

National audit of diagnosis of lung cancer on chest radiography

Background

Chest radiography is the standard radiological technique for the investigation of respiratory disease and is universally used. Many papers have been published on its efficacy in lung carcinoma, and, more recently, audits of missed lung carcinoma, with miss rates varying between 10 – 50%.¹⁻³ In addition to errors of observation and interpretation,⁴ there are also errors due to poor communication, unreported films and poor decision-making.^{5,6} Digital techniques with image processing may improve detection rates.⁷

The literature has given some standards for audit of this topic, and it was therefore considered to be a useful audit to perform to assess if nationally the standards were met. Recent work by the National Patient Safety Agency (NPSA) has found that both failure to suggest further investigation if a radiographic abnormality is found, and failure to ensure an abnormal report is acted upon by the referring clinician are significant sources of radiological incidents reported to them.⁸

Standards

The literature has shown that 100% rates are not attainable, but figures from the Mayo Clinic have demonstrated that 90% of peripheral lesions and 75% of perihilar lesions are visible on retrospective review.⁹ Thus, the following standards were set:

In patients with proven lung carcinoma:

1. The lesion should be identified in $\geq 75\%$ of chest radiographs performed within one year of the diagnosis.
2. When a lesion is reported, further investigation should be recommended in $>95\%$ of cases.

Methods

The sample comprised the last 40 consecutive patients diagnosed with lung cancer from 31 August 2005 at each location with a participating clinical radiology audit lead. Patients were identified through pathology departments and lung cancer MDTs (multidisciplinary teams). Those without a chest X-ray in the 12 months preceding diagnosis were identified from RIS (Radiology Information System) and excluded from the audit.

X-ray reports were obtained and reviewed locally. In addition to collecting data to determine whether the standards were met, the frequencies of various categories of error were recorded (Table 1).

Table 1 Categorisation of errors

Category of error	Definition
Interpretive	Lesion identified but misinterpreted
Communication	Lesion identified but not communicated to clinician
Perceptual	Lesion missed
System	Film unreported

When there was no indication in the report that a lesion had been identified, the film was reviewed to determine whether one was visible. Information on two further errors was then collected (Table 2).

Table 2 Categorisation of errors when no lesion was identified

Category of error	Definition
Perceptual	Lesion visible ¹
Technical	Poor film quality ²

An online data collection tool was designed using Snap Survey Software, Version 8 and the data were analysed using Microsoft Office Excel 2003.

Audit leads at 288 eligible radiology departments were emailed a web link to the data collection tool. The College received data from 85 departments. Thus, the response rate was 30%.

A funnel chart was used to identify radiology departments at which the percentage of missed lesions warranted further investigation. The main features of the chart are an upper control limit (UCL), a lower control limit (LCL) and a central line representing the mean (Fig. 3). 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, whereas special cause variation can be reduced or eliminated by preventing the occurrence of root causes at targeted locations.

Results

Observed rates of compliance with audit criteria were 90% for Standard 1 and 72% for Standard 2 (Table 3).

¹ Site and size were recorded.

² Film quality was rated as good, adequate or poor.

Table 3 Compliance with audit criteria

Standard	Observed rate of compliance (%)
1. The lesion should be identified in $\geq 75\%$ of chest radiographs performed within one year of the diagnosis	90
2. When a lesion is reported, further investigation should be recommended in $>95\%$ of cases	72

The observed rate of compliance exceeded the target specified in Standard 1 by 15%, but fell short of the target in Standard 2 by 24%.

The percentage of errors in each of four categories is shown in Figure 1.

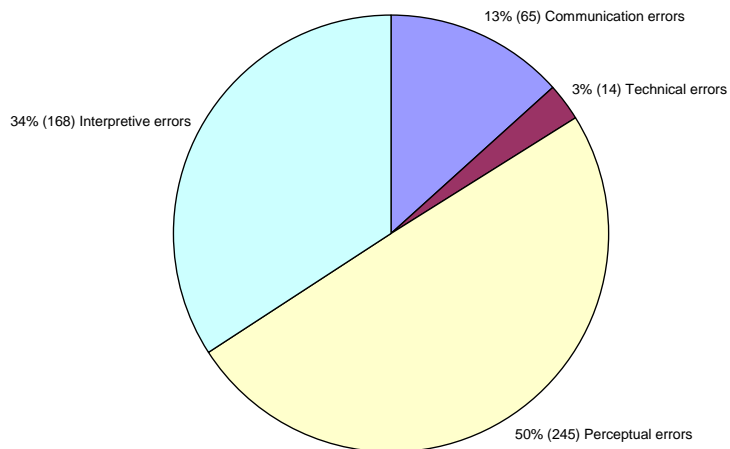


Figure 1 Percentage of errors in each of four categories.

