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Editorial: Discrepancy and Error in Diagnostic Radiology

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INTRODUCTION

Error in medicine is perceived as an important problem by almost 4 out of 5 people in Europe [1]. In the United Kingdom it is now a requirement to hold discrepancy meetings in radiology departments. This is a change that has occurred in the last ten years and has led to greater transparency with regard to error and its various manifestations in the Clinical Radiology Department.

Discrepancy has become the more acceptable term than error as it is less pejorative and initially, when the outcome is uncertain, easier to determine. A discrepancy is a lack of compatibility between two or more stated facts and the corollary is that one or more of the statements presented as fact must be wrong, although the converse is not necessarily the case..... none of the "facts" so presented needs to be correct. Where the final outcome is known, say from post-mortem, the incorrect report or reports are in error although the post-mortem itself can no longer be considered as a gold standard and may be shown to be in error by pre-mortem imaging.

'To Err is Human'

Error in medical practice is inevitable. That is not to say that all error is inevitable since some can be avoided but it is important that the patients, the politicians, the managers, the tax-paying public and the doctors themselves acknowledge the fact that there are both avoidable and unavoidable errors. There is a growing tendency in our society to need a scapegoat whenever something is perceived as having 'gone wrong'. However, whilst it is important to search out causes of error it is also important not to blame people for 'mistakes' when they are inevitable.

Litigation over medical error and successful prosecution of medical negligence has increased almost exponentially which may lead one to believe that medical errors are also increasing dramatically. This is not necessarily the case. What has happened is more complex and is more to do with the awareness of error and the sophistication of the public than with true error rates.

This article concentrates on error in investigation and diagnosis but the same principles apply to treatment.

Why is there still error in radiology ?

There are innumerable errors in medicine as there are in all human endeavours. Sonderegger-Iseli et al [2] in a paper in the Lancet in 2000 compared the accuracy of clinical diagnosis in unselected patients who died in hospital in three different medical eras.
The post mortem was taken as the gold standard, which is in itself debatable since there are similar errors in all diagnostic services.

Diagnostic errors in three medical eras

Year	Classification of error	
	Major	Minor
1972	30%	23%
1982	18%	32%
1992	14%	46%

Table 1 Clinical Diagnosis in 3 different eras
From Sonderegger-Iseli et al, Lancet 2000 (2)

Errors were classified as major or minor. (Major diagnostic error is that which affects treatment, prognosis and outcome whilst minor error is a definite mistake but one which does not affect the outcome). The number of errors had surprisingly gone up, overall, from 53% in 1972 to 60% in 1992.

In 1972 nearly a third of patients dying in hospitals had suffered a major diagnostic error and this is not an isolated finding. There are many papers to back up this sort of error level in medical diagnosis [3-15]. By 1992 the minor error had gone up, which we might have expected with the increase in litigation, but the major diagnostic error rate had gone down. Over the period of twenty years in question the serious errors halved but the less important errors doubled. More recent studies still show similar rates of radiological error [16, 17, 18].

Why have errors increased?

The twenty years in question saw the introduction of major new diagnostic tests including computed tomography, ultrasound and magnetic resonance imaging. With these tests it has been possible to drastically reduce the need for explorative surgery such as laparotomy for abdominal problems or burr holes into the head for neurological symptoms. These new tests do not always get the diagnosis absolutely correct and will result in minor errors but they do considerably assist in avoidance of major errors. Undertaking exploratory surgery in a very sick patient is, in itself, a cause of mortality. The newer techniques have an almost infinitesimal mortality risk. So the major errors go down and the minor errors go up.

