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RADIOLOGY ▪ CARDIOLOGY ▪ INTERVENTION ▪ SURGERY ▪ IT MANAGEMENT ▪ EUROPE ▪ ECONOMY ▪ TRENDS ▪ TECHNOLOGY

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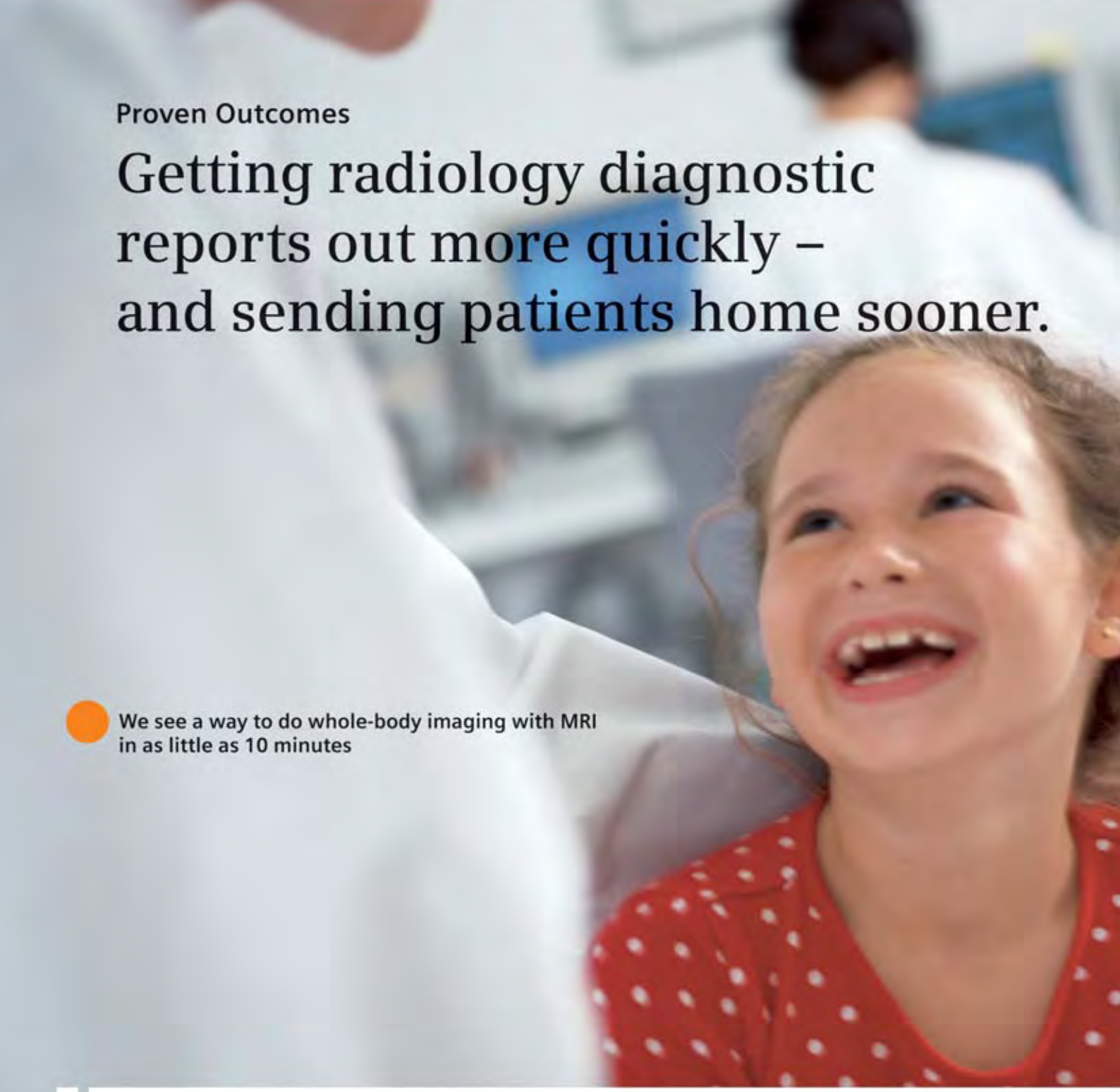

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Volume 7 Issue 2, March/April 2007

COVER STORY How PACS Reinvented Radiology

FEATURES This issue's features include:

