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Teleradiology – opportunities and challenges

PERSPECTIVES

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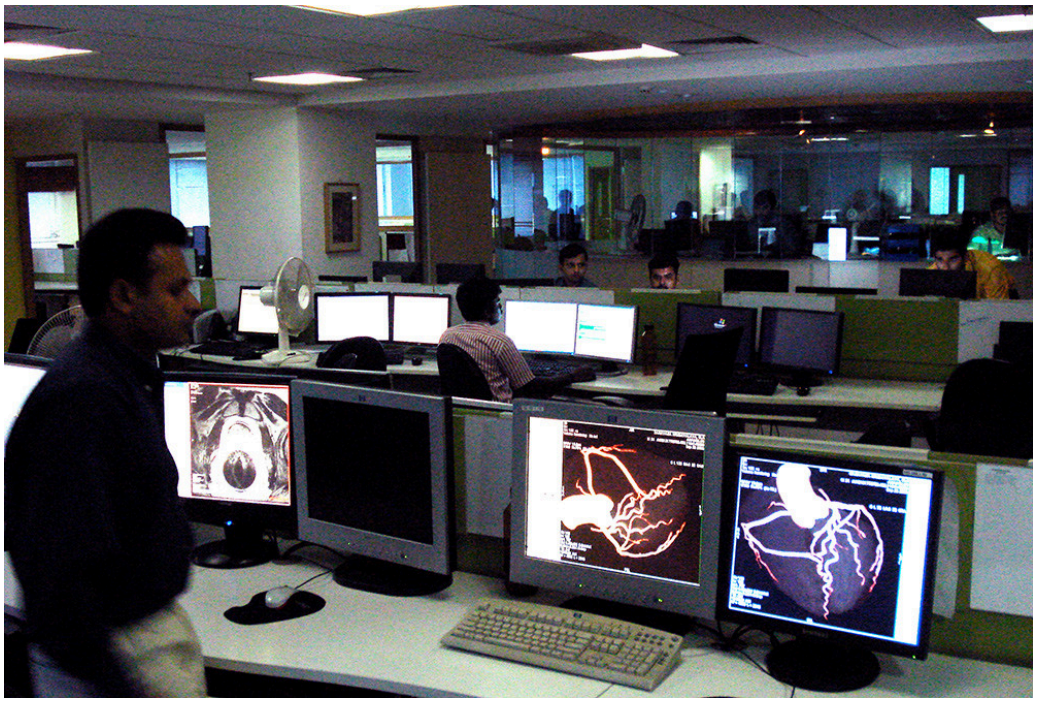
Teleradiology has turned diagnostic imaging into a commodity in an international market. The technology has also made images more readily available to clinicians, and has given rise to changes in the role of radiologists and the needs of clinicians. Used in the right way, teleradiology may help improve diagnostic imaging and enhance its effectiveness. However, using the technology to move diagnostic imaging out of the hospitals would be a step in the wrong direction.



Global teleradiology in practice. From Teleradiology Solutions, Bangalore, India. Photo: Frode Lærum

Information technology has given rise to major changes in the way we work and the way in which we organise our work. Time-consuming manual routines have been replaced by a few keystrokes, messages are conveyed without any need to search for the phone number or the person concerned, and information can be shared and made available in many different locations at the same time.

There are few areas of medicine where the technology has had such a pervasive impact as in radiology. The purpose of this article is to elucidate some of the opportunities and challenges that arise when the technology is used to transfer images and descriptions over large distances – so-called teleradiology.

Development of technology, products and services

For most radiologists, the day is filled with interpreting images, and the interpretation will often take place in another location than where the images were made. Back when the images were made on photographic film, the interpretation would most often be undertaken in proximity to the image-generating modalities – on lightboxes in separate study rooms. In principle, the interpretation could be undertaken anywhere, as long as the images and the clinical issues were available to the radiologist. This is what forms the basis of teleradiology. As a rule, the development of new services grows from new technological opportunities. For example, the first attempts at teleradiology were made approximately at the same time as the moon landing in 1969. If live images could be transferred from the moon to people's homes, it would surely be possible to transfer x-ray images to the other side of town. The same technology was consequently put to use, and we had the first examples of teleradiology (1). The images were transferred in the same way as TV programmes – a TV camera at one end shot the x-ray image, a TV screen

displayed them at the other end, and the two were connected by a communication satellite. The images were interpreted in real time. The quality was deemed to be acceptable (2), but the benefits were probably not quite proportional to the cost – satellite transfer was and remains costly.