This is not the only reason for the change in error. The problems are multifactorial. For example management policies may affect error in several unexpected ways. Whilst the introduction of scientific advance is lowering the error rate, decreased staffing levels may be raising it. The improved science would be masking the adverse effects of the staff cuts. Audit controls may clamp down on major error but the time taken to do the audit may result in increased minor error. In this imperfect world, politically driven management might rely on staff trained overeseas who have not been 'tried and tested' by the usual methods of formal interview and membership of Royal Colleges [19]. This could lead to increased error. Or they might find it politically necessary to meet some imposed target thus requiring 'out of hours' activity without additional resourcing. Or even, for example, insist that mobile diagnostic units are put onto hospital sites whilst the hospital facilities are standing empty. All of the above may lead to error.

Can errors be completely eliminated?

The answer to this question is definitely no but we must try as much as possibleto lower the error rate. To understand why it is not possible to remove error completely from a test, we have include here a few simplified graphs.

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The Perfect Test

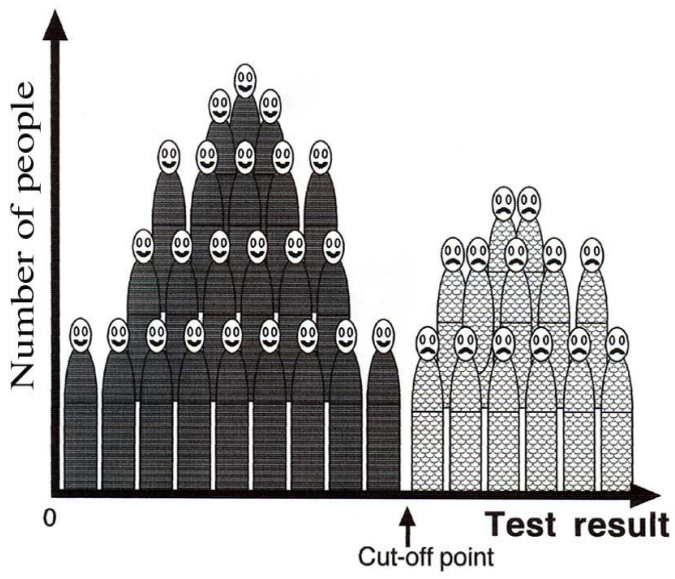

Figure 1 The Perfect Test
There is 100% differentiation between normal and abnormal patients. All normals are to the left of the cut-off point and all abnormals to the right
(From The History of Medicine, Money and Politics Goddard P 2008 Clinical Press Ltd Ref. 20)

With a perfect test there is no overlap between the normal and abnormal populations. Thus it is easy when reading the test to decide whether the patient has the disease or not by knowledge of the cut-off point.

Unfortunately this almost never happens. Nearly all diagnostic tests involve overlapping normal and abnormal populations. The populations may be equal or, as is more commonly the case, the diseased population may be considerably smaller than the normal population.

Most tests (if not all) are imperfect and there is no clear cut-off point between those who are normal and those who are ill. This is what one would expect since early in a disease process the abnormality will not be very marked and so may not show up. Conversely there are always a few less fortunate people who are not ill but look and behave as if they are. Some tests are very imperfect and do not distinguish a proportion of patients from the normal population even if they are very ill.

Since there is no definite cut-off point between normality and abnormality/disease the way in which the test is interpreted depends on how and why it is being performed and the knowledge of the tester. For example, if a test is being performed as a screening test or as a preliminary test in a patient with new symptoms it may be most important to identify all the patients with an abnormality (high sensitivity). . This would mean that a negative test, in which the person was diagnosed as normal (i.e. not having the disease), would be highly accurate. Unfortunately by setting the cut off point in this way many normal patients would be included in the positive result (false positives). Eliminating some of the normal patients from the remaining mix of normal and ill populations may be very useful if there is a further test to be performed which is more selective (specific) but perhaps associated with higher risk or cost. Eventually by a series of tests the error rate could be reduced. In the next graph the test result has been interpreted with a low threshold.

