

IPEM position statement on NHS England's 9000 attendances per linac benchmark

Executive Summary

This position statement sets out the Institute's concerns regarding the NHS England Service Specification for Adult External Beam Radiotherapy Services requiring an average of 9,000 attendances per linear accelerator (linac) within all radiotherapy departments, and an increase of this figure by 15% over three years. The data shown in this report demonstrates that the benchmark is effectively unachievable.

The introduction of advanced techniques such as image-guided radiotherapy (IGRT) and intensity-modulated radiotherapy (IMRT) over the period of this analysis (2009-2022) have hardly reduced the average utilization of linacs in England and Wales. During the outbreak of COVID-19 from April 2020, results from the FAST-Forward clinical trial of a reduction in breast fractionation from 15 to 5 fractions were swiftly acted on by UK radiotherapy centres. Since fewer attendances were required from the same number of linacs, this reduced the value of attendances per linac very significantly.

Based on the information highlighted above and the data presented throughout this statement, IPEM believes that the 9,000 attendances benchmark is unachievable. Further recommendations are made about a consistent definition of the figure if it is to continue to be used. High values of utilization should engender at least as much scrutiny as low values.

Introduction

This position statement has been produced by IPEM's Radiotherapy Professional Standards Panel (RTPSP), in response to concerns raised by the Radiotherapy Physics profession regarding achieving the 9,000 attendances benchmark released by NHS England in 2019. This document discusses the recent targets and benchmarks which have been set in the context of an analysis of data available from the Radiotherapy Dataset, for England and Wales.

The history of targets for linac throughput

The 2007 NRAG Report [Ref. 1] set recommended targets of 8,000 fractions per linac per year averaged across each department, with further targets of 8,300 by 2010/11 and 8,700 by 2016.

Changing the metric from fractions to attendances meant that the 2012 review of the NRAG recommendations [Ref. 2], modified these targets, but then set a new 'indicator' of 7,300 attendances, and recognised explicitly that measuring linac throughput in isolation could provide incentives which compromised quality improvements: "this metric should be used only as an indicator of capacity". There was a strong sense that the indicator of linac throughput should only be optimized in conjunction with other measurements of productivity.

The NHS England Service Specification for Adult External Beam Radiotherapy Services [Ref. 3] has, since 2019, included a "benchmark" of 9,000 attendances per linac averaged per department.

The consultation feedback to the new service specification published in January 2019 [Ref. 4] expressed the aim of NHS England to "Reduce variation in equipment utilisation in England through changing operating arrangements, clinical practice and equipment replacement; an average 15% increase in equipment utilisation for England as a whole is expected over the next three-year period aligned to the equipment modernisation programme".

The final service specification suggested that this be achieved by

- Each machine being available to treat people at least 5 days per week;
- That servicing and planned preventative maintenance, quality assurance checks and other key activities (including capacity to accommodate machine breakdowns) do not disrupt Service User's treatments and should be undertaken on any of the other days of the week; and
- Ensure there are contingency plans and arrangements for the management of Service Users during periods of staff shortage and machine maintenance and breakdown should be in place [sic] and form part of the Network workforce sustainability strategy.

Attendances per linac in practice

The Radiotherapy Dataset has been used to extract monthly activity data for all English NHS radiotherapy centres from April 2009 up to September 2022. Data for Welsh centres has been

included as more Welsh data was gradually submitted to the RTDS.¹ Data between April and September 2022 was used to generate extrapolated figures for 2022/2023 on a *pro-rata* basis.

A linac's data was included if it had any recorded activity, month by month, so that a linac in operation for just three months of a year will be counted as a quarter of a linac for the annual calculation.

The values of attendances per linac are somewhat different to the values published (as the RAD20 metric) by NHS England for the years when this was available and most of the difference is due to the use of a nominal number of linacs in the denominator for the NHSE figures.