COUNTRY FOCUS
Radiology in Sweden

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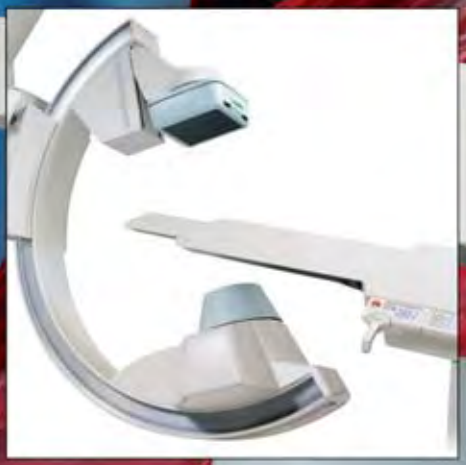

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Editorial

Prof. Iain McCall
Editor-in-Chief
EiC@imagingmanagement.org

How **PACS** has **Reinvented Radiology**

Dear readers,

Probably the most significant sole factor in the transformation of the way radiology services are provided today was catalysed by the launch of PACS systems across the globe. Aside from glowing references about the technology itself, and how it has revolutionised healthcare services, what has been the practical impact of PACS on the profession of the radiologist? And how are European countries responding to the technology? In this edition of IMAGING Management, we analyse how PACS is absorbed into not only a nation but also within the radiology department and look at the way it has prospectively altered the future of radiology.

The design, construction and operation of a PACS system that services an entire nation, that also takes into account the different needs of each service provider in the network, is a massive undertaking. Our cover story includes accounts of two such national programmes, one in the UK under the auspices of the national 'Connecting for Health' programme, the other a national implementation programme in Estonia which overcame significant challenges in financial and integration terms.

The undoubtable benefits for participants in these national programmes are, of course, a massive reduction in the time to diagnose illness and injury, a decrease in film and staff costs, and images such as x-rays and scans can be stored and mailed electronically so that doctors can speed diagnoses. Health professionals across an entire country have access to high quality information at the touch of a button. Most importantly, it plays a strong role in countering a shortage in trained radiologists overall, and a lack of specialised services in certain remote or rural medical imaging centres, that affects health systems in several European countries.

To complement this focus on national PACS programmes, we also include an article on the impact of PACS on a micro-scale – notably the influence of PACS in the department of radiology and how it has transformed the way those in the profession view their changing role.

As usual, we welcome your thoughts and comments. Email: ***editorial@imagingmanagement.org***

Prof. Iain McCall

HAVE YOUR SAY!

Letters to the Editor at editorial@imagingmanagement.org

Workshop on the Art of Leadership, Gstaad, Switzerland, Jan. 4 - 6, 2007

MIR, the sub-committee of the European Society of Radiology (ESR) on management, are pleased to announce the success of their recently-held 13th Annual Workshop (Jan 4 – 6, 2007, Gstaad, Switzerland), on the theme of "The Art of Leadership: Managing Priorities and Stress in Yourself and Those you Lead". Said Prof. Georg Bongartz, outgoing Chair, "MIR workshops provide a lively forum for senior radiologists to explore current management topics and obtain further tools to aid their personal effectiveness and growth as managers of others".

Feedback from regular and new participants confirms the tangible value of workshop sessions, including:

- Examining a range of current leadership theory and figuring out what fits the world of radiology best;
- Opportunities for each participant to get group and leader feedback on real-life personal leadership challenges;
- Tips and tools for winning back lost time and focusing on priorities;
- Techniques for managing stress;
- A base strategy for work/life equilibrium;
- An introduction to a powerful technique for coaching and developing others in the workplace.

As well as taking away their own extensive notes and personal plans, participants were introduced to a range of further reading and resources for continued self-development. Feedback from participants of this workshop was as enthusiastic as in previous years, encouraging MIR to start planning the next workshop. The call for the next MIR workshop is expected to be announced during the Annual MIR Congress in Oxford, UK, 10 – 13 October, 2007.

Why 'Management' in Radiology?

In the mid-Nineties, a group of radiologists recognised the growing impact of rapid changes in the radiology landscape, in concert with a lack of dedicated management training across Europe for radiologists. They established the "European Working Group on Management in Radiology", (EWGMR) to address this skills deficit.

EWGMR organised the first winter course on management in radiology in 1995 in Davos (Switzerland), addressing general concepts in radiology. Further workshops focused on areas such as building and leading working teams, human resource management, interpersonal effectiveness and change management. In 2003, EWGMR became the Subcommittee on Management of the European Association (now – Society) of Radiology (MIR), and the winter course was renamed the "MIR workshop".

Structure of the Workshop

Usually organised during the first or second weekend of each year in alpine locations, the workshop typically starts on a Thursday afternoon and ends on Saturday, at midday. Sessions last from 8am till 7pm, with a four-hour break for networking and outdoor activities. Both new and returning attendees at the workshop benefit from a select and limited participant level, allowing trainers to have greater input with individual participants. The venue, topic and faculty of the workshop is chosen by MIR members. Three major contrast agent producers (GE Healthcare, Schering and Guerbet) have sponsored the course since it began.