Looking more closely at perceptual errors, the percentage of missed lesions ranged from 0–27% (Mdn = 7%, IQR = 11%) (Fig. 2).

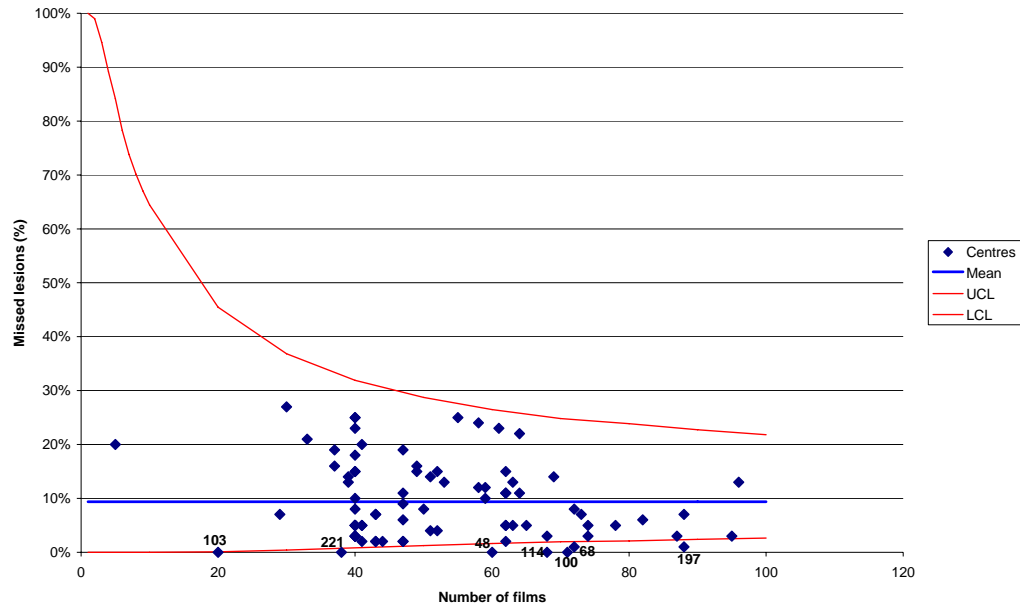


Figure 3 Funnel chart of percentage of missed lesions. Departments 103, 221, 48, 114, 100, 68 and 197 exhibit special cause variation. However, these fall below the LCL.

A significant number of lesions were missed in the perihilar regions and in the upper zones (Table 4).

Table 4 Percentage of missed lesions at each site

Site of missed lesion	Percentage of misses at each site
Right side upper	17% (70)
Right side middle zone	6% (27)
Right side lower zone	10% (40)
Right side perihilar	25% (102)
Left side upper zone	12% (51)
Left side middle zone	4% (17)
Left side lower zone	9% (39)
Left side perihilar	17% (72)

Overall, 4452 films were included in the audit, 92% (4076) were reported and 7% (332) were unreported. Data on a further 1% (44) were missing. Of the reported films, 87% (3539) were reported by consultant radiologists, 8% (337) by specialist registrars in radiology and 5% (200) by chest physicians.

Conclusions

This audit shows that nationally, targets in the literature for the detection of malignancy on a chest radiograph performed within one year of diagnosis are

being met. 71% of missed lesions were in the perihilar regions or upper zones. These are recognised review areas, and individual performance may be improved by routine scrutiny of these regions when reporting.

In cases where the lesion is shown, further investigation should be recommended in accordance with published standards and guidance.¹⁰⁻¹² The target was not met in this audit. It is recommended that those departments failing to meet this target should review the processes in place for alerting the lung cancer MDT to the possible diagnosis of lung cancer, and consider repeating the audit at a later date to ensure this process is robust.

Also of concern, particularly with the widespread roll out of PACS (Picture Archiving and Communications System) are fail-safe mechanisms to ensure that a report is acted upon by the referring clinician. The Royal College of Radiologists has been in discussion with the NPSA to facilitate alert mechanisms through the PACS procurement process.

It is regrettable that many departments did not have the resources to participate in this audit (64% of non-participating departments gave this as their reason). Unfortunately with departments under increasing strain due to lack of manpower and financial constraints audit is all too often one of the first quality measures to suffer. Audit will form a central part of appraisal and hence revalidation and the Royal College of Radiologists will strive to ensure that it is actively promoted, encouraged and resourced.

Recommendations

1. Individual performance may be improved by scrutinising the review areas when reporting chest radiographs.
2. Review local policy for recommending and implementing further action if there is a suspicious finding.
3. Review fail-safe mechanisms to ensure an abnormal report is acted upon by the referring clinician.

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