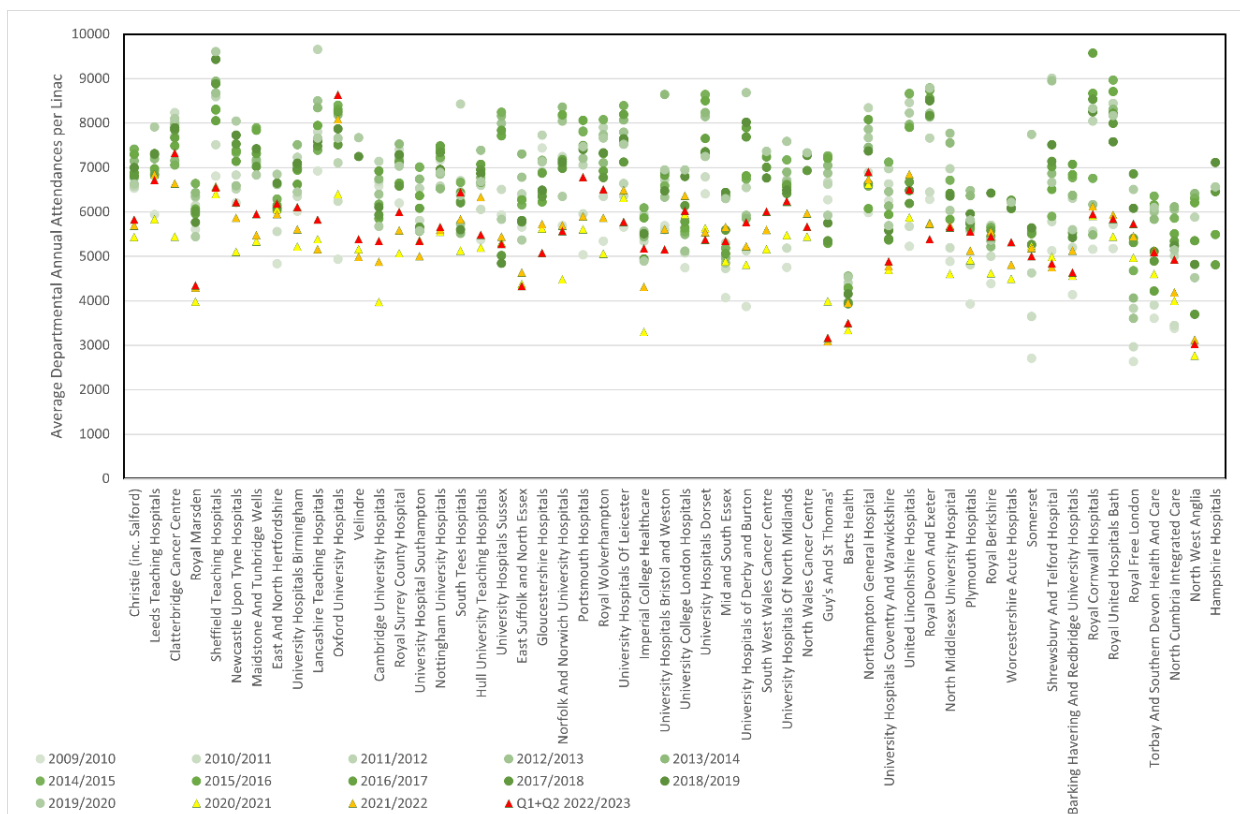


Figure 1 Average Departmental Attendances per Linac for English and Welsh Radiotherapy Centres 2009-2023

¹ Data from Salford Royal has been included with that of the Christie. Data from Guys and St Thomas's has been excluded from the statistical calculations as it is known that there is missing data for the recent submissions from this Trust. Data from the first year of operation of new centres in Worcester and Basingstoke (2014/2015) have also been excluded. Data for Gamma Knives and MRI linacs are excluded from the raw data, but Cyberknife data is included.

Figure 1 shows how the value of ‘attendances per linac’ has varied for each individual centre, with the darker data points showing the most recent data. The data is ordered, from left to right, by the decreasing size of the centre (based on the most recent value of total attendances). Triangles represent the three years since COVID.