Expert Course Leaders

The 13th workshop in the series was by Gerd Pohl and Tony Poots, two highly experienced management trainers who created a dynamic learning environment for attendees to network and collectively explore the topics. Through a mix of lectures, discussions, simulations and coaching techniques, participants were encouraged to analyse their leadership role and plan their personal development as leaders. The complementary approach of both leaders, Tony with practical hints and examples for daily improvement and Gerd offering a more philosophical and psychological approach to the topic, offered attendees a thorough perspective on each issue.

Highlights from the Sessions

According to Dr Sergei Nazarenko, a regular participant at the workshop, "One of the most enlightening lessons was about the link between self-esteem and leadership style. Also, we learned that distraction from important issues is not only due to external but also internal "work-interruptions", acting like escape mechanisms from stressful situations". He continues: "We also learned to distance ourselves in order to maintain objectivity to our own judgement and performance. The two facilitators made us aware of the potential in each and all of us and opened our eyes to mistakes we repeatedly make – just because we like them".

This workshop was the last one organised by Antonio Santoro, Rome, who served as secretary to MIR over many years. His task will now be handed over to the ESR office in Vienna, where Henrik Silber will be the coordinator of future MIR events. Moreover, Georg Bongartz announced that his tenure as Chair of the MIR will end in March and he introduced his successor, Nicola Strickland, UK.

www.ewgmr.org

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Next Connectathon: April 15 - 20, 2007 Berlin, Germany

IHE is an initiative by healthcare professionals and industry to improve the way computer systems in healthcare share information. IHE promotes the coordinated use of established standards such as DICOM and HL7 to address specific clinical needs in support of optimal patient care.

IHE provides a detailed implementation and testing process to promote the adoption of standards-based interoperability by vendors and users of healthcare information systems. The process culminates in the Connectathon, a weeklong interoperability-testing event. The Connectathon provides the most detailed validation of the participants' integration work. Participating companies prepare for the event using testing software - the MESA test tools - developed for this purpose.

During the Connectathon systems exchange information with complementary systems from multiple vendors, performing all of the transactions required for the roles they have selected, called IHE Actors, in support of defined clinical use cases, called IHE Integration Profiles. Thousands of vendor-to-vendor connections have been tested overall, and tens of thousands of transactions passed among the systems tested.

The next Connectathon will take place from April 15 – 20, 2007 in Berlin, Germany.

www.ihe-europe.org

CARS 2007 21st International Congress and Exhibition June 27 - 30, 2007 Berlin, Germany

www.cars-int.org

Annual Meeting of ISCAS, EuroPACS, CAR, CMI, CAD and SPIE/CARS

Author
Prof. H.U. Lemke
Research Professor of Radiology
University of Southern California
Los Angeles, USA

The response to the call for papers for CARS 2007 in January 2007 was very positive. An all-time high of 573 submitted abstracts has been achieved. Fig. 1 shows the relative distribution of abstracts with respect to themes and countries. In addition to many new topics, included in the given themes, a special characteristic of the submissions was their wide international origin.

As can be expected, this year's CARS host country, Germany, provided the highest number (161) of abstracts. With 83 abstracts coming from the USA and 73 from Japan, these three countries have contributed more than half of all abstracts. Of great importance to the discipline of CARS, however, is also the extension of the country circle with Algeria, Belarus, Ireland, Lithuania, Malaysia, Mexico and Romania. With these newcomers, altogether 44 countries contributed to the abstract submission for CARS 2007, also an all-time high for CARS.

