Most departments provide quick access to general X-rays, but in many hospitals there are long waits for less routine examinations which can slow a patient’s diagnosis and treatment.

One-quarter of departments now have ‘hot reporting’, although most departments fail to meet their standards for reporting speed.

Departments correctly give priority to reporting results for A&E and GP requests. But in 10 per cent of places more than one-third of examinations do not have written reports.

Only a minority of departments test the satisfaction of patients and referring clinicians.

Sixty per cent of the equipment in use is within the recommended maximum age set by the Royal College and recent extra funding should reduce the remainder that is outside this limit.

Many departments are using radiographers more flexibly to take on new roles and there is scope to extend this further.
The Audit Commission promotes the best use of public money by ensuring the proper stewardship of public finances and by helping those responsible for public services to achieve economy, efficiency and effectiveness.

The Commission was established in 1983 to appoint and regulate the external auditors of local authorities in England and Wales. In 1990 its role was extended to include the NHS. In April 2000, the Commission was given additional responsibility for carrying out best value inspections of certain local government services and functions. Today its remit covers more than 13,000 bodies which between them spend nearly £100 billion of public money annually. The Commission operates independently and derives most of its income from the fees charged to audited bodies.

Auditors are appointed from District Audit and private accountancy firms to monitor public expenditure. Auditors were first appointed in the 1840s to inspect the accounts of authorities administering the Poor Law. Audits ensured that safeguards were in place against fraud and corruption and that local rates were being used for the purposes intended. These founding principles remain as relevant today as they were 150 years ago.

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For more information on the work of the Commission, please contact:
Andrew Foster, Controller, The Audit Commission, 1 Vincent Square, London SW1P 2PN, Tel: 020 7828 1212
Website: www.audit-commission.gov.uk
Introduction and background

1. Radiology uses X-ray, ultrasound and other techniques to provide images to help diagnose and monitor patients’ conditions. Now, with the increasing importance of interventional radiology, it also offers treatments, some of which would have previously involved surgery (see Appendix for a description of the procedures). Approximately 30 million radiology examinations are carried out every year. Some patients are seriously ill, such as those with major breast cancer or heart attacks. Others have less life threatening conditions, such as simple fractures, or may have symptoms that require investigation. All rightly expect prompt and competent examination and assessment.

2. Radiology services are a significant resource [BOX A] and are central to delivering fast and reliable diagnoses, a key element in the Government’s plan for the NHS [Refs. 1, 2]. Managing a radiology department means coping with a range of pressures and conflicts:

- **Increasing demand.** The number of examinations has grown by 2 per cent a year over the last five years. Some of the biggest increases have been in complex and time-consuming techniques such as Computed Tomography (CT – 40 per cent since 1996/97) and Magnetic Resonance Imaging (MRI – 60 per cent since 1996/97) (Ref. 3).

- **Pressure for 24-hour services.** Increasingly patients and referring clinicians expect that radiology services should be available 24 hours a day, seven days a week. Yet many departments still operate a ‘nine to five’ service, with only minimal out-of-hours emergency cover.

- **Diverse services.** Continuing to deliver high volume basic examinations, such as general X-rays, whilst developing low volume but complex interventional procedures.

- **Increasing sub-specialisation** by both radiologists and radiographers make it increasingly difficult to provide staff for rotas and reporting.

- **Risks of radiation to the patient’s health.** It is important that patients are only exposed to X-rays where the benefits from improved clinical information outweigh the radiation risks to the patient. Recent regulations (Ref. 4) aim to protect the public from unnecessary exposure to radiation and place a responsibility on radiology staff to justify each exposure.

- **Balancing speed and quality of reporting.** It can take longer if a radiologist reports the results of an examination to the referring clinician than if the clinician interprets the image him or herself, but the likely higher quality interpretation by the radiologist may lead to better clinical outcomes.

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1 Department of Health’s *NHS Plan* (Ref. 1). For instance, the National Cancer Plan depends on radiology services diagnosing and staging patients with cancer; the National Service Framework for Coronary Heart Disease requires radiology to diagnose diseases of the arteries and veins.
In 2000/01 £830 million was spent on NHS radiology services.

**BOX A**

**Key facts about radiology services**

- In 2000/01 the NHS in England and Wales spent £830 million on providing radiology services. The average examination costs almost £30.
- The service employs around 22,000 staff.
- Radiologists are doctors specially trained to decide on appropriate imaging investigations, carry out some of the more complex ones, and interpret images. Consultants account for 74 per cent of the 2,400 radiologists in England and Wales. They take a minimum of seven years to train after leaving medical school.
- Radiographers carry out many of the X-ray and other examinations. There are 10,000 working in the NHS in England and Wales. They have undergone a minimum of three years’ education and training, nowadays including a university degree, in using imaging equipment safely to ensure the best image is produced.
- Other staff include assistants/helpers, clinical physicists, radiology nurses, secretarial and administrative staff.
- Although patients come to radiology from most parts of the health service, the bulk of the work is from Accident and Emergency (A&E), general practice and orthopaedics.
- Sixty eight per cent of examinations are general X-rays and 17 per cent involve ultrasound. The rest of the workload is made up of small volume, specialist investigations and treatments [EXHIBIT 1]. These can involve the use of sophisticated scanners, such as Computed Tomography (CT) and Magnetic Resonance Imaging (MRI), or Nuclear Medicine (see Appendix).

