

ORIGINAL PAPER

# National audit of provision of MRI services 2006/07

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Received 1 February 2008; received in revised form 4 September 2008; accepted 10 September 2008

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In 2003 the Royal College of Radiologists Clinical Radiology Audit Sub-Committee began an audit process evaluating the standards of provision of magnetic resonance imaging (MRI) services. This was prompted by the publication of the 2002 Audit Commission Report, which had identified that lack of MRI provision was responsible for more than half of the total waiting times for diagnostic imaging investigations. The audit found that the time from request to report did not meet the standard for cancer staging examinations, but nationally, was within the target set for routine orthopaedic examinations. However, national mean waiting times were longer than recommended for both cancer and orthopaedic MRI. Since then, there has been massive investment in MRI capacity, both from installation of MRI systems in NHS Trusts, and in England, from outsourcing of routine MRI cases through the Department of Health contract with an independent provider. A re-audit in 2006/7 shows that there has been a significant improvement in waiting times for routine orthopaedic examinations, but the position with cancer staging examinations has deteriorated. Control chart methodology shows that underperformance is due to common cause variation, i.e., improvements need to be made to the overall process from receiving the request for MRI to the issue of the report. Follow-up with participating departments demonstrated there were some common themes for underperformance, and suggestions for improvement are made from departments with best performance.

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## Introduction

Magnetic resonance imaging (MRI) provision was identified by the 2002 Audit Commission Report as lacking in many areas. There was unequal access to MRI throughout the UK, and waiting times varied greatly for both urgent and non-urgent studies.<sup>1</sup> The Commission found that although the median MRI waiting time was 20 weeks, at one in four departments it was more than 34 weeks. Delay in access to MRI was responsible for more than half of the total waiting times for imaging.

The Department of Health (DH) responded by announcing a further tranche of investment in 50 MRI systems<sup>2</sup> on top of the 42 already installed after the publication of the Cancer Plan in 2000.<sup>3</sup> Against this background, the Royal College of Radiologists began a national audit process of the standard of provision of MRI services in the UK in 2003.<sup>4</sup> For cancer staging examinations a standard was set of 14 days from request to report with a target of 95%. For routine orthopaedic cases a standard of request to report of up to 13 weeks was set with a target of 50%. We found that although the mean percentage of routine orthopaedic cases reported within 13 weeks met the specified target, the mean percentage of cancer staging cases reported within 14 days did not. More recently, in England outsourcing to an independent provider has been introduced with the

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aim of reducing waiting times for MRI. The purpose of the re-audit was to assess the impact of the additional MRI resources using the same standards as those of the previous round, i.e., (1) Cancer staging cases should be reported within 14 days of request in 95% of cases, and (2) routine orthopaedic scans should be reported within 13 weeks of request in 50% of cases.<sup>5</sup>