The Usual Type of Test: A seriously imperfect one

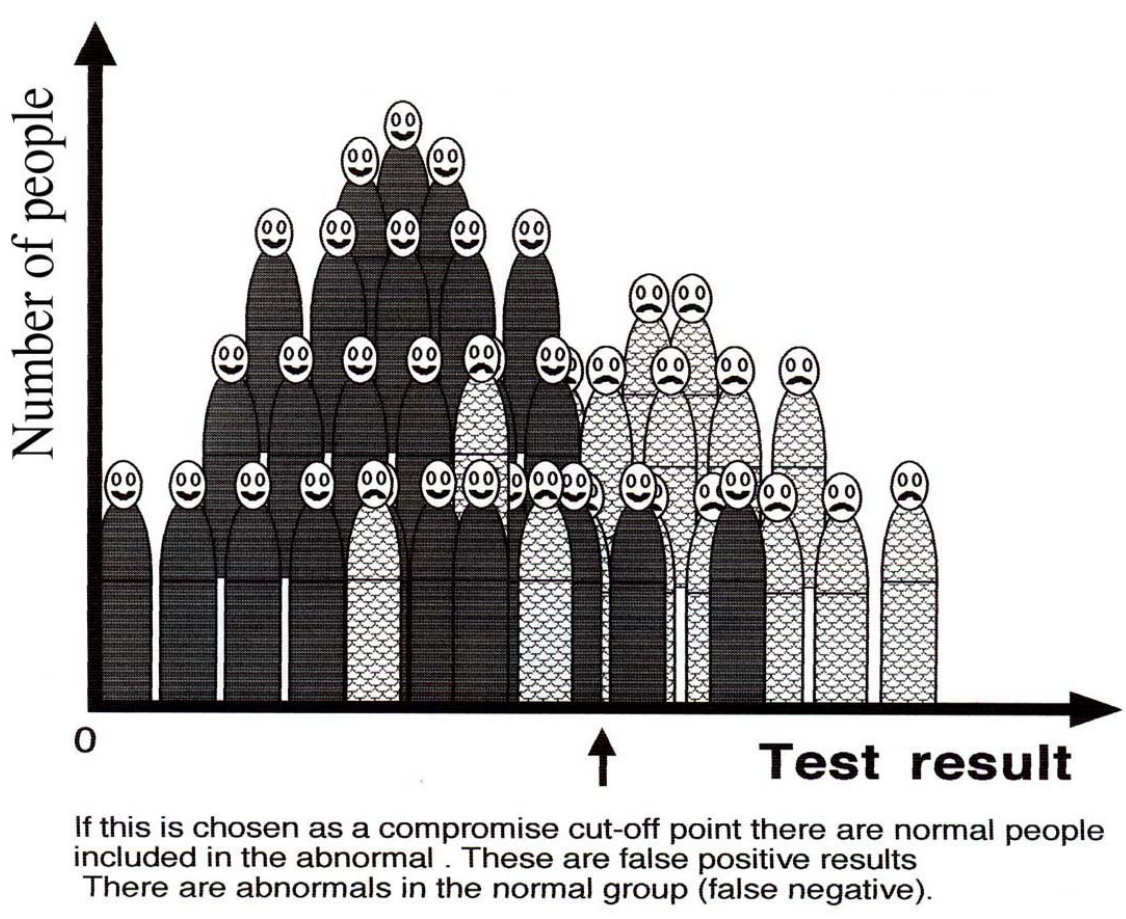

Figure 2 An Imperfect test
Wherever the cut-off point is chosen there will be either some normal and/or abnormal in the wrong groups
(From The History of Medicine, Money and Politics, Goddard P 2008 Clinical Press Ltd Ref. 20)