**EXHIBIT 1**

**Types of radiology examinations, England and Wales 2000/01**

There is a wide range of different examinations carried out by radiology departments, although nearly 70 per cent are X-rays.

Source: Audit Commission
3. The Audit Commission’s first study of radiology services in 1995 (*Improving Your Image*) (Ref. 5) reported that:

- an estimated 20 per cent of X-rays did not help patient care (Ref. 6).\(^1\) This waste could be reduced by better use of referral guidelines, more checking of individual requests and reviewing patterns of requests at multidisciplinary meetings;
- measuring patient and clinician satisfaction was an important part of improving the quality of service;
- faster reporting was needed in many places, possibly achieved by ‘hot reporting’ arrangements (where a designated radiologist and secretary are available throughout the day to report ‘on demand’);
- departments’ unit costs of equipment and staff varied by up to 30 per cent from the mean due to differences in utilisation of rooms and equipment, staff productivity and grade mix;
- better scheduling of appointments to eliminate peaks of work could increase efficiency and shorten waiting times; and
- limited investment over many years had left some departments with cramped accommodation that was unwelcoming for patients, and with old equipment that was awkward to use and limited in scope. Better investment planning was needed.

4. The Audit Commission has re-surveyed radiology departments as part of its Acute Hospital Portfolio (see back cover). Almost all NHS hospitals in England and Wales are involved. Comparative data were collected for 2000/01 covering 246 radiology departments. The Commission’s auditors have used these data to provide a tailored performance assessment of radiology services for each NHS trust and recommend action, including any necessary further audit work.

5. This review summarises the material findings from the data in five main sections:

- patients’ access to radiology services and reporting;
- managing demand for examinations;
- the utilisation of equipment;
- staffing: productivity, vacancies and roles; and
- the impact of size of department on costs.

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\(^1\) Findings reported from National Radiological Protection Board (Ref. 6).
The time patients have to wait increases [their] anxiety over ‘what’s wrong with me?’

Findings

Access

6. The time patients have to wait for an examination matters greatly to them. A longer wait increases anxiety over ‘what’s wrong with me?’ (Ref. 5). Referring clinicians also are interested in examinations being carried out and reported promptly. There are three key issues in a patient’s experience of radiology services:

- availability;
- wait for the examination; and
- prompt and thorough reporting of the results.

Two key measures of waiting times are included in this review: ‘waiting time’ and ‘reporting time’ [EXHIBIT 2].
Many radiology departments provide rapid access for patients with suspected cancer...

Availability of radiology services

7. Most patients are first referred by their GP for an outpatient appointment. If necessary, they are then given an appointment to have an X-ray or other radiological examination. Some departments have different arrangements to deal with urgent problems. The Audit Commission’s 2000/01 survey found that many radiology departments provide rapid access for patients with suspected cancer: 74 per cent of departments for breast cancer, 46 per cent for lung cancer and 47 per cent for colorectal cancer. And 59 per cent of departments will take referrals directly from GPs.

8. Radiology departments face increasing pressures to provide out-of-hours services, for instance to support the diagnosis and management of emergency cases, such as suspected stroke. Possible solutions include:

- **’on-call’ arrangements.** Of all departments with CT 96 per cent have on-call arrangements for emergencies. 80 per cent of departments offer on-call interventional services, with 73 per cent of these offering a full range of services, including imaging, to identify sites of blood loss and for guiding minimal invasive treatment;

- **extended-hours services during the week.** While most scanners operate for only nine or fewer hours a day, 45 per cent of MRI scanners and 14 per cent of CT scanners operate for ten or more hours every weekday; and

- **24-hour, 7-day service.** Only a few departments offer such a service.

9. Where a patient is referred from the outpatients’ department there is usually a need to co-ordinate further visits to outpatients with the radiology department, with the aim of providing care on a single visit or when planning care as a series of booked appointments. However 80 per cent of hospitals do not have a central booking system, making it difficult to achieve this reliably. Only 21 per cent of radiology departments have electronic systems for allowing an examination to be requested directly from a clinic or ward.

10. The Commission will investigate in more detail the provision of out-of-hours services in its study of improving the management of hospital beds also being carried out as part of the Acute Hospital Portfolio.
Relatively short waits were found for general X-rays, which account for two-thirds of exams.