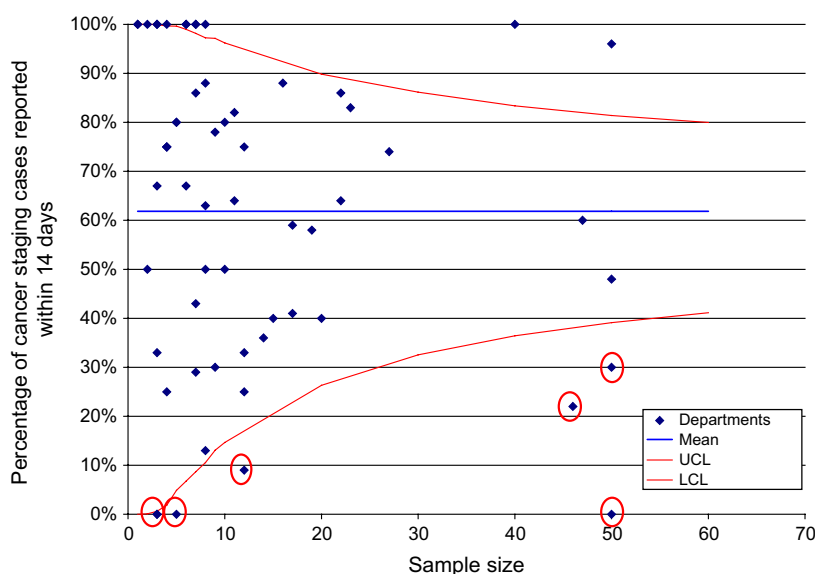
## Materials and methods

Audit leads or clinical directors at 248 radiology departments were invited to participate. The sample comprised up to 50 consecutive cancer-staging cases and up to 50 consecutive routine orthopaedic patients who underwent an MRI examination during a representative week in November, December, or early January 2007 at each location. Data were collected by a participating clinical radiology audit lead or director, or their nominated deputy.

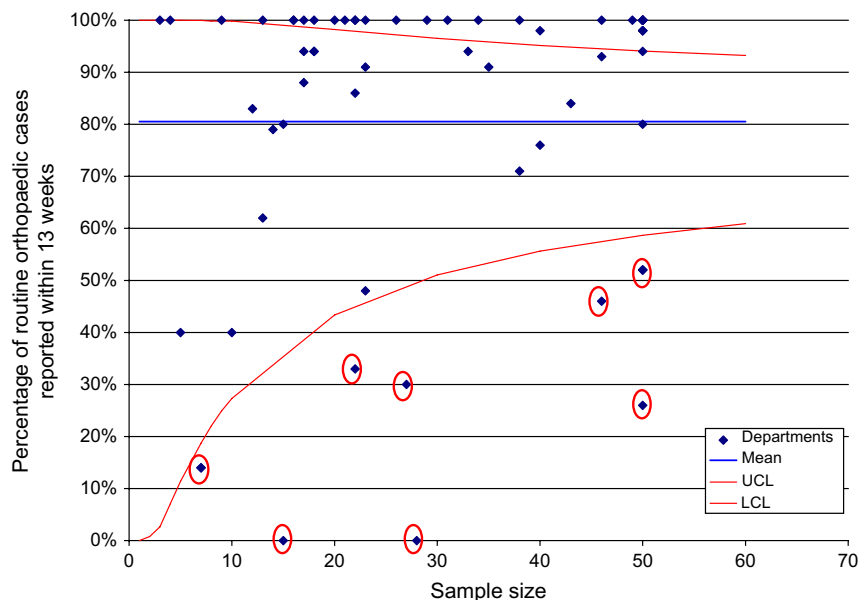
Two Microsoft Excel worksheets were used to record the date of request, the date of the examination, and the date of the report for each case. Intervals between each of these dates, as well as summary data, were calculated automatically. The summary data were collected on three online data collection tools between November 2006 and March 2007. The tools were designed

using Snap Survey Software, Version 8 and the data were analysed using Microsoft Office Excel 2003 and Confidence Interval Analysis, Version 2.1.2.

Departments were also asked to supply information concerning equipment, staffing, access, and demand and capacity data. Statistical process control analysis<sup>6,7</sup> utilizing funnel plots, was used to identify departments at which compliance rates warranted further investigation (Figs. 1 and 2). The main features of the chart are an upper control limit (UCL), a lower control limit (LCL), and a central line representing the mean. The UCL and LCL are usually set at three SDs above and below the mean, respectively. They define the range of variation that might be expected to occur due to chance (common cause variation). Outside these limits, variation is likely to be the result of assignable, root causes (special cause variation). This has implications for remedial action: common cause variation can only be reduced, if it is unacceptably large, by fundamental changes to a process across the board, for example, better organization of the booking process or management of waiting lists. Special cause variation can be reduced or eliminated by preventing the occurrence of root causes at targeted locations. An example of special cause variation would be breakdown of the MRI machine during the period of data collection.



