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## Original Article

# A critical appraisal of the implementation of a 'gap' policy: five years experience in a department with one linear accelerator

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## Abstract

In 1995, a meeting was arranged by the Radiation Oncology Committee of the British Institute of Radiology and the Royal College of Radiologists to look at the evidence of the impact of unscheduled gaps in radiotherapy on local tumour control, and to try to address some of the concerns that this raised. Following the meeting, guidelines were drawn up by a sub-committee of the Royal College of Radiologists to advise departments how to manage unscheduled interruptions or prolongation of radical courses of radiotherapy. One of their recommendations was that there should be regular audit of the outcome of the measures taken to avoid gaps in treatment. This paper presents how the guidelines were addressed in a department with one linac, together with the results of a 5-year audit.

**Keywords**

Gap policy; unscheduled gaps in radiotherapy

## INTRODUCTION

In the early 1990s, the Royal College of Radiologists (RCR) became aware of evidence being published which showed that local tumour control rates and cure rates were being adversely affected by unscheduled gaps in radiotherapy, extending the overall length of treatment time. These concerns were first raised when the results of some of the unconventional treatment schedules, which were introduced in an effort to improve cure rates, became available. In particular, the work of Sambrooke,[1] in the 1960s, proposed a schedule that modified normal fractionated treatment by introducing a planned 'split' in the course. The gap between the two parts of the treatment was two weeks, with a view to being able to increase the tumour dose by reducing acute reactions. However, the adverse effect of this was particularly well demonstrated by Overgaard et al.[2] (with analysis of the results showing a 15% reduction in local control rate for every 7-day gap), Barton et al.,[3] and Skladowski et al.[4] The patients particularly affected were those with squamous cell lesions of the head and neck region.

In October 1995, a meeting was organised at the British Institute of Radiology (BIR)[5] by the Radiation Oncology Committee of the BIR and the RCR. The reason for the meeting was to look at the evidence of the impact of unscheduled gaps in radiotherapy on local tumour control, and to try to address some of the concerns that this raised. At the meeting, a paper by Duncan et al.[6] showed an increase in local relapse rates and deaths from laryngeal cancer when there were interruptions to treatment. It was suggested that the reason for this was due to tumour re-population in the extended intervals between treatments.

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Following the meeting, guidelines were drawn up by the RCR[7] to advise departments how to manage unscheduled interruptions or prolongation of radical courses of radiotherapy.

## METHOD

Historically, radical radiotherapy has been delivered five days a week, with no treatment on Saturday or Sunday. This means that, for instance, a course of 20 treatments will take 28 elapsed days to deliver (unless the course starts on a Monday, when it will be completed in 26 days). The weekends are considered scheduled interruptions. If a treatment course encompasses a bank holiday or a planned machine service, then these are planned, but unscheduled interruptions. Unplanned interruptions may arise from circumstances within the department that may affect all patients, or ones that only affect individual patients. So a machine breakdown will affect all the patients being treated on that machine, but a failure of ambulance transport may only affect one patient. There are also clinical circumstances that may lead to an unplanned break.

Following the BIR meeting, it was agreed by the clinical oncologists and the radiographers that a policy for avoiding gaps should be drawn up, although the College guidelines had not been produced at that time. It was acknowledged that there would be special difficulties arising because the department had only one linear accelerator. The department was fortunate that it did not have a waiting list. There was also no on-call rota for weekend working, because this was required so rarely, and no routine shift working.

The first step in formulating a policy was for the clinicians to identify those patients that would be adversely affected by an increase in their overall treatment time. The published evidence showed that those groups most affected were patients with squamous cell lesions of the head and neck, cervix, vagina and skin, and transitional cell lesions of the bladder. (Subsequently, the College guidelines[7] also identified squamous cell lesions of the lung and medulloblastoma). It was agreed that the clinicians would 'categorise' all patients. Because the department already used numbers to indicate the priority for treatment, letters were used.

