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# Vision For Academic Radiology, "the Network As An Infrastructure"

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## Abstract

The development and evolution anticipated for the 21st century in radiology's conversion into a discipline that more broadly incorporates the diverse specialties of engineering science, information management, decision analysis, and physics into the art of medicine has created an opportunity to prospectively evaluate the interaction of the radiological scientists in academia and the clinicians to whom they provide consultation.

## INTRODUCTION:

The development and evolution anticipated for the 21st century in radiology's conversion into a discipline that more broadly incorporates the diverse specialties of engineering science, information management, decision analysis, and physics into the art of medicine has created an opportunity to prospectively evaluate the interaction of the radiological scientists in academia and the clinicians to whom they provide consultation. Thus, the evolving complexity of imaging sciences and the increasing reliance of clinical medicine upon "definitive" imaging studies will make it necessary for the radiologist to be an optimal interdisciplinary consultant. Therefore, it will no longer be sufficient anymore for radiology training to build upon the basic anatomy and physiology taught in medical school, but it must also expand and enhance the ability of its trainees to function as general imagers while integrating science and clinical information, i.e., as fully integrated members of the health care team.

The radiologic scientist of the 21st century will need to be able to act as a nexus of information, allowing for the seamless acquisition, interpretation, and distribution of information so that clinical services can function effectively. This role will require the ability to not only converse with the clinical specialists about their needs on their level, but also to educate them, along with him/herself, as to how the acquisition, interpretation, and outcome of imaging studies may affect the care and eventual outcome for a patient.

There will also be a need for the radiologic scientist to be

able to take the lead role in the performance of outcomes research, with well designed studies, and to be a contributing member in their funding. This outcome's assessment will need to be a primary focus for radiology in the next century, as physiologic principles and processes are incorporated into new imaging modalities and techniques.

On a clinical level, the main thrust of this change in radiology as a profession represents a shift to a more central role in patient care. Thus this may happen, firstly it may entail more direct contact with the patients, or at least with the primary care physicians, in order to expedite appropriate management and an imaging work-up prior to subspecialists' referral. Secondly with the integration of the time needed for patient care, testing required and remuneration/managed care issues ever increasing in complexity, the ability for the radiologist to serve as an adequate and appropriate triage consultant even on a subspecialist level becomes more critical.

This substantial paradigm shift in the profession will work best with the acceptance of radiology as a central hub for dissemination of information within a clinical care environment. Our vision of how the imaging department and its members can be urged to change its attitudes toward training and its perception of its mission to be the catalyst and necessary partner in patient care and outcomes analysis via an integrated network is the focus of this paper.

## RESOURCES:

In the Department of Radiology, the main functions of the more senior staff are not so much in the garnering of

information, but rather in its interpretation. The gathering of the data must be done by other well trained personnel, such as residents in an academic environment, and technologists in either academic or clinical environments. This information, once it is acquired, needs to be effectively disseminated for the overall functioning of a healthcare delivery system. A network environment that is interdependent and optimized will play a central role in assisting radiology to function as the nexus of information. Eventual outcomes assessment and technology evaluation can then also be easily instituted.

A practical, efficient clinical radiology information system encompasses easily retrievable patient intake data, imaging results, their interpretation, as well as the storage of this data. This batch of information must be immediately transferrable to the appropriate clinical caretakers, and/or to subsequent imagers for comparative interpretation. For this to work, only an integrated network can allow for such a flow of information without impediment. In addition, this batch of data is eminently suited, as it is coupled to the hospital information system, for longitudinal outcomes research. The results thus obtained would allow for clinicians to access on-line what imaging services are indicated, available, and most effectively coupled with likely outcome scenarios for a host of particular clinical questions. As a further benefit one can distill from these data a database of departmental imaging research interests and available expertise would be provided, available not only to the associated clinical services within one institution, but also to other hospitals and even to other research institutions.

The real positive net effect of such an integration of information via an integrated computerized network, with radiology as the hub, could be a system where the radiologist can be the facilitator to solve clinical problems, based on outcomes assessment on a continuing basis. This would allow making imaging intervention, research, and teaching more timely, effective and cost efficient. In particular, through the integration of a radiology information system and PACS imaging via an integrated network, longitudinal studies would not only allow for multifactor analysis for what variables may impact on eventual outcomes, but imaging evaluation and questions regarding the technique and information available by various imaging modalities would also be accessible for use in outcomes assessment and multifactor analysis for patient oriented research. These analyses are only feasible if large longitudinal studies can be performed with relatively inexpensive and ready access to

images, clinical data, and formal interpretational information. In summary, all these mechanisms would not only increase the efficiency, accuracy and continued quality improvement in the department, but also would improve an academic department's visibility and allow for the possibility of widespread extramural collaborative initiatives.

One additional change is that staff radiologists need to be inhouse, "visible", and thus available to the clinical team at all particularly critical times. It is only reasonable for a team to be cohesive if all members of the team are putting in the same effort. The ongoing reimbursement battle is nudging, no pushing us, in that direction anyway! The issue then becomes: How do we convince our fellow imagers of this paradigm shift. We propose that by the tight integration of the network environment, network resources and an orderly work/responsibility flow one can improve and leverage staff radiologists' productivity, and increase a radiology department's visibility and essential position vis-a-vis patient care. Let us speculate on the impact such a networked clinical/RIS/PACS network would have in the various aspects of an academic radiology department's responsibilities.