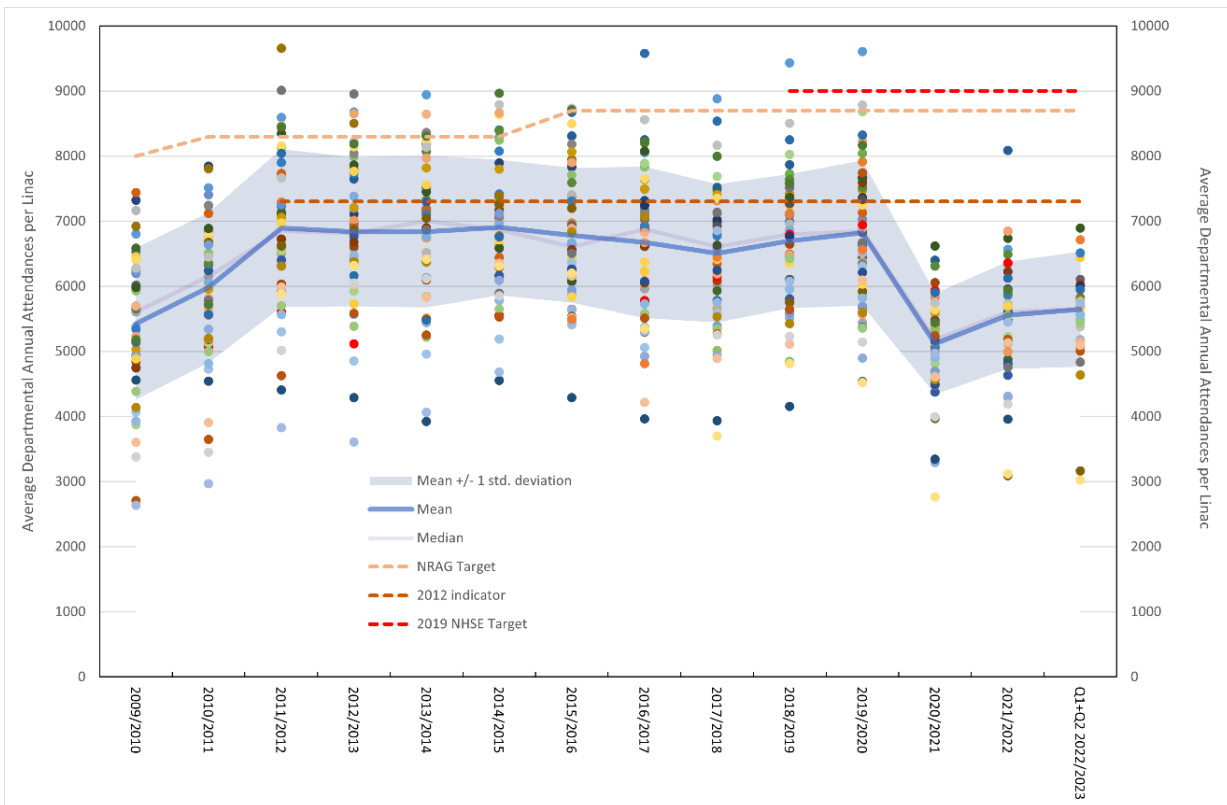


Figure 2 Average Departmental Attendances per Linac for English and Welsh Radiotherapy Centres 2009-2023 - changes over time and national targets. The shaded region shows values within one standard deviation of the mean for the year.

Figure 2 shows the data of individual centres as a coloured dot, with the inclusion of mean and median figures, and the national targets and indicators mentioned above are also shown.

The oldest data seems to show a significant increase in attendances per linac between 2009 and 2012, but thereafter a slight trend towards lower attendances per linac up till April 2020.

Figure 3 shows the total of the departmental average number of linacs in use. Welsh data is shown separately, as this data was not complete until recently.