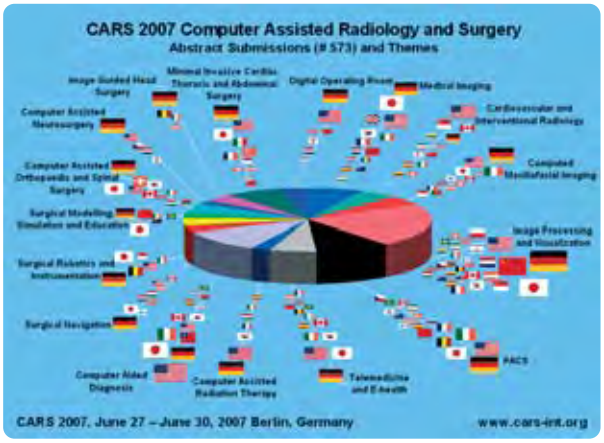

Fig. 1

A further interesting observation which can be derived from Fig. 1 is that the classic themes of CARS, i.e. medical imaging, image processing and visualisation, PACS and Computer Aided Diagnosis (CAD), still attract the widest spectrum of contributing countries. Fewer countries have submitted to the Computer Assisted Surgery (CAS) related themes, for example surgical navigation, surgical robotics and instrumentation, surgical modelling, simulation and education, computer assisted orthopaedic surgery, computer assisted neurosurgery, image guided head surgery, minimal invasive cardiac, thoracic and abdominal surgery, or the Digital Operating Room (DOR). With the 181 abstracts submitted for these themes, however, it can be observed that the CAS components are growing absolutely and relatively with respect to the other themes of CARS.

Compared to previous statistics on the abstract submissions, the Digital Operating Room theme with special emphasis on surgical PACS and standards is the fastest growing area of CARS. A strong cooperation between CARS and SPIE Medical Imaging, EuroPACS, ISCAS and the newly established DICOM Working Group 24 (WG24) "DICOM in Surgery" contributes towards this development. More than 100 members, at present from 15 different countries, have joined the WG24 with a work focus on developing standards for therapy imaging and model management. Their present and future input for advancing standards in the operating room is contributing to the internationality of CARS as a discipline and congress.

CARS as a forum promotes that a widest possible community in the world will benefit from the advances in CARS assisted medicine.

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This year's annual edition will include between 400 - 600 delegates from different countries. The conference programme will offer information on the latest and most significant developments in clinical practice, research and education within digital radiology, including:

- PACS Planning and Purchasing Strategies
- PACS Evaluation and Economical Aspects
- PACS Beyond Radiology (Cardiology, Endoscopy, Ophthalmology, etc.)
- Image Distribution, Storage and Archiving Strategies
- Workflow and Data Flow in Radiology
- PACS/RIS/HIS Integration Issues
- Regional PACS and Teleradiology
- Security and Privacy, Quality Assurance, Legal Aspects
- Standardisation (DICOM, HL7, IHE)
- PACS and E-Learning in Radiology and Medical Sciences

www.europacs.org

Asset Tracking Technology for Hospitals

Asset tracking, a new and evolving technology, gives hospitals the ability to detect, identify, and locate assets (e.g. infusion pumps, wheelchairs) at any time, as well as record the physical locations of those assets over time. ECRI recently published an overview of asset tracking for hospitals that choose to start the selection process for this technology now.

ECRI's guidance article found that while implementing an asset tracking system now would bring immediate benefits for some healthcare facilities, others are better off waiting for the marketplace to develop further. A comprehensive follow-up article published in ECRI's Health Devices journal expands on product specifications and purchasing options. Hospitals can benefit from lessons learned through ECRI's testing of the process of installing an asset tracking system, included in an analysis in the same journal issue.

ECRI's evaluation critically examines the performance of four suppliers' systems products: the Agility Healthcare Solutions AgileTrac, the Ekahau RTLS (Real-Time Location System), the Radianse Find Assets, and the Versus Technology Versus Information System (VIS). The products are rated for two basic locating applications: finding equipment for IPM (inspection and preventive maintenance) and recalls, and finding it for clinical use.

www.ecri.org.uk

New Format for Annual Congress

Delegates at the annual Cardiovascular and Interventional Society of Europe (CIRSE) congress can expect an updated, restructured conference this edition. This year the programme has changed format, so that delegates can follow one of six main themes right through the meeting, including:

- Vascular intervention
- Transcatheter embolisation
- Non-vascular intervention
- Interventional oncology
- Clinical practice development
- Basic education theme

The congress programme is designed so that attendees can follow one of these themes with little or no overlap. Importantly, for junior attendees, the basic educational theme running through the meeting has eight Foundation Courses, divided into two main topics: peripheral vascular disease and transcatheter embolisation. There are also three basic workshops on embolisation technique to build on the knowledge gained during the corresponding Foundation Course. For the first time, there will be an optional online test after the Foundation Course as part of the e-learning initiative.

To register for the congress, or view the programme in greater detail, please visit the CIRSE website.

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Editor European Affairs
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EURATOM DIRECTIVE ON MRI SAFETY AND PROTECTION OF WORKERS' HEALTH

Increasing Involvement in the EU

What is the Directive about?

Directive 2004/40/EC of the European Parliament and of the Council of 29 April 2004 lays down minimum requirements for the protection of workers from risks arising from exposure to electromagnetic fields (EMF) and waves.