### **TRAINING: MEDICAL STUDENT TEACHING**

Bringing radiology into the medical education loop early is the key to having a clinician interested and knowledgeable about in what happens in the imaging suite. This is the first step for future effective dialogue in the form of a well documented imaging requisition, making its way to the imaging department. As in an integrated networked system, it is quite possible that there may be no direct relationship between the physician making the request for the imaging study and the radiologist performing this study, and with accessibility to the imager being even further limited, as clinical teams are pulled in different directions, possibly at multiple sites. Thus, there is great need for radiology in adequately educating medical students so that the future clinician develops a lasting sense of mutual dependency.

Integrating radiology training into early medical education should start as early as in anatomy and can take the form of regular lectures that present the spectrum of imaging studies, show normal and diseased appearances pertinent to the organ system being discussed, and in addition is an excellent way to showcase imagers as teachers and consultants. In the physiology blocks, there should be integration of nuclear

medicine and MRI physiological imaging studies in the teaching of renal, cardiac, and hepatobiliary disease. In the 3rd, but more likely the 4th medical school years, the use of multimedia technologies can allow for information that is archived in an electronic format to be used for on-line continuing education. This integration of a networked environment allows the creation of this on-line continuing education material to be done dynamically and interactively. It is much more practical to be able to create a teaching file if you can merely indicate on the network system that such a case should be considered a teaching file. The images, clinical history, and interpretation are then readily available as a package of digital information; and, along with current CD-ROM resources for physicians, appropriate information can then be tagged for attachment to the digital teaching file along with a worldwide web network link to the National Library of Medicine for current references.

One expectation of increasing the visibility of the field early in medical training is that people with interest and/or academic aspirations can be recruited early. The possibility of the integration of medical students into existing or starting research projects within the Department of Radiological Sciences can then become a standard rather than an exception. The recruiting process can then continue by mentoring those students that have made themselves known through constant and relatively intense contacts with the imaging department.

## **RESIDENTS**

The effect that well trained educated residents can actually minimize the impact that their educational needs place on a department cannot be over-emphasized. This can best be accomplished in a collaborative environment where collegiality and professional integrity is the rule. The better taught a resident is, the more effectively the service runs. If a well coordinated resident education process is in place, that allows vast amounts of skills to be taught in a short span of time, the resulting increased clinical efficiency will lead to improved research, clinical, and educational opportunities for both staff and residents. This need not occur all in-house. Ancillary educational opportunities, such as: AFIP, collaborative rotations at other facilities, and self-directed research time, can all contribute heavily towards this goal.

To hit the ground running in each rotation the first year incoming residents could spend a short (e.g., 2-5 day) intensive training with a multimedia training tool prior to beginning clinical duties on the new service [1]. It would

allow for an improved baseline of knowledge that benefits both the resident, staff, and the clinical service. This would also provide the staff working with residents with a reason to expect a baseline of knowledge for each resident, and therein freeing the staff to educate on a more individual basis and to allow for discourse on more sophisticated and advanced issues. The achievement of today is the baseline of tomorrow. Well educated residents are the best "advertisement" a department and, thus, a medical school can have.

The network environment, actually becomes a currency of exchange for the radiological imaging scientist. The ability to move that currency as efficiently as possibly and effectively becomes a critical pathway in performance of clinical duties and research. Thus, the ability to direct information of a specific nature to a specific person rapidly with reporting of its receipt, necessitates not only a digital network of personal work stations, but actual bulletin board areas for specific areas of interest, be it modality or organ system. Fellows, residents and medical students in particular would have the ability of individual and shared learning labs, research space and support personnel [2].

With a central server and individual work stations permanently and practically situated in the department, the library, the wards, and various laboratory areas as well as portable digital systems with communication over a wireless network will create a powerful service and learning network for radiologists.

## **MEETINGS, PRESENTATIONS AND INSTITUTIONAL COLLABORATIONS**

Though some may advocate that mere integrated radiology information systems would be sufficient for outcomes assessment, the ability to integrate the actual imaging with tying-in of PACS and the ability to have ready access to results and consults at any location in the department via wireless systems opens up the ability to not only expedite the delivery of care, but to be able to dynamically assess outcomes as necessary [3]. For example, radiologists dealing with a radiographic study, i.e., chest x-ray obtained after some new interventional procedure such as thorascopic pulmonary nodule resection, might be able to analyze the data of the last thousand patients' initial post-operative chest x-ray and examine for trends which could then be easily correlated with outcomes online!

## **OUTCOMES ANALYSIS**

It is this vision wherein lies the opportunity to become

educated and familiar with basic research skills and outcomes: the shifting of the clinical role for imaging. The sooner we align ourselves with the time and patient demands of our clinical colleagues and we assess actual outcomes of our work, the better the chance we stand of staying in business as a central clearing house of information. Otherwise, we risk being excluded from the loop altogether and being considered extemporaneous.

The imaging department must insinuate itself and integrate itself completely into clinical care or be excluded and / or replaced. The need for on-line diagnosis and patient

management and access to data for outcomes assessments mandates that whoever controls the data be able to provide results rapidly and expeditiously and those who cannot will lose control of this data.

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