Low threshold

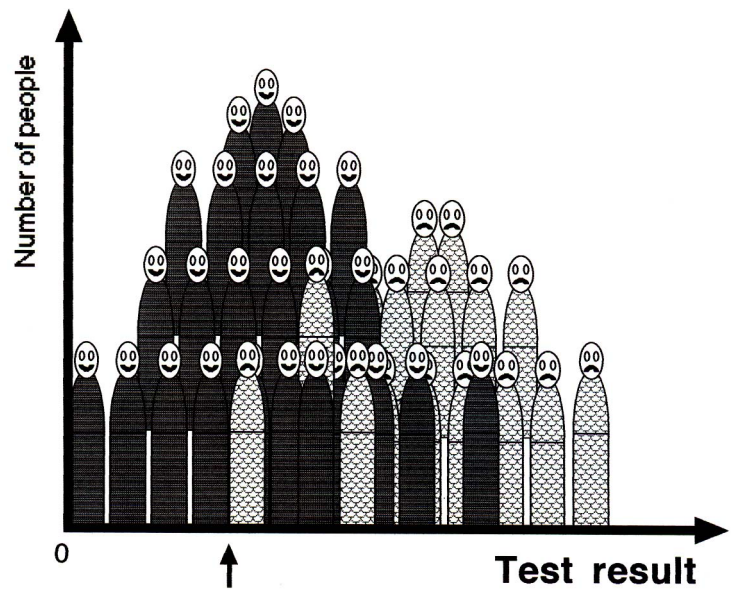

Figure 3
A very low threshold has been chosen for the cut-off point. If all of the people to the right of the cut-off point are considered as abnormal then all the sick people will have been included but so will many of the normal group. There are no false negatives but ther are many false positives.
(From The History of Medicine, Money and Politics, Goddard P 2008 Clinical Press Ltd Ref. 20)

In the example above the low threshold has picked up all the abnormal or 'ill' patients but to do so has included a large proportion of normal patients. It is reassuring for those who have a negative result since they are highly likely to be normal but those with a positive result have about a 50/50 chance of having the particular illness tested for (low positive predicitve value).

Conversely, if it was important to make sure that nobody is diagnosed as abnormal when they might in fact be normal the cut-off point or threshold would have to be set far to the right of the graph as shown below.

High Threshold

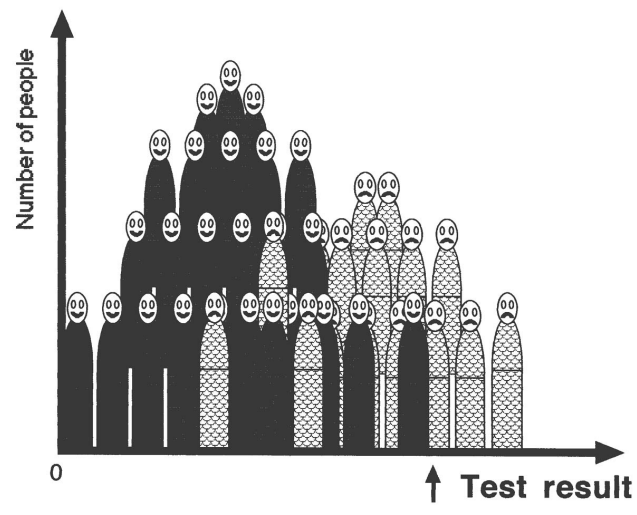

Figure 4 If a high threshold is chosen the normals can be excluded but this is at the expense of missing many abnormal patients. There are many false negative results.*(From The History of Medicine, Money and Politics, Goddard P 2008 Clinical Press Ltd Ref. 20)*

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Choosing a high threshold will mean that no normal patients (or very, very few) will be included in the abnormal group (high specificity). In the test shown in figure 4 the patients to the right of the cut-off point are all abnormal (high positive predictive value) but to the left there is a mixture of normal and abnormal patients (true and false negatives).

It could be considered important to use a high threshold if, for example, a treatment was particularly painful, toxic or expensive. It may be 'safer' to treat only those who are definitely ill and wait for further developments in the others. Or perhaps do a series of different tests or to repeat the investigation at an interval (as described in the article in this issue of WEMJ on *The Role of repeat digital subtraction angiography in non traumatic subarachnoid hemorrhage* [21])

These are examples of inevitable errors occurring in a test because of the inherent characteristics of the populations being studied. It is important that medical staff are not castigated for making this sort of inevitable error since it will prevent them from admitting the case and taking responsibility for errors which are avoidable.