**Figure 1** Funnel plot of percentage of cancer staging cases reported within 14 days. Although the mean of 62% is well below the target of 95% of cases reported within 14 days, the majority of departments show common cause variation, lying within the control limits. This suggests that most departments would require a change in process. The 7 departments\* lying below the lower control limit (LCL) will have an individual, special cause for variation which should be identified and resolved locally. \*Two departments with identical sample sizes reported the same number of compliant cases.



**Figure 2** Funnel plot of percentage of routine orthopaedic cases reported within 13 weeks. The mean of 80% is well above the target of 50% but there are more departments outside the control limits than within indicating that variation is special cause. Although many departments have a special cause for good performance (above the upper control limit, UCL) there are 9\* which lie below the lower control limit (LCL). These departments should identify and resolve their individual special cause for variation. \*Two departments with identical sample sizes reported the same number of compliant cases.

## Results

The College received data from 66 National Health departments, all with MRI systems. The response rate was 27%. Of the departments that submitted data, 51 (77%) were in England, five (8%) were in Scotland, eight (12%) were in Wales, and two (3%) were in Northern Ireland. Thirty-nine (59%) were located in district general hospitals, 25 (38%) were located in teaching or university hospitals and two (3%) in other types of hospital. Fifty percent (33/66) of the 2006/07 participants also participated in 2003; however, it was noted that there had been reconfiguration of several Trusts, some of which had changed names, and some departments that had submitted data in 2003 were now amalgamated. Therefore, it is likely that more than 50% of radiology departments participated in both 2003 and 2006/7.

### National compliance rates

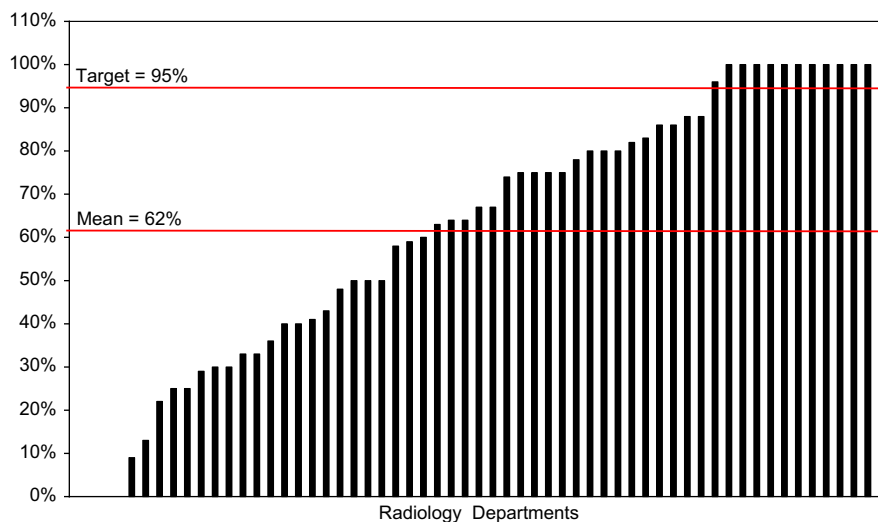
Fifty-seven percent (456/805) of cancer staging cases were reported within 14 days of request (95% CI 53.2–60%) and 82% (1557/1891) of routine orthopaedic cases were reported within 13 weeks of request (95% CI 80.6–84%). Thus, compliance fell short of the target for cancer staging cases (95%) by 38%, but exceeded the target for routine orthopaedic cases (50%) by 32%.

The mean (SD) waiting time from request to examination and from examination to report for cancer staging cases was 13.1 days (8.6 days; 95% CI 10.8–15.4 days) and 3.4 days (2.6 days; 95% CI 2.7–4.1 days), respectively. The mean (SD) waiting time from request to examination and from examination to report for routine orthopaedic cases was 11.5 weeks (15.5 weeks; 95% CI 7.6–15.4 weeks) and 1.2 weeks (1.8 weeks; 95% CI 0.7–1.7 weeks), respectively.