- Category A: patients who should not have prolongation of their treatment course;
- Category B: all other patients having radical treatment;
- Category C: patients being treated for palliation.

It was important to appreciate that priority and category were different – thus a patient needing palliative radiotherapy for spinal cord compression would be category C but priority 1.

Following this, consideration was given to the reasons for gaps arising and the methods that could be used to ensure that the treatment was delivered in the prescribed time. Planned interruptions arose from public holidays and routine servicing of the machine. In addition to public holidays, one day a month was lost for machine servicing. This meant that in any one year there were a possible 22 days that could prolong a course of treatment. The first cause that was considered was that of machine servicing. Once every 3 months, the service was from Tuesday lunchtime to Thursday lunchtime and the machine was unavailable for treatment on the Wednesday. However, in other months when the service was just one day, it was agreed with the physics department that the machine would be clinically available for the first hour of the day. This left a total of 14 days for which compensation might have to be made.

The daily dose prescribed for the patients was the next consideration. The clinicians felt it was only appropriate for patients receiving less than 2.50 Gy each fraction to be treated twice in a day, with a gap of at least eight hours. This was the daily dose prescribed for patients with bladder cancer, but most patients who fell into 'Cat. A' were receiving 2.50 Gy or more. For these patients the only option that remained was to treat them on a Saturday or a bank holiday.

An operational policy was drawn up by the Superintendent Radiographer, following consultations with the clinicians, and referring to the draft guidelines of RCR[8] and a notes from the presentation by Porter[9] at the BIR meeting in 1995 which outlined technical considerations. The first step was to decide to start all 'Cat. A' patients on a Monday whenever possible. This had the consequence of committing them to having a treatment



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period of two days shorter than the convention; e.g. a 20-fraction treatment would be delivered in 26 days, rather than 28. However, it also gave them dedicated starting appointment slots as the Monday start slots were kept for them.

For a Monday Bank Holiday, patients already on treatment were treated on the previous Saturday; for a Friday, they were treated on the day; for any other weekday, they were treated either on the previous Saturday or on the day. The preceding Saturday rather than the following one was preferred, because this avoided the patients having a three day break in treatment. When a patient started treatment on a Monday, and there was a break in the week, such as a three monthly service, then the subsequent Saturday was used. Because there were fewer patients having daily fractions of less than 2.50 Gy and the machine had an exceptionally high work load, these patients were also treated on the Saturdays and Bank Holidays. For the single day services, Physics agreed that the machine could be available for clinical use for one hour, before the service commenced.

Once this policy[10] had been established, it was applied to unplanned interruptions also. Special consideration was given to the problem of machine breakdown. Although the same guidelines could be applied, there was always the possibility that there could be an event that meant the machine was out of action for several days. It was therefore agreed that under those circumstances, 'Cat. A' patients would be transferred to the larger department of the Cancer Centre which had several linacs available for treatment. This has happened once during the audit period.

A particular difficulty arose when patients used the hospital transport service to reach the department. The transport services were unable to provide Saturday and Bank Holiday cover, so these patients were encouraged to seek alternative means of travel. Usually, because friends and relatives were not working, it was rarely a problem.

The guidelines were submitted to the oncologists, radiographers and physicists for approval, and implemented in November 1995 (just in time for a 3-month service and Christmas/New Year!). A spreadsheet was designed so that the success or otherwise of the policy could be audited. When the guidelines of the RCR were published, comparison was made to ensure all aspects had been addressed in the local policy.

The principles and reasons for the policy were discussed with the radiographers, to ensure that they understood the importance of the issues. It was agreed that any radiographer who worked could choose between having a day off, or payment at emergency call rates. The staffing levels were usually a superintendent and a senior radiographer, unless more than eight patients were for treatment, when a third radiographer of any grade would be added to the team. Physics cover was not provided, but there was an understanding that they could be notified of any problems that occurred. In addition, there was no cover from the oncologists, although there were always medical staff on the ward, and an oncologist was on call from the larger department.