Waiting for the examination

11. The wait for a routine (that is, non-urgent) examination is defined as the time from the request arriving in the radiology department to the patient undergoing the investigation [EXHIBIT 2]. Using this definition the average wait for the half a million patients waiting on 31 March 2001 was nine weeks, although this varied according to the type of examination. Relatively short waits were found for:

- general X-rays. These account for over two-thirds of all examinations. Over one-half of departments provide direct access with no appointment necessary, so involve no wait for the patient before they come to hospital [EXHIBIT 3]. The average wait is less than a week but exceeds three weeks at 13 departments; and

- symptomatic mammography. The average wait is two weeks but in 25 per cent of departments it exceeds three weeks.

12. However, for less routine examinations there were long waits in many departments. The three examinations with the longest waits were MRI, general ultrasound and barium enemas [TABLE 1]. These results are consistent with the joint Audit Commission/Commission for Health Improvement report on cancer (Ref. 7), and other work (Ref. 8), which found that waits for radiological examinations are a common bottleneck in both diagnosis and subsequent treatment.

13. Some of the departments with the longest waits were tackling the problem using waiting list initiatives that involve radiologists and/or radiographers working additional sessions. The most common initiatives were for general ultrasound (at 24 per cent of departments), MRI (19 per cent), CT (20 per cent), barium enemas (18 per cent) and gynaecological ultrasound (12 per cent).
Prompt and thorough reporting of results

**Speed**

14. When only an image is required this is usually sent out within a day of the examination (this is accepted practice for examinations that can be interpreted by the referring clinician rather than a radiologist), such as general X-rays for follow-up fracture clinics. However most examinations require a radiologist’s skilled interpretation. The Audit Commission’s 2000/01 survey collected data on the speed of reporting, that is the time between the examination taking place and the report being sent to the requesting clinician.

15. Priority is generally given to reporting emergency and urgent examinations. However, most hospitals are failing to meet their own standards for speed of reporting, both for these and routine examinations. Only for GP requested examinations does reporting time consistently meet local standards [TABLE 2, overleaf].

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**TABLE 1: WAITING TIMES AND WAITING LISTS FOR DIFFERENT EXAMINATIONS, ENGLAND AND WALES 31 MARCH 2001**

<table>
<thead>
<tr>
<th>Investigation</th>
<th>Average wait (median)</th>
<th>In 25 per cent of departments average wait is longer than:</th>
<th>Patients waiting for examinations</th>
</tr>
</thead>
<tbody>
<tr>
<td>MRI scan</td>
<td>20 weeks</td>
<td>34 weeks</td>
<td>110,000</td>
</tr>
<tr>
<td>General ultrasound</td>
<td>8 weeks</td>
<td>12 weeks</td>
<td>128,000</td>
</tr>
<tr>
<td>Barium enemas</td>
<td>6 weeks</td>
<td>11 weeks</td>
<td>30,000</td>
</tr>
<tr>
<td>CT scan</td>
<td>6 weeks</td>
<td>10 weeks</td>
<td>54,000</td>
</tr>
<tr>
<td>Gynaecological ultrasound</td>
<td>6 weeks</td>
<td>10 weeks</td>
<td>47,000</td>
</tr>
<tr>
<td>Barium meals</td>
<td>4 weeks</td>
<td>8 weeks</td>
<td>13,000</td>
</tr>
<tr>
<td>Nuclear medicine</td>
<td>4 weeks</td>
<td>6 weeks</td>
<td>19,000</td>
</tr>
<tr>
<td>IVUs</td>
<td>4 weeks</td>
<td>6 weeks</td>
<td>10,000</td>
</tr>
<tr>
<td>Interventional procedures</td>
<td>3 weeks</td>
<td>6 weeks</td>
<td>7,000</td>
</tr>
<tr>
<td>Symptomatic mammography</td>
<td>2 weeks</td>
<td>3 weeks</td>
<td>15,000</td>
</tr>
<tr>
<td>Obstetric ultrasound</td>
<td>Under a week</td>
<td>2 weeks</td>
<td>23,000</td>
</tr>
<tr>
<td>General X-rays</td>
<td>Under a week</td>
<td>One week</td>
<td>22,000</td>
</tr>
<tr>
<td><strong>TOTAL</strong></td>
<td></td>
<td></td>
<td><strong>478,000</strong></td>
</tr>
</tbody>
</table>

Source: Audit Commission

---

...most hospitals are failing to meet their own standards for speed of reporting...
**Hot reporting**

16. Twenty six per cent of departments have arrangements for ‘hot reporting’ and, as a consequence, have a faster turnaround for some types of reports. Thirteen per cent provide hot reporting for A&E examinations, 19 per cent for general examinations and 15 per cent for other examinations such as CT scanning. Hot reporting is most common in teaching departments: 80 per cent of those in London and 57 per cent of those elsewhere. This may relate to the teaching hospitals’ greater availability of trainee radiologists (Specialist Registrars) who often provide this service. At the time of the Audit Commission 2000/01 survey those departments with hot reporting had a faster turnaround for all sources of referral except for urgent inpatients, and it was statistically significant in the case of reporting of routine GP reports. Given these results local managers need to assess the possible feasibility and benefits of introducing hot reporting arrangements in their own departments. This requires a review of the whole process of reporting, including arrangements for radiologists, secretaries, administrative staff and information and technology support systems.

