parameters for monitoring, safety, patients' experience, capacity and cost effectiveness of service.
- How will the defined monitoring be achieved?

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