## RESULTS

The initial seventeen month period, from November 1995 to March 1997 and the following four years to March 2001 were available for analysis. A record was kept of the diseases treated as 'Cat. A', the number of elapsed treatment days as well as prescribed days, the number of patients treated to schedule, the measures needed to achieve this, and the reasons for failure to meeting the schedule. Table 1 shows these results, and it should be noted that some patients required more than one measure to be taken to achieve their treatment in the prescribed time. Table 1 highlights several things. The most important is that only 5 patients exceeded their prescribed treatment time for reasons other than clinical – 1.9% of the total. Of these patients, 2 suffered failure of hospital transport, 2 would not attend consistently and the fourth was not treated on a service day. Of the 13 who exceeded their prescribed treatment time for clinical reasons, they were all rested for 1 week because of acute reactions. None of these patients were receiving concurrent chemotherapy, which frequently exacerbates radiation reactions, and there was a mixture of diagnoses and doses. Another aspect, which can be seen from Table 1, is that the total number of patients treated as 'Cat. A' had fallen from a high of 79 in April 1997/March



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1998, to a low of 27 in April 1999/March 2000. This was particularly noticeable in the numbers for bladder cancer (26 in November 1995/March 1997 to 0 in April 2000/March 2001). Very few patients were treated twice in one day (10 occasions in Nov 1995/March 1997 and 2 in April 1998/March 1999). This change in numbers can also be seen in the proportion of daily fractions that were 'Cat. A', falling from nearly 17% in 1997/98, to 6% in 2000/01.[11]

## DISCUSSION

The guidelines of the RCR identified five major causes for unscheduled gaps in treatment. The first of these was machine availability, which was affected by servicing and breakdowns of the machines. It was recommended that all centres providing radical radiotherapy should have at least two fully staffed and operational linear accelerators. Despite having only one machine, no patient's schedule was interrupted by either servicing or breakdown. Because 'Cat. A' patients were always scheduled in a morning, any breakdown that occurred was always repaired in time to treat the patient by the afternoon, (except for one patient who was transferred to the larger centre because there was a breakdown on the morning of his last treatment and uncertainty when the machine would be available). On the few occasions a breakdown happened, the patients were offered hospitality until the repair had been completed. (However, this also highlights the very high reliability of the machine in use and the skill of the maintenance engineers). The engineers also assisted in delivering treatments to schedule by making the machine available on the single day service.

The second cause was due to public and statutory holidays. The decision to treat on the Saturday preceding the holiday provided a better pattern of treatment, so that under most circumstances breaks continued to be of 2 days, although the treatment week varied between 4 and 6 days. This was considered to be preferable to having a break of three days and then one day. When there were two days holiday, and no obvious best choice of days to treat, the patients involved were asked for their preference. This occurred over the holidays in December 1999/January 2000, when the patients decided that they would prefer to keep to a Monday–Friday schedule.

The third cause was the problems caused when patients need hospital transport. In practice,