**Technology and speed of service**

17. Use of digital images can also increase the speed of reporting, as well as allow improved manipulation of images, particularly if combined with electronic transmission of the report. However this requires substantial capital funding, and to achieve benefits the investment in technology needs to be combined with improvements in work processes (Ref. 9). Only a minority of departments are currently able to provide referring clinicians with access to digital images, although most can give referring clinicians access to electronic versions of written reports [EXHIBIT 4].

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A median test showed that reporting of routine GP examinations was significantly different, at the 5 per cent level, in departments with hot reporting (median of 3.0 days) compared with departments without hot reporting (median 4.2 days).

### TABLE 2

<table>
<thead>
<tr>
<th>Speed of reporting examinations</th>
<th>Typical local standard</th>
<th>Performance observed (mean in days)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Emergency and urgent inpatient examinations</td>
<td>1</td>
<td>2.0</td>
</tr>
<tr>
<td>Emergency and urgent other examinations</td>
<td>1</td>
<td>1.8</td>
</tr>
<tr>
<td>Routine inpatient examinations</td>
<td>2</td>
<td>5.4</td>
</tr>
<tr>
<td>Routine outpatient examinations</td>
<td>5</td>
<td>6.9</td>
</tr>
<tr>
<td>Routine GP examinations</td>
<td>5</td>
<td>4.7</td>
</tr>
</tbody>
</table>
Use of information and digital technology, England and Wales April 2001

The use of technology by departments varied widely, with only a minority of departments able to provide referring clinicians with access to digital images. The use of technology at the different stages of the examination and reporting process is shown below.

Quality of reporting

18. Referring clinicians rate the quality of reporting by radiology staff as the third most important aspect of a radiology service, after image quality and the speed of carrying out urgent inpatient examinations.¹

¹ Improving Your Image (Ref 5). Results from survey of 450 hospital based referring clinicians.
...there are wide differences in the proportion of examinations reported by radiology staff...

**Reporting of examinations by radiology staff**

19. The Royal College of Radiologists standard is that examinations should only be reported by radiologists, by radiographers working within agreed protocols or by specific referring clinicians following agreement with the radiology department (Ref. 10). Nationally 76 per cent of examinations are reported in these ways: the remainder are either reported by referring clinicians without agreement with the radiology department or are unreported. Consultant radiologists report 65 per cent of all examinations, a further 8 per cent are ultrasound examinations reported by ultrasonographers (radiographers specialising in ultrasound examinations) and 3 per cent are reported by referring clinicians with agreement of the radiology department. The latter include examinations for specialist fracture, dental and chest clinics. However, there are wide differences between departments in the proportion of examinations reported by radiology staff (radiologists, radiographers or ultrasonographers), ranging from 40 per cent to 100 per cent [EXHIBIT 5].

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**EXHIBIT 5**

**Reporting by radiology staff, England and Wales 2000/01**

There are wide differences in the proportion of examinations finally reported by radiology staff.

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1 Audits of ultrasonographer reporting have confirmed its high quality for certain examinations (Refs. 11, 12).
20. Of most concern is examinations not being reported at all or reported by referring clinicians without the agreement of the radiology department [EXHIBIT 6]. In one in ten departments these examinations represent more than one-third of the total. Many examinations go unreported because films sent out to referring clinicians, often to avoid delays in reporting, are never returned for final reporting by the radiologist. Not reporting examinations runs contrary both to Royal College standards and the legal requirement that each radiation exposure must be justified and ‘a clinical evaluation is recorded for each medical exposure’. If information is not recorded in the patient’s notes it is not available for use by other clinicians managing the patient and the investigation may be unnecessarily repeated, increasing the radiation risk and incurring extra costs.

EXHIBIT 6
Examinations unreported or reported by referring clinicians without agreement with radiology, England and Wales 2000/01
In one in ten departments these examinations represent more than a third of the total.

Source: Audit Commission

21. Results are less likely to be reported in hospitals where the X-ray rate is high. Departments with more than one in five examinations left unreported had examination rates on average 25 per cent higher for A&E patients and 20 per cent higher for outpatients. One possible explanation of these differences is that, as the use of examinations increases, so the proportion of unnecessary examinations also increases and these are sifted out of the reporting process by hard-pressed departments.

1 Ionising Radiation (Medical Exposure) Regulations 2000 (Ref. 4), Regulation 7.
Most departments give priority to ensuring that requests from A&E or GPs do get reported.

22. Most departments give priority to ensuring that requests from A&E departments or GPs do get reported. This is because many requests from A&E are by junior doctors who usually lack experience to interpret the images themselves (Ref. 13). GPs do not see the image, which is kept at the hospital, and so rely on seeing a report. The survey found:

- on average 80 per cent of examinations requested from A&E departments are reported by radiologists [EXHIBIT 7A], with a further 5 per cent reported by radiographers. However there is some variation between individual departments that needs investigating by local management; and

- nationally 98 per cent of examinations requested by GPs were reported by a radiologist. In addition some ultrasound examinations are reported by ultrasonographers. However in a few departments the proportion of GP examinations reported by radiologists is low [EXHIBIT 7B].