Ten years later, technology for transferring data through telephone lines had become available, and a standard x-ray image could be transferred in four minutes at the rate of a local phone call (3). Interpretation was still undertaken in real time, the camera was placed in front of the x-ray film while the image was transferred over the telephone line. Even though the costs of transfer decreased and the quality and detail of the image increased, this model also proved to be less than appropriate for more comprehensive radiological activities. Managing the real-time transfer and interpretation of images via TV technology was complicated, and in spite of the progress made, the quality remained far from optimal. It was still easier and cheaper to move the radiologist than to move the images.

The next step of the development was digitalisation of the images, so that they could be stored and forwarded, and transfer could thus be separated from interpretation (4). However, it was the combination of systems for digitalisation of images, systems for storing and communicating images (Picture Archiving and Communication Systems, PACS) and cheaper and better communication technologies that turned teleradiology into an interesting option for a larger audience (5).

The Nordic countries were at the forefront. Large distances and sparsely populated areas made teleradiology interesting, and advanced technical competence made it possible. The pioneering efforts of Jan Størmer, radiologist and Senior Consultant at the University Hospital of North Norway, should be emphasised in particular. As early as in 1992, x-ray images were transferred from Tromsø Military Hospital to the then Tromsø Regional Hospital (6). Instead of having assistance from a radiologist once a week, images could be interpreted by a radiologist every day. In 1995, digital recording of images was introduced (7), and the service had thus become fully digital.

From the mid-1990s onwards the technology improved in terms of speed, quality and cost. Portability has been further improved (8), but the technological principles for teleradiological image transfer remain the same. On the other hand, we have seen the emergence of new teleradiological services. In the US, companies such as NightHawk, vRad and a dozen others have delivered commercial interpretation services since the 1990s. In Europe, a few companies have emerged with the intention of offering services for the European market, and even in Norway private actors may supply teleradiological services, even though they primarily use the technology to distribute the workload among their own departments.

In 2009, an estimated 50 – 55 % of all American hospitals used some form of internal or external teleradiological services (9). In 2010, one-third of all Norwegian hospitals reported to the teleradiological committee of the Norwegian Radiological Association that they were using teleradiology for primary interpretation (10, 11).

Opportunities and restrictions

The opportunity to provide radiological services at night was an important impetus in the US. Initially, the specialists themselves were on call at home, but gradually radiologists were hired especially for the night shift (12). In Norway as well, seven of a total of 26 hospitals reported to have implemented full or partial on-call collaboration with the use of teleradiology (11). Since not all parts of the world have their night at the same time, some have seen the opportunity for providing services across national boundaries and time zones. Companies such as Teleradiology Solutions in Bangalore and Telemedicine Clinic in Sydney provide interpretation services for the American and European market – daytime there is night-time for their customers.

Another important impetus has come from the shortage of radiologists and the unbalanced distribution of patients. Now, it has become easier to move the images to where the radiologists are than to move the radiologists, and no radiologist should have to wait for something to do. Teleradiology has also paved the way for quality improvements. One can consult with sub-specialists for advice in difficult cases, the doctor on duty can consult with the doctor on call without the latter having to come to the hospital, images can be exchanged as part of quality-assurance routines, particularly instructive cases can be distributed (anonymously), and multi-centre studies have been made easier.

A French study estimated that in 37 % of the cases involving teleradiology, referral of the patient to a larger hospital was avoided, and hospitalisation was avoided in 12 % of the cases (13). In Japan, the annual potential savings were estimated at USD 1.27 million (14). Other studies have been less positive. A study of two European projects observed that neither of them was established on a permanent basis. The technology remained a challenge, it was costly, there were language problems, and cultural and professional differences gave rise to disagreement in 10 % of the cases (15). In 2008, the Trainees' Forum of the European Society of Radiology voiced concerns that instructive cases had become less available to them, because the cases were sent to sub-specialists by teleradiology (16).