### Compliance rates within departments

The percentage of cancer staging cases reported within 14 days and the percentage of routine orthopaedic cases reported within 13 weeks are shown for each department in Figs. 3 and 4, respectively. Twenty-two percent (13/59) of departments complied with the standard for reporting cancer staging cases (95% CI 13.4–34.1%) and 83% (52/63) of departments complied with the standard for reporting routine orthopaedic cases (95% CI 71.4–90%).

The mean percentage of cancer staging cases reported within 14 days was 62% (SD = 31.3, 95% CI 53.8–70.2%) and the mean percentage of routine orthopaedic cases reported within 13 weeks was 81% (SD = 28.6, 95% CI 73.8–88.2%). Based on these results, compliance with the standard for reporting cancer staging cases appears to be the



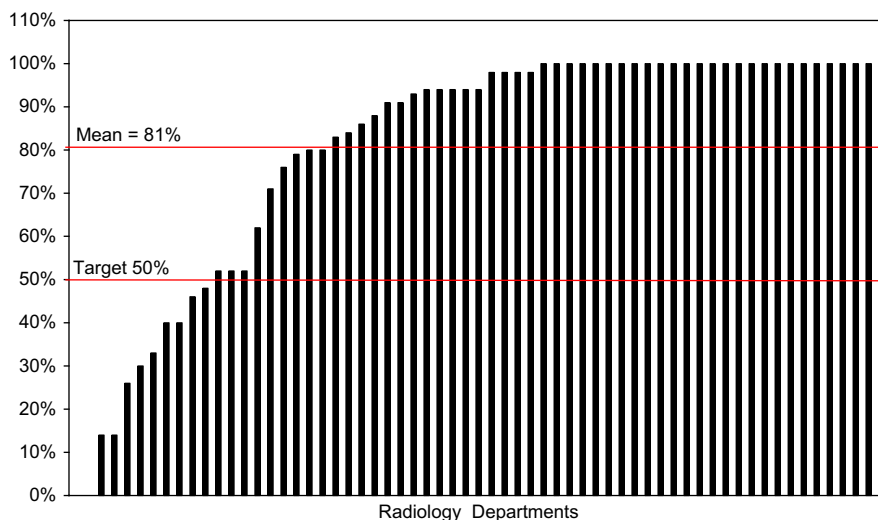
**Figure 3** Percentage of cancer staging cases reported within 14 days at each department.

same as in the 2003 audit, but compliance with the standard for reporting routine orthopaedic cases appears to have risen from 66% in 2003 to 81% in 2006/7 (Table 1).

Funnel plots show that the percentage of cancer staging cases reported within 14 days fell below the lower control limit (LCL) in seven departments (Fig. 1) and the percentage of routine orthopaedic cases reported within 13 weeks fell below the LCL at nine departments (Fig. 2). These outliers are identified in Figs. 1 and 2 by red ovals; there are six ovals in Fig. 1 and eight in Fig. 2 because in both plots, two departments with identical sample sizes reported the same number of compliant cases. Using a 3 SD control limit, the inference is that there is an individual, special cause for variation in the departments that fall below the LCL.

Further investigation for identification and resolution of these causes of variation is warranted. Such causes often are not due to personal failings, but more frequently are due to data collection and to departmental organization and systems. For example, transcriptional delay may result in a 2 week cancer target not being met but would allow a less demanding 13 week orthopaedic target to be achieved.