EXHIBITS 7A AND B

Rates of reporting, England and Wales 2000/01

The percentage of A&E and GP examinations reported by radiology staff varies widely.

Source: Audit Commission
Surveys of patients and referring clinicians

23. The Audit Commission recommended in 1995 that quality could be improved by focusing on patient and clinician satisfaction. However the current study found in 2001 that only a minority of departments were testing ‘user satisfaction’. Only 34 per cent of departments had carried out a survey of patients and 17 per cent of referring clinicians, in the previous year. Some departments had used other means to keep in contact with the needs of those using the service, such as regular meetings with referring clinicians and joint audit activities. Local managers need to review arrangements to ensure there are regular means to assess patient and clinician satisfaction with the service.

Managing demand

24. In order to provide an appropriate and prompt service to patients and referring clinicians, radiology capacity needs to match demand. But first it is important to establish that requests made by referring clinicians are appropriate and will provide information to improve patient diagnosis, treatment and management. Capacity, of both equipment and staff, to carry out and report examinations then needs to be matched to demand.

25. Improving Your Image reported research, by the National Radiological Protection Board, suggesting that 20 per cent of X-rays did not help patient care (Ref. 6). For instance X-rays for lower back pain are generally considered to confer little or no diagnostic benefit (Ref. 14). High examination rates compared with similar departments may indicate that some examinations are unnecessary. Alternatively in hospitals with low rates for an examination, some patients may be missing out on necessary examinations. The Audit Commission’s 2000/01 survey found wide variations in the ratio of examinations to numbers of patients [EXHIBIT 8]. Large variations remain even when the comparison is limited to a single type of hospital.

EXHIBIT 8
Frequency of examinations, England and Wales 2000/01

The ratio of examinations to patients varies widely.
26. Examination rates depend on many factors, only some of which can be influenced by radiology staff. They can exert influence by educating referrers, having referrers use guidelines (Ref. 15) and protocols, and by radiologists vetting requests. To achieve a lasting impact requires continuous efforts by departments, which will absorb resources but can have dramatic effects (Ref. 16). Auditors will help identify those trusts with consistently high examination rates, investigate the underlying reasons and, in discussion with trust management, assess what action to take.

**Utilisation of equipment**

27. Radiology departments use many, often expensive, items of equipment, 90 per cent of major items are purchased with NHS funds. The remainder are leased from the private sector or purchased from charitable funds. A typical department has around 30 major items of equipment including:

- several types of X-ray machine designed to examine specific parts of the body such as the head or chest (typical replacement cost of £150,000 per item);
- several types of ultrasound machines for gynaecology, obstetrics and other general examinations (£70,000 per item);
- fluoroscopic screening equipment used for examinations such as barium meals and barium enemas (£250,000);
- gamma cameras used for examinations such as identifying hidden fractures some of which may be related to osteoporosis, spread of cancers and the function of kidneys (£350,000);
- CT scanners used for body section imaging using X-rays taken from different angles (£500,000); and
- MRI scanners using magnetism to produce images of different sections of the body (£850,000). At the time of the Audit Commission’s 2000/01 survey 65 per cent (160 out of 246) of radiology departments had these.

The Royal College of Radiologists Guidelines, *Making the Best Use of a Department of Clinical Radiology* (Ref. 15) provides advice to referring doctors on appropriate radiological investigations for specific clinical problems.
28. Low utilisation of equipment may cause a bottleneck. The Audit Commission’s 2000/01 survey shows wide variations in utilisation of specialist equipment [EXHIBIT 9]. In the case of CT and MRI scanners throughput is clearly related to operating hours. Around 80 per cent of CT scanners and 50 per cent of MRI scanners operate for nine hours or less on weekdays [EXHIBIT 10]. Departments with waiting times for CT longer than ten weeks tend on average to operate their scanners for an hour longer than other departments, so have recognised the need to extend their services. Departments with long waiting times, which have not extended their operating hours, need to investigate the barriers and opportunities for doing so. This may include improving work scheduling or working practices, developing approaches to overcome shortages of necessary staff and re-prioritising budgets.

EXHIBIT 9

Throughput of equipment, England and Wales 2000/01

The annual throughput per item of equipment varies widely between departments. The inter-quartile range is shown, together with the median.

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Source: Audit Commission
Many CT and MRI scanners operate for nine hours or fewer on weekdays.

...41 per cent of equipment was older than the [Royal College] standard.

**Age of equipment**

29. Many items of old equipment were being used in departments in 1995 (Ref. 5). The Audit Commission’s 2000/01 survey also found that much equipment was old. Although old equipment declines in performance or becomes limited in its flexibility to carry out new ways of examining patients, some of it can still provide a useful service and can be improved by upgrading parts or software. One yardstick that matches age of equipment to its performance is the Royal College of Radiologists recommended maximum ages for different items of equipment (Ref. 10).\(^1\) The Audit Commission’s 2000/01 survey found, at March 2001, that 41 per cent of equipment items was older than this standard [EXHIBIT 11]. Much of the older equipment is X-ray machines, gamma cameras (for nuclear medicine) and fluoroscopy. The Audit Commission estimates that the cost of replacing all equipment over the RCR recommended maximum age is £510 million, using the indicative costs at paragraph 27.