*Table 1. Record of treatment of Category A patients.*

| Diagnosis | Nov 95 – March 97 | April 97 – March 98 | April 98 – March 99 | April 99 – March 00 | April 00 – March 01 | Totals |
|---|---|---|---|---|---|---|
| Ca Anus | 2 | 3 | 3 | 0 | 0 | 8 |
| Ca Bladder | 26 | 20 | 13 | 4 | 0 | 63 |
| Ca Bronchus | 5 | 10 | 3 | 9 | 2 | 29 |
| Ca Cervix | 3 | 7 | 3 | 3 | 3 | 19 |
| Ca Head & Neck | 31 | 21 | 24 | 10 | 28 | 114 |
| Ca Oesophagus | 7 | 14 | 2 | 1 | 3 | 27 |
| Ca Penis | 0 | 1 | 0 | 0 | 0 | 1 |
| Squamous lesions of Skin | 0 | 1 | 1 | 0 | 1 | 3 |
| Ca Vagina | 2 | 2 | 1 | 0 | 0 | 5 |
| **Total** | **76** | **79** | **50** | **27** | **37** | **269** |
| Treated to schedule | 68 | 76 | 47 | 24 | 36 | 251 |
| Treated twice daily | 10 | 0 | 2 | 0 | 0 | 12 |
| Treated on bank holiday | 40 | 13 | 13 | 12 | 2 | 80 |
| Treated Sat for service or B/H | 23 | 58 | 46 | 9 | 10 | 146 |
| Treated on service | 8 | 42 | 14 | 18 | 32 | 114 |
| Treated 2 days under | 16 | 56 | 43 | 22 | 28 | 165 |
| No special treatment | 2 | 5 | 1 | 0 | 3 | 11 |
| Number not to schedule | 8 | 3 | 3 | 3 | 1 | 18 |
| Range in days | 1–13 | 2–7 | 1–7 | 0 | 2 | 1–13 |
| Clinical | 7 | 2 | 1 | 3 | 0 | 13 |
| Other | 1 | 1 | 2 | 0 | 1 | 5 |



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despite not having an agreement with the transport service that our patients will be transported on a Saturday or public holiday, this has rarely been a problem – only 2 patients out of 269 had their treatment schedule prolonged because of a lack of transport.

Far more instances of prolongation of the patients' treatment schedule were due to clinical reasons; 13 patients experienced this, with rest periods of at least a week, and in one patient, nearly two weeks. These breaks occurred as a result of severe reactions, as discussed earlier. All patients received proactive support, and encouragement to comply with advice given to minimise potential reactions, but some still required a break in treatment.

The final cause was identified as arising from social circumstances. All our patients were made aware of the importance of daily attendance, and only two failed to attend when asked to.

When the compensatory options available were considered, the preferred one of transfer to another machine was obviously not available. Although treating twice in one day, with a minimum gap of six hours, was recommended, this was also an option that was rarely used, for two reasons. Firstly, the only treatment machine was always overbooked, so increasing the number of daily attendances was not favoured by the radiographers, and the patients were not very keen to attend twice either. Secondly, the clinicians did not want patients receiving daily fractions of 2.50 Gy and over to be treated twice. This meant that the radiographers were committed to Saturday and public holiday working, and they felt it was more acceptable to treat all the 'Cat. A' patients then. Because of the success of the policy, there has never been a requirement to consider any of the less favoured options relating to dose adjustment.

The RCR guidelines made nine recommendations with regard to implementation of the policy. Of these, as already discussed, it was not possible to comply with first one, to have two machines. Also there was no funding to provide the additional service, and research has not been undertaken into the impact of prolongation of treatment times. All other recommendations were complied with, and the recent introduction of a second linear accelerator has allowed the first recommendation to become an option for the department.

The introduction of the policy had some incidental benefits. Firstly, in the event of a machine breakdown, it was quite easy to decide which patients could be cancelled if necessary. After the 'Cat. A' patients, priority was given to those radical patients due to finish on that day, or those whom adding an extra day would take them over a further weekend. Any potential excessive gaps and scheduled breaks were brought to the attention of the oncologists. This gave them the opportunity to delay treatment, for instance until after the holiday, if they felt it to be clinically appropriate. However, this does highlight the fact that there was no attempt to ensure that all radical patients other than 'Cat. A' were treated within the prescribed time, although the number of treatment days in excess was recorded. This showed that in the period of the audit, November 1995/March 2001 of the 1718 patients treated as 'Cat. B', only 257 (15%) were treated to schedule, with a range of days excess between 1–22 (Table 2).

The clinicians were also consulted about the palliative patients on treatment, in case there was any clinical priority that was not immediately obvious.

A further result of the policy was that Saturday morning working became very acceptable to the radiographers, and when the machine was exceptionally busy, they would often choose to work a Saturday morning session to treat palliative patients who had been prescribed single fractions. This did not necessarily coincide with working because of the 'gap' policy, and the patients had to be carefully selected because of the lack of medical cover.

