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Reissued from November 2004

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Preface

The transmission of images between centres has been established for a number of years and has proved to be valuable for centres seeking expert opinions on emergency and problem cases. More recently radiological images have been transmitted to main centres from outlying hospitals in areas of low population density where small radiology departments have proven unsustainable. The vastly improved capacity of the internet and the speed of transmission has permitted a much wider use of teleradiology with centres around the world providing day-time reporting for out of hours imaging services in other countries in differing time zones. The potential for image transmission is now virtually limitless resulting in major changes to the way radiological services are provided.

This change has advantages but also has potential threats to the quality of care provided to patients and to the radiologist's interaction with their clinical colleagues. It is important however, that the quality of radiological services provided for the patient, are of a high standard. It is also important that those providing the service are properly trained, are registered with the appropriate authorities and undergo continuing update through Continuing Medical Education (CME). The services provided must be open to audit and the ability to discuss cases with those reporting the studies must be available. This document has been developed by the European Association of Radiology (EAR) in conjunction with the Radiological Section of the Union of European Medical Specialists (UEMS) to provide guidance to member societies, managers of health care facilities, patient's representatives and governments on requirements for teleradiology services.

Executive Bureau of the European Association of Radiology, November 2004

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Introduction

Teleradiology is the electronic transmission of radiographic images from one geographical location to another for the purposes of interpretation and consultation. The increased development of digital imaging systems and the speed of transmission of large quantities of data have dramatically widened the scope of this medium and the range and quantity of examinations that are being transmitted. Initially, transmission of images was slow and limited to a relatively low definition of CT studies, but now large data sets of MR and high-resolution studies such as chest radiographs can be transmitted without significant loss of data.

Teleradiology has undergone a number of health-technology assessments in different countries with regard to the context of use, but a great deal of thought and study is still required. Teleradiology clearly has a number of advantages, but it also has the potential to create considerable difficulties for the delivery of a quality radiological service to patients, unless its role and the legal responsibilities involved are clearly defined.

Teleradiology has a number of well-defined benefits which have already become established and recognised. There are however many potential pitfalls, especially if teleradiology moves from its present highly specific role to a general method of service delivery.

Benefits

Teleradiology allows the transmission of images from an imaging source to a diagnostic centre. There are key advantages of this process:

1. For those communities which lie at a considerable distance from a major centre and where there is insufficient work to justify the appointment of local radiologists, teleradiology allows the images to be taken in the patient's locality and transferred for interpretation to a major centre. This has particular value in low-population areas, such as Scotland and Wales in the United Kingdom, northern parts of Sweden, Norway and Finland, some of the under-populated areas of France, Spain and some of the smaller islands of Greece.
2. Images of complex problems can be transmitted from hospitals where expertise is focused on general radiological services to major tertiary centres for evaluation and advice. This also has the advantage that the tertiary centres can decide whether a patient needs transfer from the smaller hospital to the tertiary centre for treatment without unnecessary discomfort and disruption for the patient. General radiologists can also get second expert opinions from subspecialists with ease and a degree of rapidity, which allows them to manage patients in their own localities.
3. The use of other centres to provide emergency reports on images where the local centre does not have sufficient radiologists to provide a 24-hour cover has recently been developed. In particular, where there is a time difference between geographical zones, teleradiology may become an efficient method of giving a rapid report for emergency work undertaken out of hours where no radiologist is immediately available.
4. Improved continuing professional development is possible where teleradiology can be used as an educational device with case presentations or tutorials provided by educational centres for groups of radiologists or individuals in their own hospitals.
5. Permits users to view images in different locations simultaneously for the purpose of discussions.