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\(^1\) Royal College of Radiologists, *Quality Specification for Purchasers* (Ref. 10). Suggested Replacement Ages of Equipment, Appendix 1. The maximum recommended age is seven years for all equipment types, except for X-ray and some fluoroscopy which is ten years.
EXHIBIT 11

Age of equipment, England and Wales 31 March 2001

Many items of radiology equipment are older than the maximum age recommended by the Royal College of Radiologists.

Source: Audit Commission

30. The Department of Health in England has recently provided additional funding for 38 MRI scanners (29 of which were delivered by April 2002) and 136 CT scanners (84 of which were delivered by April 2002) (Ref. 17). In 2001 the National Assembly for Wales made available £7.5 million to purchase up to six new CT scanners and two MRI scanners to take the place of scanners in need of urgent replacement (Ref. 18). These funds cover the costs of equipment but exclude maintenance costs. Trusts have to bridge any gap, particularly for smaller items such as X-ray machines, from their own capital funds or by attracting private sector investment.

Staffing

31. Staff are the most important resource in providing a radiology service, accounting for 60 per cent of total expenditure. The traditional separation of roles, with radiographers producing (more straightforward) images and radiologists interpreting them, has recently been changing as ways are sought to increase productivity. There is also a wider recognition within the professions that staff need to be given the opportunity to develop beyond their existing roles.
Staff productivity

32. *Improving Your Image* reported wide variations in staff productivity. The Audit Commission’s 2000/01 survey used the Keele/Newchurch workload categories, combined with Korner workload weights, to measure productivity. The weights reflect only the broad set of resources used, not the input of any particular staff group [BOX 8]. Once again it was found that productivity varies widely between departments for both radiologists and radiographers and there are important differences between types of trust [EXHIBIT 12]. Productivity of consultant radiologist’s is highest in teaching trusts. One possible explanation is that trainee radiologists (Specialist Registrars) who are predominately in teaching trusts, are not counted when calculating productivity.

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**EXHIBIT 12**

Productivity, England and Wales 2000/01

Productivity varies widely by type of trust, and between similar trusts, for consultant radiologists and radiographers.

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*Source: Audit Commission*
Differences in productivity are caused by many factors. The productivity measures adjust for casemix and for the non-clinical commitments of consultant radiologists. However there are factors that limit the precision of the measures, such as the casemix weightings being out-of-date (they were last updated in the mid-1990s) and so not reflecting the current resource intensity of some examinations. Also, as mentioned earlier, the weightings reflect only the broad set of resources used, not the input of any particular staff group. Nevertheless the wide variation in productivity for particular types of trusts, by a factor of three or more, suggests scope for improvements in the way that staff are allocated and deployed. In particular, managers need to investigate why some departments have high productivity and whether improved working practices could be adopted by their departments.

**BOX B**

**Calculation of staff productivity**

**Step 1:** Group the annual workload of a radiology department in the year ending 31 March 2001 into 17 common workload categories. These have been developed by Keele University and Newchurch for use in benchmarking the performance of radiology departments.

**Step 2:** Multiply the workload in each category by the appropriate Korner workload weight for that category. This allows for adjustments in casemix by weighting examinations according to the amount of resources needed to perform them. The more complex the examination the more radiologists’, radiographers’ and equipment time is needed and therefore a higher weighting is given (the maximum weighting is 60, which is applied to MRI examinations; the lowest weighting is one, which is applied to general X-rays).

**Step 3:** The sum of the weighted workload of each category in Step 2 is the total Korner units.

**Step 4:** Productivity of consultant radiologists is given by dividing total Korner units (Step 3) by the contracted consultant clinical sessions spent on reporting or carrying out examinations. It excludes sessions on on-call, teaching, audit, regular clinico-radiological meetings, management and administration.

**Step 5:** Productivity of radiographer is given by dividing total Korner units (Step 3) by the number of whole time equivalent radiographers in post, excluding students.
High staff vacancies in some departments raise concerns about delivering the service.

Staff numbers and vacancies

34. The Audit Commission’s 2000/01 survey shows that the mean vacancy rate for both consultant radiologists and radiographers was 10 per cent. The Department of Health’s survey of all clinical vacancies (Ref. 19) over the same period reports only 4.6 per cent for consultant radiologists in England and 4.4 per cent for radiographers, although the regional pattern is similar to the Audit Commission’s survey.¹ The main difference is that the Department’s survey includes only vacancies of three months or more (intended to highlight vacancies that are difficult to fill, whereas the Commission includes all vacancies). The Commission’s survey may also identify more posts vacant as it was completed specially by radiology department managers, whereas the Department’s survey is collected routinely from the trust’s human resource department.

