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The Modern Radiology Department

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Key Points

• A central, integrated radiology department offers many opportunities with regard to quality, 24/7 coverage, logistics, economics, management and specialised logistic support compared to decentralised imaging structures.

• Sub-specialisation related to clinical fields and continuous participation in multidisciplinary activities in the hospital are key factors contributing to the radiologist's clinical relevance to patients and colleagues.

• Implementation of the evolving hybrid imaging modalities requiring knowledge and skills in both radiology and nuclear medicine can best be accomplished when both disciplines are integrated in a central imaging department.

The close relationship between the evolution of information technology and advanced biomedical engineering leads to a constant, strong innovative drive for radiologic imaging. Modern advanced imaging offers unprecedented medical information. Cross-sectional imaging techniques, especially magnetic resonance imaging (MRI) and computed tomography (CT) are generally considered to be among the most important innovations in modern medicine (Fuchs and Sox 2001), and have a central role for patient care in every major hospital. Due to the increasing role and unique opportunities of these powerful technologies, and the high cost related to imaging equipment for the hospital, the question may be raised: which is the optimal organisational form for implementation of these powerful technologies, and what is required in terms of knowledge and skills in order to serve the patient best?

The Central Radiology Department: Opportunities

The optimal form of the radiology department depends on a variety of factors, including architectural layout of the hospital, available space for imaging equipment, logistics for inpatients and outpatients and distribution of medical specialties within the campus. A central hospital imaging platform organised in the form of an integrated radiology department, including all biomedical imaging services offers many synergistic effects (Krestin 2009). These include long-term planning and investment strategy for heavy equipment, medical, technical and administrative staff, IT systems such as Radiological Information Systems (RIS) and Picture Archiving and Communication Systems (PACS) for the entire service chain from scheduling to reporting, risk management, quality management, logistics and ergonomics.

Providing 24/7 coverage for diagnostic and interventional radiology in a large general hospital or tertiary referral centre hospital requires a large team of radiologists trained in several sub-specialised areas, such as interventional radiology, neuroradiology or paediatric radiology, but also sufficient "all-round capabilities". This is more easily provided by a large central imaging department than by small delocalised and sub-specialised medical units.

Using imaging equipment for all indications and all patients of an institution may allow optimisation of processes for patient care, cost-effective use of resources, and of fer adequate training for medical, technical and administrative personnel. Most biomedical imaging procedures require risk management related to safety aspects of ionising radiation, contrast agents, magnetic fields, intravascular procedures, etc. The quality processes, which are needed in order to guarantee safe imaging to the patients, are best implemented in a common management structure.

Postgraduate training programmes and acquisition of expertise in subspecialised fields of radiology are easier to plan and implement in unified imaging departments with access to all modalities and subspecialties than in decentralised structures, in which imaging is integrated into different clinical departments and postgraduate training programmes.

Finally, professionals providing expertise in areas that support the activities of the radiologist such as MR physics, informatics, image processing or quality management can usually only be afforded by larger structures where they can create synergistic effects.

Challenges: Performance Criteria

The performance of a modern radiology department can be measured by a variety of criteria:

• The patient wishes for timely and personalised scheduling, a “smooth and safe” experience in the department and access to information whenever needed.

• The referring physician requires an easy, quick referral process, clear information regarding risk management (contrast agents, radiation, MR safety), timely turnaround of repor ts, and radiologic medical expertise, including 24-hour coverage.

• Residents look for a complete, didactic postgraduate training programme and interesting career plans; their satisfaction may be surveyed by central authorities.

• Hospital administrators tend to look mainly at indicators for process efficiency or for quality, such as patient satisfaction, team management and return on investment.

• Academic departments are in addition measured by their contribution to undergraduate training, their third-party research funds and scientific output, and the academic careers and visibility of their staff on a national and international level.

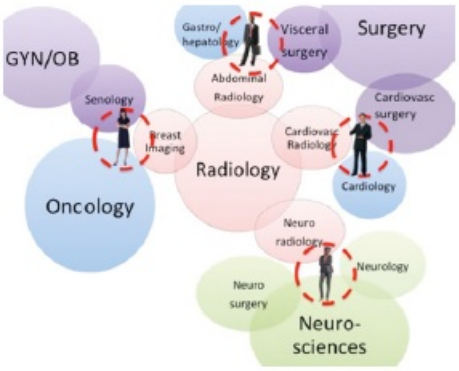
A successful radiology department should meet all of the above performance criteria - a challenge for leadership.

Challenges and Opportunities: Digitisation and “Commoditisation”

Because PACS are now widely used in hospitals, images acquired in the radiology department can be immediately made available to the referring physician for visualisation. The traditional flow of information in the hospital has, therefore, become considerably accelerated, and referring physicians may be tempted to self-interpret images that are not accompanied by a radiology report immediately, albeit a preliminary interpretation. Decentralised or even remote post-processing of standard diagnostic images is possible in many institutions by means of web-based or dedicated post-processing software. Specialised clinicians may make use of these tools for various purposes, such as treatment planning, quantitative image evaluation, or scientific or didactic applications, without involving the radiology department.

The term commoditisation refers to imaging being regarded as a relatively undifferentiated technical service that can be offered anywhere, in a competitive fashion, thus undervaluing the expertise of the radiologist for imaging protocol management and interpretation (Forman et al. 2011). Certain referring physicians may even choose to self interpret or re-interpret imaging studies.