Real and Potential Problems

Communication

Clinico-radiological Communication

If reporting of radiographs is taken away from close proximity with the patient, the clinical contact between the referring clinicians and radiologists is substantially reduced. Many teleradiology facilities do have phone links with the hospitals from which images are obtained, but direct discussion between a referring clinician and the reporting radiologist on individual cases is restricted. Indeed the bond between the patient and the radiologist becomes unclear. If urgent or significant unexpected features are found, the teleradiology service must transmit them directly to the referring clinician and/or the patient (1). This will be impossible unless there is a clear point of contact for the teleradiology service.

It was shown that clinico-radiological discussions result in a change of clinical diagnosis in 50% of the cases and a change of treatment in 60% of the cases discussed (2). Clinico-radiological liaison is easy in conventional radiology departments through a number of contact mechanisms including multi-disciplinary meetings, direct discussions in the department or in clinics, telephone or local secretaries. These opportunities are much less with teleradiology.

Team Working

The ability to hold multi-disciplinary meetings is much more difficult with teleradiology even with teleconference links. It is now widely accepted that multi-disciplinary meetings, which are often led by the radiology department, are essential in the management of problematic cases, e.g. cancer care. They maximise the understanding of the clinical problems by radiologists (3).

External reviews of health care disasters have emphasised the importance of team working especially in medicine (4, 5, 6, 7) and the need for enhanced team working in radiology has been highlighted (8, 9). Interaction between different members of the hospital team with radiology would be impaired, if radiology was undertaken at the long distance by a teleradiology link.

Linguistic Problems

In many circumstances there would be significant language difficulties with the provision of teleradiology in Europe. While English is widely used at conferences, health care in individual European countries is delivered in the national language. It would be problematic for individual countries to contract their radiology out to other countries, if there were significant language difficulties. Misunderstandings and misinterpretation may well occur, unless the referring clinician and the radiologist are all conversing in the same language.

Wording of Report and Clinical Impact

Even if teleradiologists and referring clinicians have a common first language, it has to be recognised that radiological reporting is not a precise activity. Radiological reports often rely on verbal expressions of probability (10). The pitfalls of vague radiology reports have been highlighted (11).

Modern imaging demonstrates an abundance of findings, both relevant pathology and incidental findings/'pseudo-disease' (12, 13, 14). Multiple pathology can exist in the same patient (8). The clarity and certainty conveyed in the text is particularly important in converting a report that is merely 'diagnostically accurate' into one that has a diagnostic outcome and potentially a therapeutic outcome for the patient (15). Clinicians are more likely to act on the nuances intended in a report generated by a radiologist with whom they regularly liaise compared with a report generated by a teleradiology service. Specific wording of reports for general family doctors may be necessary (16). Health care delivery varies between different countries. Recommendations for further imaging/specialist referral, which might be appropriate in the country where a teleradiology service is provided, may be inappropriate in the country of the patient.



Access to Previous Examinations

The failure to review previous examinations has been shown to be a significant cause of errors in both perception and cognition. It is therefore important that previous studies are available to the reporting radiologist where these are relevant. This may be possible, if the teleradiology service has access to the referrer's PACS system, which may be possible in area networks for specialist referrals, but is unlikely to be feasible for distant teleradiology services providing a reporting service.

Downstream Costs

Teleradiology may generate significant downstream costs. There is potentially increased cost from suggestions by the teleradiology service that further unnecessary investigations are required due to the inexperience or insecurity of the reader of the initial study or from clinicians responding to reports describing clinically insignificant radiological features which have a high prevalence in modern imaging. This problem will be compounded by a potential lack of background clinical knowledge of the case and referring clinician by the teleradiology service. Clinicians who are not confident in a report from a teleradiology service may ask radiologists with whom they work to re-report the images and to advise on case management, thus leading to duplication and poor use of financial resources. There may be perverse commercial incentives for teleradiologists to suggest further imaging. The importance of very close communication between the radiologist and the clinician to minimise inappropriate clinical referrals for imaging has been emphasised (16, 17).