35. In both surveys vacancy rates are highest in the north of England for radiologists, but in London and the South East for radiographers. This raises concerns about having sufficient radiologists and radiographers in post in these areas to deliver a radiology service. Radiology departments are currently spending (in 2000/01) £18 million on locum and agency staff: £6 million for radiologists, £8 million for radiographers and £4 million for other staff, accounting for 3.6 per cent of the total pay bill. This situation requires careful monitoring and appropriate action.

Extended roles of radiographers

36. In many trusts the roles of radiographers have been extended to include new tasks, particularly in non-teaching trusts [EXHIBIT 13]. The survey shows that in many departments radiographers give intravenous injections, issue ultrasound reports, undertake barium enemas to an agreed protocol and report A&E films [EXHIBIT 14].

¹ Both surveys use the same formula (% vacancies = vacancies/(staff-in-post + vacancies)), whole time equivalent units, mean averages, staff groups (consultant radiologists and qualified radiographers excluding students), include actively advertised vacancies only; and the same period, vacancies at March 2001. However the Department’s figures use staff-in-post at September 2000, whereas the Audit Commission uses staff-in-post at March 2001. The Department’s figures have small differences due to breast screening staff being included.
Many radiographers have extended roles, particularly in non-teaching hospitals, England and Wales April 2001.

Source: Audit Commission

Many radiographers take on a wide range of extended roles. Safeguards should include suitable training and back-up, agreed protocols, participation in regular audit and formal arrangements for delegation (Ref. 20).
Use of helpers

38. In addition to extending the role of radiographers upward, there is scope for radiographers to delegate some of their more straightforward tasks to helpers or assistants. Helpers can provide support to radiographers in tasks such as positioning patients during examinations, collating films and reports. The total number of helpers used to support radiographers and radiologists has increased by 46 per cent since the mid-1990s, from 893 to 1,307 whole time equivalents. The Audit Commission’s 2000/01 survey found that those departments which most extended the roles of radiographers also had the highest number of helpers. Departments in non-teaching trusts make most use of helpers, giving radiographers the opportunity to take on more extended roles.

Size of department

39. Radiological examinations vary greatly in their complexity and the resources required to carry them out. Korner units [see BOX B] can be used as a means of adjusting for the effects of this complexity in comparing costs. Average costs per Korner unit are 14 per cent lower in the largest trusts than the smallest [EXHIBIT 15]. This implied economy of scale is likely to be due to a number of factors including spreading more widely the fixed costs of the minimum set of equipment needed to run a radiology service and the differences in productivity by type of trust mentioned in paragraph 32.

EXHIBIT 15

Size of department and costs, England and Wales 2000/01

Average costs are lower in large departments than small departments. Size is measured by total number of examinations in 2000/01.

Source: Audit Commission

Data gathered by the Audit Commission’s auditors in 1996/97 but not published.
Conclusions

40. Many radiology departments have responded positively to the increasing demands placed upon them. Examples include: provision of direct rapid access, especially for patients with suspected cancer; local waiting list initiatives backed up by extended operating hours and equipment; faster processing of results due to ‘hot reporting’ and digital image processing; giving priority in reporting to those who need most help such as junior doctors in A&E; and extending radiographers’ roles and the use of helpers.

41. However, despite this progress, there remain a number of common problems that many trusts need to address.

<table>
<thead>
<tr>
<th>Common problems</th>
<th>Possible actions</th>
</tr>
</thead>
<tbody>
<tr>
<td>Booking systems for radiology and outpatients are not linked.</td>
<td>Corporate management ensures IT plans address linkages.</td>
</tr>
<tr>
<td>Inability to meet demand for ‘round the clock’ services with current staffing levels.</td>
<td>Consider sharing resources between departments. Extend radiographer roles.</td>
</tr>
<tr>
<td>Slow turnaround of reports.</td>
<td>Hot reporting. More information technology to aid reporting.</td>
</tr>
<tr>
<td>High rate of unreported examinations.</td>
<td>Protocols to clarify when non-reporting is permissible. Audit compliance with protocols.</td>
</tr>
<tr>
<td>Old equipment with limited capacity.</td>
<td>Robust long-term plans for replacement.</td>
</tr>
<tr>
<td>Radiological service capacity not considered when planning new clinical services.</td>
<td>Ensure plans consider radiology as a matter of course (Ref. 21).</td>
</tr>
<tr>
<td>Long waits for some types of examination, particularly CT and MRI scans.</td>
<td>Screen requests for justification. Develop guidelines on appropriateness for referrers. Improve work scheduling. Extend equipment operating hours. Extend radiographer roles.</td>
</tr>
</tbody>
</table>

Royal College of Radiologists, Workload and Manpower in Clinical Radiology (Ref. 21).
Appendix B. An example is the approach taken by the Addenbrookes Formula that links radiology consultant levels to expansion of new consultant appointments in other specialties.
42. There also needs to be some action at a national level.