Many more departments were above the upper control limit (UCL) in Fig. 2 than in Fig. 1, potentially reflecting more widespread good practice in reporting routine orthopaedic cases than in reporting cancer staging cases. However, many departments have had waiting times reduced significantly for routine orthopaedic cases by outsourcing to independent provider. Therefore,



**Figure 4** Percentage of routine orthopaedic cases reported within 13 weeks at each department.

**Table 1** Mean (SD) percentage of cancer staging cases reported within 14 days and mean (SD) percentage of routine orthopaedic cases reported within 13 weeks comparing 2003 and 2006

	2003	2006/07
Cancer staging cases reported within 14 days of request	62%	62% (31.3)
Routine orthopaedic cases reported within 13 weeks of request	66%	81% (28.6)

these results are strong indications that outsourced provision has had a definite impact on routine orthopaedic waiting times.

### Equipment and staffing

In 2003, 45% of magnets were 1 T, and 55% 1.5 T, whereas in this cycle only 16% were 1 T. There has only been a slight improvement in funding of sessions with only 83.9% of departments reporting full funding of available sessions (80% in 2003). The percentage of departments offering a funded on-call service had increased minimally from 28 to 32%, but there had been no change in proportion (22%) of departments offering a service to general practitioners (GPs).

Nearly 52% of departments reported staffing difficulties, similar to 2003. The most common theme was a shortage of funding for radiographer and radiologist sessions, and freezing of posts.

Sixteen percent of departments stated there was a local independent imaging centre undertaking NHS MRI examinations, and the median number of outsourced examinations was 300 per annum.

### Demand and capacity

The waiting list backlog ranged from 40 to 1150 requests, with a median of 361 requests. This did not change significantly over the month surveyed with the mean backlog ranging from 30 to 1151, with a median of 353 requests at the end of the data collection period. The median time estimated to clear the backlog was 300 h. Median normal demand was 400 requests and deferred demand (i.e. requests received for work to be done at a scheduled future date) was 13. The median activity was 420 examinations and the median funded capacity was 400 examinations for the month. Median absolute capacity, i.e., number of examinations that could have been done if (a) they were fitted into the normal working day and (b) enough staff were available to do them was 377 examinations.

## Discussion

Additional MRI resources appear to have had little impact on waiting times for reporting cancer staging cases. For cancer cases, analysis of the funnel plots show it is common-cause variation that prevails, hence the overall process for all departments must be improved to have an impact on performance. This is significant considering the targets set in the NHS Cancer Reform Strategy<sup>8</sup> of a 31 day standard from diagnosis/decision to treat to first treatment of >99%; and 62 day standard (from urgent GP referral to first treatment) of >96%.

Although the mean percentage of routine orthopaedic cases reported within 13 weeks met the specified target in the previous audit, it did so by an increased margin in the current audit, and this seems likely to be due to the provision of MRI for routine cases outsourced to the independent provider. Although the principal findings of the study are quite clear, with a low response rate, the possibility of some response bias having occurred is not excluded.

Seven departments reporting cancer staging cases and nine departments reporting routine orthopaedic cases were identified as warranting further investigation on account of the likelihood of assignable root causes adversely affecting their compliance rates. These departments were contacted.

Case mix was identified as one explanation for underperformance with regard to cancer waiting times. The view was expressed by many responders that cancer staging examinations are perceived as specialized and are often reported by one or two radiologists with a special interest in that particular field, in accordance with local cancer network policies. The outsourcing of the less complex routine MRI work was also said to have had an impact on performance because business cases for funding and staffing had been based on a mix of complex and routine cases, whereas the mix of work had changed to a greater proportion of more complex and time-consuming work.

In one department, the majority of examinations were for prostatic carcinoma. Local policy determined that these patients were imaged 6 weeks after biopsy to prevent post-biopsy changes altering the appearances of the prostate and making the reports inaccurate. This is an example of special-cause variation, and the local policy will need to be reviewed. Some cancer networks have a policy of performing a staging MRI even if there has been a recent biopsy, accepting that there may be haemorrhagic change.

Responses from those departments underperforming in the imaging of orthopaedic cases, suggested that small departments might have fared worse, as these would more likely be adversely affected by vacancies, annual leave, and covering emergencies. Another significant explanation cited by several departments was the proportion of patients who were referred to the independent provider in outsourcing but who were returned back after periods of several weeks or on occasions several months with the explanation that the patient was not contactable or not appropriate for an MRI examination on a mobile unit.