Image communication outside the hospital opens up a variety of opportunities for the radiology department. These include the creation of intraand inter-institutional networks, improved availability of previous imaging studies, expert consultation for difficult imaging studies or second opinion services. On the other hand, teleradiology services also offer the possibility to economise on local radiology staff by sending locally produced images to distant radiology services for interpretation.



Challenges: Increasing Medical Sub-specialisation

The trend towards sub-specialisation in internal medicine and surgery related to organ or disease entities often provides the referrer with increased knowledge with regard to the indications for imaging, radiologic anatomy and expected pathologic findings. Radiologists working in multidisciplinary teams or diseaserelated “centres” thus require additional knowledge in the fields of their clinical counterparts and in-depth knowledge of their needs.

Some imaging procedures and image-guided interventions are the object of “turf wars” between nonradiologist physicians such as cardiologists, neurologists or vascular specialists. Several reasons may explain the interest of nonradiologists physicians in “owning” an imaging procedure: (1) the knowledge acquired in a given field may make the nonradiologist physician believe that he or she can or must do without a radiologist, especially in situations where the radiology department does not or cannot provide trained and skilled staff radiologists in the respective field; (2)

ownership of an advanced imaging technology may appear to a sub-specialised non-radiologist physician as an advantage to his or her field as a research tool and for promoting careers; (3) self-referral offers the opportunity to confirm the physician's own diagnosis, and also gives financial incentives, although it has been shown that the practice of self–referral results in overuse of imaging procedure and increased cost for the health system as compared with radiologist referral (Hillman et al. 1990). Self-referral requires direct access to imaging technology. Although this may be easily obtained in the case of ultrasonography, different forms may apply in the case of CT, MRI or nuclear medicine. Nonradiologists may obtain imaging privileges for certain indications on certain equipment of the radiology department, with the radiology technician reporting directly to the clinician, or both imaging equipment and technical staff may be integrated in nonradiology departments, thus leading to decentralisation of imaging services. Whatever solution is preferred, the radiologist will always end up in an unfavourable position if his referrer chooses to become a competitor for a given procedure.

Radiology departments providing adequate subspecialised imaging services in the relevant clinical fields of the hospital are much less at risk of being involved in "turf wars" as described above than departments who are staffed by general radiologists. The concept of radiologic subspecialisation must correspond to the local referral patterns, workload and needs in a hospital with regard to clinical fields that may be organ-related, patient-related or pathology-related. At least 2-3 radiologists with subspecialty training are usually required for full coverage of a relevant field with regard to clinical services, teaching and research. This number increases to 4-5 for subspecialty areas where 24 hour services are to be provided, e.g., for interventional radiology. Depending on the local situation, a matrix system may often appear useful, in which some staff radiologists may be integrated in more than one subspecialty.

Fellowship training positions can be established in relevant subspecialties; advanced training usually requires a minimum of two years, depending on the local spectrum. This concept provides interesting career opportunities for senior radiologists, provided that sufficient staff positions are available in the radiology department, and organisation in the form of subspecialty units can be created. The structural and financial requirements may represent a leadership challenge, because the hospital administration needs to be convinced to invest in the central radiology department, and rely on its organisational structure.

Clinical Relevance of the Radiologist

In order to make radiologic medical expertise valuable in the modern multidisciplinary environment, radiologic services need to be fast, accurate, accessible and relevant (Forman 2011). This includes competent guidance with regard to imaging indications, adequate risk management and protocol selection for individual imaging studies, quality and timeliness of repor ting, active participation in the definition of clinical pathways, availability for second opinions on external images (role of consultant) and regular par ticipation in subspecialised clinical rounds and tumour boards. The subspecialised radiologist remains attached to his or her depar tment, but works closely with his clinical counterpar ts, and ensures advanced postgraduate training and research activities in his field. He or she may also have a key role representing radiology in disease–related multidisciplinary centres (Reekers 2014). This form of organisation places the patient in the centre of the multidisciplinary team of specialists (see Figure 1). It has been shown in tertiary cancer care centres that radiologic consulting leads to important changes in patient management. However, the average daily work volume for second opinions and reinterpretation of external images may add up to almost 20% of the workload of a senior radiologist (Brook et al. 2011; DiPiro et al. 2002).

Role of Nuclear Medicine

Although the role of traditional scintigraphy has diminished significantly over the past decade, new imaging modalities combining MR and CT with modalities such as positron emission tomography (PET) or single – photon emission computed tomography (SPECT) have been successfully introduced in clinical medicine. Because the implementation and interpretation of PET-CT, MR-PET and SPECT-CT requires technical and medical skills related to both radiology and nuclear medicine, these combined imaging modalities are also referred to as "hybrid imaging techniques", and play an increasing role in clinical fields such as oncologic imaging, neuroimaging or musculoskeletal imaging. Hybrid imaging may also have an increasing role in the future with regard to new molecular imaging techniques in the context of "personalised medicine"and "theranostics" (European Society of Radiology 2011).

It appears obvious that the organisational structure of a modern imaging department should allow for training curricula that enable some trainees of these disciplines to acquire certification in both disciplines, so that subspecialists eventually can interpret all relevant imaging modalities that are relevant in their respective fields. Clearly, this can be best achieved in structures where nuclear medicine is integrated with radiology in the same department. Although this is the case in many North American institutions, organisational structures in Europe are currently still quite variable, as are the training programmes for dual specialists in many European countries. However, change is likely to occur over the years to come.

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