Punishing the inevitable leads to hiding of the avoidable.

Inevitable errors can only be avoided by changing the type of investigation or treatment to one that does not have such a high intrinsic error. Getting the diagnosis right is fundamental. If you cannot be certain of the diagnosis it is, of course, difficult to be sure of the required treatment. Indeed similar graphs could be drawn for treatment for once again some error cannot be avoided. Some complications will occur however skillful or experienced the surgeon or physician.

It is a different matter when the error is avoidable.

Avoidable errors

"We have left undone those things which we ought to have done and done those things which we ought not to have done: and there is no health in us"
A general confession, The Book of Common Prayer.

Avoidable errors can occur due to many causes. They can be classified as errors of omission and commission. The former is not doing what one should have done and the latter is doing or saying something one should not have done. In addition in radiology there are errors of perception or interpretation.

Errors of perception occur when an abnormality is missed despite being visible on a test (error of omission) or reported as present when it is not there (commission). When the abnormality is noted an error of interpretation may mean that the wrong connotation is given to the finding. The Royal College of Radiologists in a Standards document [22] stated that discrepancies can occur due to

- Inadequate, misleading or incorrect clinical information
- Poor imaging technique
- Excessive workload or poor working conditions
- Observation (including false-positives) or interpretation errors
- Ambiguity of wording or summary of report

Inadequate, misleading or incorrect clinical information

This seems obvious but has been challenged in court and in tribunals. Radiological investigations are perceived by some as having inherent properties that are not altered by clinical information. Although physically true the interpretation of the investigation has to be done by an observer and this observer will be influenced by clinical information. This was shown in a paper on the reporting of Computed Tomography [23] which concluded that clinical information affects the CT report. If the information is accurate it has a beneficial effect; if it is inaccurate it has a detrimental effect. The more complex the investigation, the more important the clinical information. There was a correlation between readers regarding the influence of clinical information. Correct clinical information therefore improves the radiology report. It is the responsibility of the clinician to provide this information in an accurate and legible form.

Poor imaging technique

This may be inherent in the test itself as discussed above in the section on unavoidable error in which case it may be that the wrong test was chosen. Or poor technique may be due to poor technical skill on the part of the radiographer or radiologist or due to problems with the patient such as severe illness or refusal to cooperate.

Excessive workload and poor working conditions

These will lead to error. This is a problem for management to address.

Observation (including false-positives) or interpretation errors

We would suggest that there are many reasons for errors of perception or interpretation including

- Lack of knowledge (poor training, trained in a different field, lack of CPD)
- Less than perfect investigation (old or faulty technology, inadequate technicians, wrong choice of investigation, system error)
- Ergonomic factors: Poor viewing conditions (poor ambient conditions, noisy, interrupted, poor eyesight) [24]
- Working too fast (overworked, tired)
- Working to targets (trying to perform for the masters)
- Satisfaction of search ('Happy Eye Syndrome')
- Serendipity (by chance the abnormality may be spotted or missed.)

Ambiguity of wording or summary of report

Since the output from the radiologist is usually in the form of a report it cannot be stressed enough that accurate, unambiguous wording is essential. In addition the method of communication between the radiologists and the clinicians should be optimised. It is important that the report should be produced and communicated in a readable, timely manner. It is particularly important that communication is effectively achieved when a discrepancy is observed between an initial report, such as that produced by a clinician in accident and emergency, and a later report by a radiologist [25].

Acceptance that errors and discrepancies do exist

There are well-tried ways of decreasing error in radiological investigation but it is first important to believe that the errors do exist. This may be a bigger stumbling block than one would at first imagine depending on the prevailing medical and political environment and is one of the reasons that doctors historically have not spoken out with regard to problems.