When departments with best performance were contacted regarding orthopaedic waiting times, their responses suggested that although outsourcing did take some patients off the list, a range of other factors also contributed. The other factors cited by these departments are also cited by the Radiology Service Improvement team<sup>9,10</sup> and included (1) better organization, e.g., accurate and timely capacity and demand data collection; process mapping to identify bottlenecks; well-controlled waiting lists; and efficient booking systems for MRI cards. (2) Examining according to protocol for the routine orthopaedic cases, which does not require a radiologist's presence; having a list of patients who are available at short notice to come in for an examination when a slot became available due to cancellation; Saturday lists; and separate evening lists for private patients. (3) Better use of radiologists' and radiographers' time, e.g., distributing studies to a named reporter; dedicated orthopaedic and cancer radiologists; batching and outsourcing to visiting radiologists from other NHS trusts; and moving radiographers from 5 8-h days to 4 10-h days. (4) Investment in equipment and technology, e.g., new MRI machines, picture archiving and communication system (PACS), and voice-activated dictation. (5) The use of alternative investigations (e.g., arthroscopy for knees). There are many other suggestions for MRI service improvement methodology in publications from the Radiology Service Improvement team.<sup>9,10</sup>

The increase in the percentage of 1.5 T magnets from 55 to 84% reflects the investment in MRI by the Department of Health. However, there appears to have been little increase in funding of sessions to match the capital investment with 16% of departments still operating at reduced funding capacity. These departments commented that private sector capacity in their locality would have been unnecessary if they had received the funding to operate a normal working week.

Staffing issues seem to have remained static. Comments were made in the free text sections

that it had been difficult to secure funding through business planning for radiology, radiographer, and ancillary staff in the prevailing financial climate, and that vacant posts had been frozen. Many departments stated they would be able to extend the working day if funding for additional staff could be secured.

The median waiting list backlog was 361 requests (range 40–1150 requests). Taking the median time estimated of 300 h to perform these examinations, and the median open time of 8 h per day, it would take about 1.8 months to clear this backlog. In 2003 the median time estimated to clear the waiting list was 1.5 months, suggesting deterioration in performance nationally despite the capital investment. However, these data must be interpreted with caution; there may have been reporting bias among the participants, and there is a wide variation in the time taken for different MRI examinations. The time to report the MRI examinations is variable, with more complex cases taking considerably more time.

Median normal demand was 400 requests and deferred demand (i.e. requests received for work to be done at a scheduled future date) was 13 requests, almost matching median funded capacity of 400 examinations, although a request may ask for more than one examination.

This suggests that if the backlog could be cleared by increasing capacity, through more efficient ways of working, or extending the working day, waiting lists could effectively be eliminated, but publications by the Radiology Service Improvement Team<sup>9,10</sup> warn that one result of improving waiting lists is a rise in demand, so this aspect has to be constantly managed.

In conclusion, although additional MRI resources appear to have had a positive impact on orthopaedic waiting times, this does not appear to be the case for waiting times for reporting cancer staging cases. It is worrying that 16% of departments report a shortfall in funding and are not operating a full working week.

Follow-up of outlying participating departments has clearly illuminated some possible explanations for individual underperformance and generated some ideas for helping radiology departments to achieve better results in the future. This will be essential to meet the challenges of the NHS Cancer Reform Strategy<sup>8</sup> and the 18 week commissioning pathway.<sup>11</sup>

## Acknowledgements

The authors are grateful to all radiology staff who participated in this audit, and in particular, to Dr

Jeremy Hacking and others for their helpful responses to our follow-up questions. The authors also acknowledge the input and support of the Clinical Radiology Audit Sub-committee to the 2003 and 2006 audits.

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