Discussion

Figure 3 demonstrates a large drop in 2011 of about 35 linacs, which goes a long way to explaining the increase in attendances per linac seen between 2009 and 2012. This would roughly have coincided with ten years having

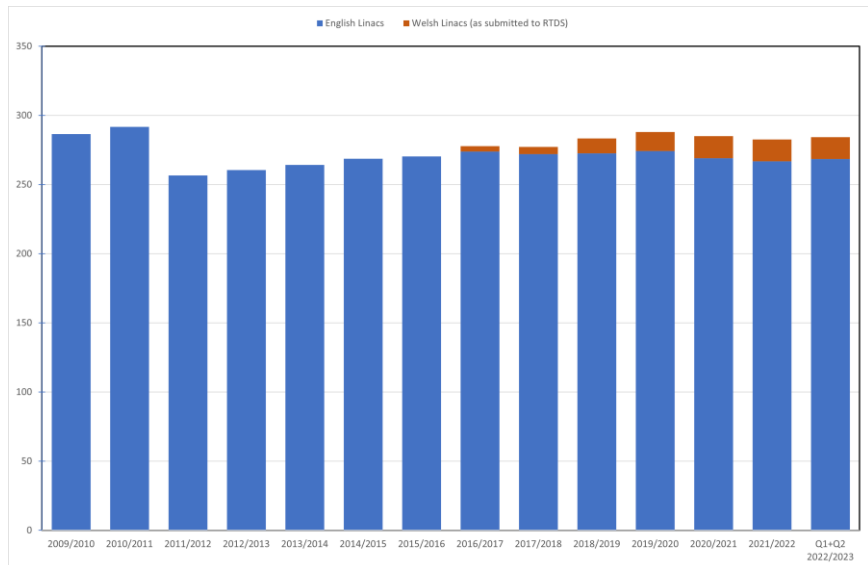


Figure 3 Total number of linacs in use between 2009 and 2022

passed since the “New Opportunities Fund” (NOF) which paid for 56 new linacs from the national lottery in around 1999, and one explanation would be that some of the extra linacs provided by NOF were not replaced.

Given that, between 2009 and 2020, RTDS shows a 16-fold increase in the number of attendances delivered using cone-beam CT, it would be surprising if the extra quality and safety provided by image-guidance could be delivered while *increasing* productivity in terms of attendances per linac. Intensity Modulated Radiotherapy was also introduced over this same decade, to a position in 2020 where most radiotherapy centres were delivering IMRT to 40% of patients (by the RTDS definition).

It is remarkable that the introduction of IMRT and IGRT does not appear to have reduced linac capacity over the decade during which these advanced techniques became routine.

The NRAG target for attendances per linac was barely achieved by any centres, perhaps partly because the impacts of IMRT and IGRT were not foreseen back in 2007. The 7,300 ‘indicator’ set by the 2012 review appears to have been an achievable bar for a proportion of radiotherapy centres at that time, but most centres never reached that level.

The 9,000 fractions per linac benchmark set in 2019 was only ever reached by a single centre, and as highlighted in the IPEM Position Statement from 2020 [Ref. 5], that centre was unable to introduce important techniques such as DIBH in the 10-minute slots which were the default appointment time at that time: “meeting the national benchmark of 9,000 attendances per year to improve equipment utilisation rates can be unrealistic when aiming to deliver advanced radiotherapy using the latest evidence based protocols”. That centre now has an extra linac.

When the COVID pandemic hit the UK In April 2020, and the findings of the FAST-forward trial encouraged the rapid shift to 5 fractions as the standard fractionation for breast cancer patients (such patients representing roughly a quarter of all radiotherapy patients) the total number of attendances also plummeted by a quarter.

The drop in attendances per linac seen in 2020/2021 has the following causes:

- The combination of the FAST-forward implementation and a reduction in radiotherapy referrals overall of approximately 10% will have reduced fraction demand without a concomitant reduction in linac capacity.
- The patient appointments that were ‘lost’ to FAST-forward were often short and would not generally have involved CBCT imaging so the average complexity of a radiotherapy fraction would have *increased* from 2020/2021.
- Some centres have taken advantage of the extra capacity released by FAST-forward to introduce DIBH and more frequent imaging which will have further increased the average appointment time.
- While the more widespread introduction of SABR still represents a small proportion of all the attendances in any department, this too will have the effect of reducing the linac throughput.
- The need for extra cleaning, donning, and doffing of PPE by Therapeutic Radiographers, and the extra care required to manage anxious patients during the pandemic, would also have increased the average appointment time.