Previous research on radiology error has found that the overall error rate is between 2% and 30% depending on a combination of the inherent accuracy of the technique and the competence of the investigator [4]. The popular view amongst the public and certainly amongst lawyers may be that doctors most of the time purposely and consciously cover up errors. It is, in the view of the authors, more likely that the process of becoming a doctor encourages the clinicians to believe in their own infallibility. There may be several factors involved in this including stress-induced anxiety. The traditionally trained medical students had to hide their post-traumatic stress from day one onwards, when given a body to dissect. They did so, eventually not even realising that it was there.

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Medical training is vastly different now... little or no dissection and the anatomy is taught on computer images. This creates less stress but may also provide less direct training.

The next shock is the realisation of the enormity and at the same time incompleteness of the subject. At school it was perfectly possible for an assiduous student to study the entire syllabus on each of the subjects at O level (now GCSE) and at A level. The required level of knowledge was understandable and hard work meant that it could all be covered. Not so with medicine.... the subject is so vast that it is not even possible to know all the titles of all the books on medicine or even of one small specialty within medical science.

Then there are the gaps in knowledge. Whilst the amount of information on medicine is definitely huge it is also true that there are significant areas about which we know little or nothing. There are conditions and diseases that have resisted all attempts to find a cause or a treatment. Often when treatment does work we do not know exactly why and when a patient dies we may never know the reason since we do not usually obtain a post mortem.

It would be hoped that the stress would diminish as a qualified doctor. But the reality of the long hours, the amount of work and ongoing learning and the novelty of each case mean that the junior doctor can never get on top of his/her subject. Moreover where in the past the long hours on call were shouldered by junior doctors, recent changes in medical training have lead to a 'role reversal' with consultants often working longer hours than their junior colleagues.

The simple response to all this is denial. A medical student confronted with the realities of clinical medicine develops a veneer of omniscience. Pretending to the world that they understand and know everything and that they are confident and in control, whilst internally they may know this to be a lie. Some §§§§gradually begin to believe their own lies, aided and abetted by people who also want to believe in them. In the end admitting any weakness or any lack of knowledge becomes unacceptable.

Such a doctor, believing in his own hubris, can inspire confidence in a patient or, when the pride is seen for the sham it really is, can lead to hatred of his arrogance. In some ways we may consider that the doctor is not really at fault in this scenario. His early experience, training, overwork, lack of time and necessity have led him to this situation.

In addition to knowledge, training and preparation, enormous confidence is required if you are, for example, to operate on someone's beating heart or open their skull to operate on their brain. It is important that the confidence is not misplaced and that the arrogance does not hide ignorance. If the confidence was well-placed but excessive criticism has undermined that confidence, it is inevitable that he or she will not be able to continue in their previous role. Thus we are always on the horns of a dilemma.

Finally it must be realised that all men (and women) are mortal. If the aim of medicine is to keep people alive it must eventually fail since every patient will eventually die. Even the very best doctors will witness this failure many times over. They can only continue to work if they do not ascribe this failure as being their own, further burdening themselves with guilt.

If the doctor does not believe he makes mistakes he will not look for or acknowledge his error. When complications of his practice occur, as they inevitably will, he will not wish to confront them and will certainly not want to apologise to patients for mistakes he has made. If he is confronted directly and irrefutably with these errors he may find that he is less able to function as a doctor.

On relatively rare occasions a doctor may know that he has made a mistake but will try to cover it up. This is likely to be due to fear of reprisal; by disapproval of his colleagues, litigation on the part of the patient, suspension or dismissal by his employing authority or being judged (and maybe struck off) by the General Medical Council.