Quality Control

Quality control is more difficult with teleradiology. Error in radiology is common (8). Learning from mistakes through participation in radiological discrepancy/error meetings is established practice (18, 19, 20). Much informal feedback occurs at clinico-radiological meetings and corridor encounters. Audit is another potent form of radiological quality assurance (21). All these activities are much more difficult for a teleradiology service which would need a very close link between the radiologists and clinicians at the source hospital with the service provider of the teleradiology services. It is difficult for teleradiology services to have a proper feedback of the outcome and undertake satisfactory audit of their reports.

Legal Issues

There are a number of potential legal issues.

- a. The registration of the reporting doctors must be recognised by the regulatory body of the EU member state where a hospital or health purchasing body purchases the service. This is an essential requirement in order to maintain proper standards of reporting. The reporting radiologists must demonstrate that they undergo appropriate CME and be properly trained in the tasks to be undertaken. In some EU member states teleradiologists may be required to demonstrate that they are revalidated.
- b. The providers of the service must abide by EU Health and Safety legislation including the working time directive. Radiological accuracy and patient safety is downgraded, if viewing time of images decrease and errors increase with excessive workload. (22, 23, 24, 25).
- c. The use of teleradiology also creates difficulties in terms of the medico-legal issues and the medico-legal responsibilities of the referring hospital and that of the reporting teleradiology services must be identified. It is likely that any radiologist that reviews images has a responsibility. Liability may also reside with the purchasers of the teleradiology service and/or the employers of the teleradiologist. It must be clear who it is who maintains responsibility for the patient. It must also be defined whether the



patient establishes a legal relationship with the tele-radiologist and how any liability will be apportioned. Teleradiology providers would have to comply with any statutory duty of candour to inform patients when they become aware of a negligent act or omission (26). At present the legal status of teleradiology remains to be clearly established.

- d. **Consent.** It is not clear whether the patients will be required to give explicit consent for their images to be transferred to another EU country for reporting.
- e. **Jurisdiction.** An individual has the right to sue a company providing electronic services within another country and the suit would be heard in the patient's own country.
- f. **Patient confidentiality.** The teleradiology service must ensure patient confidentiality and be of adequate technical specification. It must comply with the data protection legislation in the transmitting and receiving country (27, 28, 29).
- g. Teleradiology providers would need to comply with the Euratom directive with appropriate arrangements for justification (30). There is increasing awareness of the need to reduce the high radiation dose that many patients receive at CT scanning (31, 32, 33, 34, 35). When creating teleradiology contracts, it must be made clear who has responsibility for defining the protocol of an individual CT study, e.g. high or low dose depending on clinical indication.

Potential Impact on the Role of the Radiologist

- a. There is a significant danger that the provision of teleradiology services, especially subspecialty services, may diminish the value of the local radiologists and potentially remove most of the more interesting cases to major centres. This will act as a disincentive to general radiologists providing a service in the locality, may result in deskilling and the loss of the local radiological service and the closure of some departments. It may also lead to the isolation of radiographers with high technology equipment but inadequate radiological supervision.
- b. The provision of teleradiology for subspecialty services potentially has the long-term consequence of splitting radiology into its component parts. This has severe implications for general radiology and for radiology training. If all neuroradiology scans are reported through teleradiology services in neuroradiology reporting areas, this will, first of all, produce a vast quantity of work which will need to be covered and, secondly, will remove a major area of interest for general radiologists. A similar situation applies to musculoskeletal radiology and all other subspecialty areas. The advantages of having expert opinions on individual cases is evident, but if all reporting is focussed on subspecialties, there is a real danger of a lack of joined-up thinking in terms of the overall care of the patient. A lack of cross-correlation between subspecialties or generalist perspective may result in diagnostic errors due to the failure of putting together the total picture of the case (36). It may also increase costs.



Guidelines for the Development and Use of Teleradiology

In view of the fact that teleradiology has advantages and significant disadvantages, it is important to develop guidelines for the use of teleradiology. The following guidelines should be used.