- Support for the development of robust workload and productivity measures. These should be based on existing initiatives such as the Keele/Newchurch workload categories.

- The development of better national information on the workforce and vacancies, with long-term predictions, linked to...

- …national strategies for recruitment, training and retention. This will be particularly important over the next few years as the NHS expands its capacity.

- Continuing professional development for radiographers, enabling them to extend their roles, and accredited education programmes for helpers. This will help to attract and retain suitable staff.
Appendix: Main radiology procedures

There are a number of techniques used to provide images of the patient.

**General X-rays.** The examinations that most people have had at sometime, for example to see whether bones are broken or to examine the chest. A machine directs a beam of X-rays through the part of the body being examined and on to a special film or digital imager.

An increasing number of examinations (7 per cent in 2000/01) involve multiple cross-sectional imaging by **CT or MRI scanners**, rather than the more traditional single image which relied for effectiveness on the correct positioning of the patient by the radiographer.

- **CT scan.** This is a more sophisticated way of using X-rays. The patient lies on a narrow table and passes through a circular hole in the scanner. X-ray images are produced for different views or ‘slices’ of the body, enabling the radiologist to view the image in two or three dimensions.

- **MRI scan.** Uses strong magnetic fields to produce images. The pictures produced are very precise and particularly good for differentiating soft tissues of similar density. MRI is the examination of choice for most musculoskeletal and neurological imaging. However MRI scanners are very expensive, at around £1 million to buy and are therefore concentrated at hospitals where they can be used most extensively.

**Breast screening** is provided for all women aged between 50 and 65 (70 from 2003). There are two types of examinations for women: screening of the general female population and examinations for those with a known breast lesion. This study only considers the latter, known as symptomatic mammography, as it is carried out within radiology departments. The former is excluded as it is carried out in a range of organisational settings, including some radiology departments.

**Fluoroscopy** is a technique where an X-ray beam passes through the body and the image can be viewed as a moving picture on a TV screen. Snapshot pictures can be made of any important findings or the whole scan can be recorded on video. For example, in a **barium meal** a drink of barium solution, which is shown up well by X-rays, is taken to give pictures of the stomach and intestines. A **barium enema** is a similar examination of the large bowel.

**Ultrasound.** Uses high frequency sound waves to produce an image, operating on a similar principle to radar. Used for examination of blood vessels and soft tissues, as well as longstanding uses in obstetrics.
Nuclear medicine. A small amount of radioactive material (which emits gamma rays) is injected into a vein or swallowed or inhaled. The radioactive material concentrates on a particular organ or tissue, such as the thyroid gland. A special ‘gamma camera’ detects the radiation and builds up a picture. The technique examines the functioning of the organ rather than merely presenting an image.

Interventional radiology. There are increasing numbers of interventional procedures, many of which replace the need for surgery. These account for less than 1 per cent of examinations but are highly complex. They include angioplasty (a procedure in which a balloon is inserted into an artery or vein to widen it to improve circulation), stenting (insertion of a tube to keep an artery or vein open) and renal biopsies (removal of a sample of tissue from a diseased kidney).
References


17. Department of Health, information supplied to the Audit Commission.


The Acute Hospital Portfolio is a collection of audits that are available for auditors to undertake at acute trusts, according to local priorities. They focus on key service areas or resources within the trust that are of concern to trust managers and patients. Each year the Audit Commission selects up to four topics from the Portfolio to survey across all trusts. Three main stages to the survey work are carried out in sequence on an annual cycle:

**Data collection**

- April-July
- Emphasis on data quality
- Support from auditors

**Diagnostic audit**

- from November
- Independent tailored review by auditors
- Takes account of local context
- Information for decision making

**In-depth audit**

- from February
- Targeted on problem areas
- Action plan for change

The data collection and diagnostic work is the core of the survey, and each trust receives from its auditor a tailored assessment of its performance based on the data collected. In-depth audit work is then carried out at only a minority of trusts – those that demonstrably need it. This survey is repeated for each topic within four years, so that progress can be monitored both at individual trusts and nationally. A maximum of 16 topics is currently envisaged to allow coverage of all the key issues and service areas.

This review reports the results from the survey of Radiology. It is one of the four topics in the second phase of the Portfolio. Similar reviews will also be produced for each of the other three topics this year – *Medical Staffing*, *Medicines Management*, *Procurement and Supply* and, next year – *Outpatients*, *Bed Management*, *Operating Theatres*, and *Waits for Admission*. Previous reviews reports have been published from the first phase of work covering *Accident and Emergency*, *Catering*, *Day Surgery* and *Ward Staffing*.

More details are available on the Acute Hospital Portfolio website (http://www.audit-commission.gov.uk/itc/acuteportfolio.shtml). The data for the first phase of four topics and the accompanying computer software are also available to NHS trusts for comparative purposes. For details see the website.

Audit Commission
1 Vincent Square, London SW1P 2PN
Telephone: 020 7828 1212 Fax: 020 7976 6187
Internet: www.audit-commission.gov.uk

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