Breaking down misconceptions

There have been moves to encourage reporting of errors such as the introduction of critical incident reporting and error meetings. Some clinical departments in the past flatly refused to hold error meetings because they were deemed too dangerous. Unfortunately too many doctors have feared critical incident reporting and error (or "discrepancy") meetings as methods the managers might use to gain information that may be used against them. Unfortunately too many managers also see critical incident reporting and error meetings in exactly the same way and misuse them to the disadvantage of the medical staff and ultimately to the disadvantage of the patients.

Can errors be reduced?

There are nearly always means by which error can be reduced. The most effective way is by changing systems rather than people. If a technique or investigation has an inevitable built in error, consideration should be given to changing to another technique or repeating the investigation after a time interval [18]. If the error is not inevitable then error can be reduced by improving knowledge, skills and working conditions.

Discrepancy Meetings

Meetings to discuss and report errors are now routinely held in the majority of radiology departments in the United Kingdom following recommendations from the Royal College of Radiologists [19]. They are usually called Discrepancy Meetings and in the Royal Derby Hospital these meetings take place alternate months. Discrepancy Meetings may follow a variety of formats but in all such meetings the aim is to acknowledge, discuss and learn from errors in an open, constructive and blame-free environment. Prior to the meeting discrepancies between reports and other findings are collated and forms submitted which identify the patient, the examination, the date of the examination and a brief description of the discrepancy. Discussion occurs initially between the person submitting the form and the person perceived to have committed the discrepancy so that no one is confronted by a case at the meeting that they are not aware of or which they have not had the opportunity to review beforehand. This allows for more open discussion in a calmer, less threatening, and more instructive way. Whilst cases are not anonymised we are satisfied that our meetings are well received and attended and are fit for purpose.

At the meeting the submitted form is completed. The type of error is recorded and the impact on patient outcome is noted. This includes whether it is a minor or major error.

It is well understood that the format of the discrepancy meeting is subject to bias which can undermine the effectiveness of the process. By the time that the case is being discussed it is clear that there has been a discrepancy, additional clinical information is usually available and patient outcome is often known. Not all cases that come to light are discussed since it depends on agreement between the two radiologists concerned. Bias is therefore present in the form of hindsight, additional information, known outcome and case selection.

In addition to discrepancy meetings there is a second form of error recording which is called "near miss" reporting and the form used is designated as IR1. This is not "blame-free" and may be perceived by some as a finger pointing exercise. The

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worry is that the IR1 is sometimes used as ammunition against other healthcare professionals or other departments. This system is a requirement in the NHS which was brought in under the last government.

Litigation and negligence

"A little neglect may breed mischief"
Benjamin Franklin 1706-1790

So is error the explanation for the escalating litigation problem? This is difficult to answer.
There is a deep well of error running through medicine but doctors do not go out each day saying to themselves "Today I'm not going to bother about my patients. I'm going to be negligent". In fact they do exactly the opposite. The vast majority of them try their hardest to get things right. In our experience of medico-legal cases mistakes that led to litigation usually occurred due to a series of errors rather than a single error. One mistake was compounded by another ... something that was wrong but should have been picked up by another routine check was again missed leading to detriment on the part of the patient .... or an action did not take place because, despite the best intention, events conspired against it. Only occasionally was an individual doctor, nurse or technician the sole person to blame and even then it was usually debatable as to whether or not that person had been negligent.

Most cases brought against doctors fail but cases brought against hospitals are frequently settled out of court rather than defended. In some cases there is no doubt that the patient has suffered inordinately due to a medical complication but that there was no negligence, just bad luck. A workable no-faults system of compensation for iatrogenic disaster is considered by many to be a priority to help such cases.

Conclusion

The methods of dealing with error in radiology have changed over the last decade. The introduction of discrepancy meetings has allowed the discussion of error to move forward and has created a more open and less threatening forum. It is hoped that this will lead to a reduction in error but it is clear that there will inevitably be some error and that, as we have discussed above, some errors simply cannot be avoided because the investigations are not perfect.

Litigation is increasing and it behoves the medical profession to take this problem seriously.

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