The last cause in this list may be reversible, but the other factors are not. So we should not be surprised to find that the average England/Wales value of attendances per linac has not fully bounced back to the levels being seen before April 2020, the most recent mean value being 5,654 compared with 6,832 in 2019/2020 (a reduction of 17%).

Interestingly, if we take 2020/2021 as the baseline year, the latest data (April – September 2022) does suggest an overall mean increase in attendances per linac of 11.1% (median is 9.3%), not so very far from the NHS Service Specification aspiration of 15%, *but* most of this increase will be due to radiotherapy referrals increasing back towards normal levels, after the reductions seen during the early COVID lockdown.

The attendances per linac metric only represents the efficiency of a department in a superficial way. In particular circumstances (for instance a small department replacing a linac) the value will be artificially high, and due to economies of scale, small centres will often struggle to keep this figure high over a sustained period of time. We are not aware of any centres having managed to treat patients from another centre while linacs are replaced, for instance, which is the suggestion in the service specification.

Based on the current activity level demonstrated in the RTDS, some reasonable assumptions regarding the key productivity metrics - working days per year, working hours per day, fractions delivered per hour – can be made (below, table 1).

	Current activity	Scenario 1	Scenario 2	Notes re. parameters
Contingency	0.87	0.87	0.87	<i>Recommended contingency factor to allow smooth running of service</i>
Uptime	0.98	0.98	0.98	<i>Typical level of machine uptime guaranteed by manufacturer service contract</i>
Working days year	250	250	260	<i>Based on a 5 day working week, machine taken out of use 10 times per annum for servicing/QA. Scenario 2 assumes all QA/servicing at weekends</i>
Working hours per day	9	12	11.5	
attendances per hour	3	3.5	3.5	
Total attendances per annum	5755	8952	8922	

Scenario 1 for achieving 9000 attendances per year requires a significant increase in both fractions per hour and the length of the working day. Shifting all quality assurance and maintenance activities to weekends (Scenario 2) reduces this impact only modestly.

An increase in the working day to 3.5 attendances per hour and a 11.5/12 hour working day would require:

- At least a 28% increase in numbers of Therapeutic Radiographers
- A willing patient population, happy to attend outside the traditional 9 to 5 working day

See reference 5 for a fuller discussion of the implications of extended hours radiotherapy.

It can be shown that larger radiotherapy centres are *generally* able to sustain higher values of attendances per linac although Figure 1 shows that many smaller centres are adept at keeping

throughput up, in spite of the significant impact that linac replacements, for instance, will have on those centres.

Variability of attendances per linac across England and Wales (measured by expressing the standard deviation as a percentage of the mean) reduced somewhat between 2009 and 2014, and has not changed significantly since then, including the time since the pandemic began.

Figure 1 also shows that the value of average attendances per linac varies for any given centre, from year to year and that consistent 'improvement' is rare and temporary.

Conclusions

The use of a nominal figure for number of linacs within a radiotherapy centre produces figures which lack objectivity and are difficult to analyse. Any future use of metrics involving attendances per linac as a departmental average should use a clearer mathematical value of the denominator.

The introduction of cone beam CT-guided radiotherapy and intensity modulated delivery, mostly within the last decade, without significantly reducing throughput overall, is an achievement of which the UK radiotherapy community can be proud.

While IPEM completely supports initiatives which will make the most efficient use of the capital investment represented by the linac fleet, it is clear from the data above that a target of 9,000 attendances per linac as a departmental average is unachievable, and that the increase of 15% increase in this metric over three years, however defined, has been stymied by the COVID pandemic.

Some of the latest models of treatment machine claim to be able to achieve significantly shorter treatment times which might be expected to improve overall throughput, but there is also increased clinical motivation for fully adaptive techniques which, combined with the impact of hypofractionation, will have the opposite effect.

There may be a case for increased scrutiny on centres which appear consistently to have a low departmental average of attendances per linac, but centres with very high throughputs should receive at least the same attention.

Further work is required before realistically achievable, clinically desirable and evidence-based targets for attendances per linac can be set across England.

IPEM's Radiotherapy Professional Standards Group

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