- (1) The principle that the patient is best served by a close liaison between the patient, the clinicians and the clinical radiology department should be paramount. The provision of teleradiology services should not diminish the strength of the local provision of radiology services close to the patient.
- (2) Teleradiology referrals should be in the majority of cases organised between clinical radiologists and the teleradiology centre. It is important that the local radiologists act as practitioners under the EU Euratom directive in order to ensure that appropriate investigations are performed and to justify any further investigations suggested by the reporting radiologist (37).
- (3) The agreement and full acquiescence of local radiologists should be obtained in order for the development of teleradiology services to be implemented.
- (4) Teleradiology services developed for rural areas should be linked to the nearest substantive radiology department and the service should be managed by that department. The radiologists involved in providing the service should have close communication with the referring clinicians and patients and should understand any particular local disease and cultural factors.
- (5) The radiologists providing the service must be properly accredited and registered within the European Community. They should be formally registered in the country in which the teleradiology services are being provided, and should also be registered and subject to quality and revalidation requirements of the EU member state for which they wish to provide teleradiology services.
- (6) Under no circumstances should teleradiology reports be made by radiologists in training and the implementation of teleradiology should not be to the detriment of the training in the originating centre.
- (7) The use of subspecialty services should be for the benefit of a second opinion or for the immediate transfer of patients to specialist centres and not for the centralisation of subspecialty reporting away from general hospitals.
- (8) The reporting radiologist of the teleradiology service must be able to communicate directly with the referring radiology department and clinicians in order to discuss the clinical background and unexpected diagnosis which may be relevant to the timely management of the patient. The contact phone number of the reporting radiologist should be provided on the report.
- (9) The equipment used to undertake the whole process of teleradiology must be of a quality and standard that provide diagnostic quality images at all times.
- (10) Proper audit procedures should be in place in order to check the quality of the teleradiology service, the accuracy of the radiological reports and the overall therapeutic and clinical impact of the service. This must include user/clinician feedback.

- (11) The teleradiology service must comply with all national data protection standards within Europe as laid down in the EU directive. Transfer of images outside the EU could pose significant problems of data protection. It is essential that the privacy and the integrity of the patients' information must be preserved at all times.
- (12) There needs to be clearly defined agreement with the teleradiology service with regard to confidentiality of the images which should allow retention for comparison, proper defence against litigation or other clinically appropriate reason.
- (13) The legal arrangements must be clearly defined between the user and the provider so that proper restitution may be made to patients, if errors are made. If the service is a private arrangement, it will be governed by international law between the two countries involved, but the plaintiff should not be required to litigate in the foreign country in the event of a complaint unless they have consented formally to the initial image transfer.
- (14) At all times the provision of teleradiology must be primarily developed in the best interest of patient care and not on the basis of the shortage of radiologists, or as a cost-cutting measure which may jeopardise patient safety and standards of health care.

Conclusion

Teleradiology is already being used around the world and will become commonplace, as information transfer networks increase in capacity and extent. Teleradiology must be used for the benefit of patient care and should raise not diminish quality. Teleradiology should not be developed simply to provide a low-cost reporting service through cross-border service provision. Radiological reports are more analogous to clinical consultations than simply numerical biochemical results. Teleradiology services should be managed by referring radiologists in order to preserve multi-disciplinary care for the benefit of patients and to support radiologists to improve the quality of diagnosis in complex or specialist problems.

There must be clearly defined and agreed processes of image transfer, prioritisation of reporting, reporting styles, interaction with host departments, host hospitals and primary-care doctors and agreement protocols. The legal framework and patient safeguards under which teleradiology services develop must be robust.

The teleradiology literature has mainly consisted of technical evaluations. There have been few economic and clinical impact assessments (38, 39, 40, 41, 42, 43, 44). Prospective comprehensive cost benefit analyses need to be undertaken to determine its appropriate applications. Population/hospital effects as well as individual benefits need to be measured.



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