Discussion with the clinical oncologists, regarding the fall in numbers of 'Cat. A' patients, suggested that this could be due to a greater than usual number of head and neck patients being unsuitable for radical treatment, and more patients with bladder cancer having radical surgery. The implementation of the policy was also discussed, and it was felt that it had been shown to be successful.

*Table 2. Record of Treatment of Category B Patients*

| Year | Nov 95 – March 97 | April 97 – March 98 | April 98 – March 99 | April 99 – March 00 | April 00 – March 01 | Totals |
|---|---|---|---|---|---|---|
| Number of 'Cat. B' patients | 344 | 261 | 326 | 399 | 388 | 1718 |
| Number treated to schedule | 33 | 23 | 44 | 76 | 81 | 257 |
| Range of excess days | 1–11 | 1–8 | 1–22 | 1–13 | 1–13 | 1–22 |
| No. affected by Service B/H | 298 | 233 | 274 | 316 | 301 | 1422 |
| Clinical cause | 13 | 5 | 8 | 7 | 6 | 39 |

The department now has a second linear accelerator in clinical use, so this should mean that the second machine can cover gaps arising from servicing and breakdown. This should improve the elapsed time for 'Cat. B' patients. Already there has been an improvement from 10% treated to schedule in the period November 1995 – March 1997, to 20% in the period April 2000 – March 2001. The 'gap' policy will continue to be used for 'Cat. A' patients to eliminate unscheduled gaps arising from public holidays.

## CONCLUSION

The 'gap' policy has been in use in the department for five years and has been very successful in ensuring that there is no unavoidable prolongation of the treatment times for 'Cat. A' patients. It is hoped that the introduction of the second linear accelerator will allow an improvement to be made for all radical patients.

## References


1. Sambrooke D. Clinical trial of a modified (split course) technique of X-ray therapy in malignant tumours. Clin Radiol 1968; 36: 369–372.
2. Overgaard J, Hjelm-Hansen M, Vendelbo Johansen L, Andersen AP. Comparison of conventional and split-course radiotherapy as primary treatment in carcinoma of the larynx. Acta Oncologica 1988; 27: 147–152.
3. Barton M, Keane TJ, Gadalla T, Maki E. The effect of treatment time and treatment interruption on tumour control following radical radiotherapy of laryngeal cancer. Radiotherapy and Oncology 1992; 23: 137–143.
4. Skladowski K, Law M, Maciejewski B, Steel G. Planned and unplanned gaps in radiotherapy: the importance of gap position and gap duration. Radiotherapy and Oncology 1994; 30: 109–120.
5. British Institute of Radiology meeting "Implications of Interrupted Treatment on Outcome of Radical Radiotherapy" (programme), 20 October 1995.
6. Duncan W, MacDougall RH, Kerr GR, Downing D. Adverse effect of treatment gaps in the outcome of radiotherapy for laryngeal cancer. Radiotherapy and Oncology 1996; 41: 203–207.
7. Royal College of Radiologists, Board of Faculty of Clinical Oncology: Guidelines for the Management of the Unscheduled Interruption or Prolongation of a Radical Course of Radiotherapy (BFCO(96)4): 1996.
8. Draft of Royal College of Radiologists, Subcommittee: Guidelines for Management and Prevention of Undue Prolongation of Radical Radiotherapy Treatments.
9. Porter H. Management of Interruptions to Radiotherapy Treatments: Technical Considerations. BIR meeting, 20 October 1995.
10. Radiotherapy Department, Royal United Hospital NHS Trust; Guidelines for Minimising Extension to Treatment Durations. Policy document, 1995.
11. Radiotherapy Department, Royal United Hospital NHS Trust; Machine statistics, 1997–2001.




https://doi.org/10.1017/S1460396902000067 Published online by Cambridge University Press