Care for patients and protection of personal data

Obviously, one cannot send x-ray images and other patient information via the Internet without any restrictions, since a balance invariably needs to be struck between concerns for privacy and care for patients. On the one hand, one does not want information to end up in the wrong hands, but on the other hand it may be crucial that the information ends up with the right person.

In the US, special attention has been devoted to the qualifications of those who undertake the interpretation. Partly, this has entailed that telemedical services are operated by specialists who are accredited in the state concerned. Less attention has been devoted to other aspects of security, and there are examples

of staff members in Asia who have used threats of publication of American health data as a weapon in wage conflicts (17). Such issues have caused the EU to only allow transfer of health data to countries that have similar legislation and identical legal safeguards. In Norway, we have tended to emphasise protection of privacy – perhaps at the cost of provision of care to patients?

From medical speciality to commodity?

New technology provides new opportunities, but also new threats. Why should we employ well-paid radiologists in the Western world when we can have the images interpreted at a fraction of the cost in a low-wage country? This idea has occurred to many. Gregory Mankiw, chief economist to George Bush, is reported to have said: «We don't have a comparative advantage in producing clothing, textiles, and that's one of the reasons we've tended to lose textile jobs. Maybe we've learned that we don't have a comparative advantage in radiologists» (18). On the occasion of the annual assembly of the Canadian radiological association, its chairman Normand Laberge stated that teleradiology abroad could be a possible solution to Canada's chronic shortage of radiologists (19). This caused such an outcry that the Ontario Radiological Association submitted a vote of no confidence against him, and he had to retract his statement.

This discussion concerned the soul of radiology. There was a fear that diagnostic imaging was changing from a medical speciality into a commodity, acquired in a manner similar to medical supplies, where the quality is defined in terms of minimum criteria and the price is based on supply and demand. The threat that teleradiology might represent to American radiologists is described in articles with titles such as «Nighthawk, bird of paradise or albatross» (20) and «Radiologists are physicians, not commodities» (21). It was envisaged that Indian radiologists would outcompete the American ones, unless the American radiologists agreed to lower their prices – and wages.

McLean analysed this assertion on the basis of economic models (22). His conclusion was obvious, but interesting. First, there are not so many unemployed English-speaking radiologists in India, and it is far easier to staff textile factories with unskilled workers than to staff teleradiology centres with specialists in radiology. Second, an increasing middle class in India will give rise to a growing demand for radiological services in the home market, causing the prices to rise. Teleradiology centres in low-cost countries will play a marginal role.

The radiologist's new role

Another factor may play a more crucial role. The technology that can be used to send images to radiologists around the globe can also be used to communicate images to clinicians locally. Most studies indicate that radiologists are better than clinicians at interpreting images (23), but clinicians will increasingly often

undertake the first interpretation of the images themselves. Especially in their fields of specialisation our clinical colleagues undertake a lot of skilful interpretation. This has spurred a change in the radiologists' role – our impression is that the clinicians more frequently wish to discuss cases, rather than to receive answers. An Italian study showed that such discussions caused the clinical diagnosis to be changed in 50 % of the cases (24). Lindsay and collaborators found that an increasing availability of radiologists for direct consultation was the only factor that was significantly correlated with the clinicians' satisfaction with the radiological services (25). Swedish researchers observed that the introduction of information technology in diagnostic imaging caused the radiologists to change from being individual experts to becoming participants in a network (26).

Here at home, we can see how routine demonstrations, the purpose of which is to communicate the radiologists' answers, are gradually being replaced by dedicated conferences where individual cases are discussed in an interdisciplinary context. Conferences at which an internist, a surgeon, an oncologist, a pathologist and a radiologist are all present have become common practice in the larger hospitals. In such conferences, the clinicians will not be satisfied with any old radiologist – the importance of having a local radiologist with whom one is familiar and whose skills are known has been emphasised (27).

Proximity to the radiologist

Teleradiological methods have provided us with an opportunity to distribute the workload and improve access to competence. The use of teleradiology in the contact between existing hospitals and institutes may provide us with quality improvements as well as a more evenly shared workload. However, we should refrain from using the technology to establish new institutions, such as radiology units that serve several hospitals, or regional extramural interpretation centres (28). This will take the radiologist out of the clinical teamwork, in the opposite direction to the one in which modern radiology is developing. One could, of course, use technology to ossify old-fashioned working methods, but there is no reason to do so.

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