All Member States are required to incorporate this Directive into their national law by 2008. However, it has dramatic implications for interventional magnetic resonance (MR) imaging, because workers who are close to the MR scanner while scanning are exposed to levels substantially above the exposure limits. This is especially the case for time-varying magnetic fields in the 110 Hz–5 kHz range, which includes the field from the imaging gradients.

Scope of the Directive

The measures provide a minimum basis of protection for all workers in the EU, thus giving the Member States the option of keeping or adopting more favourable provisions. Its main aim is to provide a minimum standard of protection for those working with electromagnetic fields (EMF) and to ensure that industry is competing on an equal basis.

The Directive applies to time-varying electromagnetic fields with frequencies varying between 0 and 300 GHz. It seeks to deal with the risk to workers due to "known short-term adverse effects on the human body" caused by the circulation of induced currents and energy absorption. But it does not apply to static magnetic fields, which are a major component of exposure from MRI equipment. (A provision for static fields was removed from the proposed Directive during negotiations, but will be reconsidered when the Directive is reviewed in 2009)

Employers' obligations

The Directive lays down various types of obligation with which employers, such as hospitals, have to comply with:

- assessment, measurement and calculation, by the appropriate services and at regular intervals, of the levels of electromagnetic fields to which workers are exposed;
- saving results of this assessment on a suitable data storage medium, to be consulted at a later stage; and
- considering in the assessment of risks (e.g. the level, frequency spectrum, duration and type of exposure), the indirect effects, such as interference with medical electronic equipment and devices, fires and explosions resulting from ignition of flammable materials.

Provisions designed to avoid or reduce risks

If action values are exceeded, employers must develop and implement an action plan which would prevent exposure from exceeding the exposure limit values. This could include changing working methods, choice of appropriate work equipment, better design of work stations, etc. But, employers are not obliged to do so if they can prove that there are no risks to the workers' health.

The Directive also provides a number of other provisions including health surveillance, reports and sanctions.

The health of exposed workers has to be monitored in order to prevent any adverse effects due to exposure to electromagnetic fields. If exposure exceeds the limit values, a medical examination has to be carried out. Both the worker concerned and the doctor responsible for the health surveillance have access to the health records. Member States must provide for adequate sanctions in the event of infringement of the national provisions transposing the Directive.

In addition, Member States must provide a report to the Commission every five years on the practical implementation of the Directive, indicating the points of view of the social partners.

Every five years, the Commission must inform the European Parliament, the Council, the European Economic and Social Committee and the Advisory Committee on Safety and Health Protection at Work of the content of the reports of the Member States.

Concerns from medical community

The medical community across the EU has expressed concern that the implementation of Directive 2004/40/EC could have severe implications for medical and research use and for maintenance and testing of MRI equipment. Some medical professionals claim that it could restrict and or even prevent the use of MRI. The main concern is the over-exposure of operators and appears to relate mainly to static magnetic fields and low frequency time-varying magnetic fields.

The Directive sets out minimum health and safety requirements regarding the exposure of workers to the risks arising from EMFs, but does not apply to patients or volunteers undergoing MRI examination.

Current use of MRI

Over the last few decades, MRI scanners have been in increasing use throughout Europe and the rest of the world. They provide a powerful tool for use in diagnosis, treatment and research, and have been widely recognised as the most significant development in medical imaging since the X-ray machine.

At several hospitals in the United Kingdom, MRI is used instead of X-rays. In 2006, the NHS bought 100 new MRI scanners, at nearly 1,5 million euros a piece, making the UK a leader in MRI usage as well as research. The extent to which use of these new machines will be affected by the limits imposed by the Directive is a matter of current debate.

Other concerns voiced regarding the Directive point out that the implementation of the regulations threatens to reverse pioneering advances in MRI as it would be more difficult to use high field scanners. Diagnosis and treatment of anaesthetised, frail or anxious patients, and children, will be particularly affected. Additionally, patient and staff safety will be put at greater risk from X-rays.

Lending her voice to this debate is Liz Lynne, Member of the European Parliament's Employment Committee, who warned about the impact of a European Directive on MRI Scanners. The Electromagnetic Fields Directive will not only limit the time that operators will be able to spend near MRI machines when they are in use but also prohibit new uses of MRI technology which let doctors see how treatments are working.

According to Lynne, "The evidence from the medical profession, then as now, was overwhelmingly against restricting the use of MRI scanners. These are vital machines which can save lives; limiting their use will leave doctors reliant on less successful, more dangerous procedures. The European Commission and Governments across the European Union are beginning to realise the severe implications of this Directive on medical treatment. I am strongly urging the Commission to amend this piece of legislation before bodies are laid at its door. The sooner this situation is remedied the better."

References
http://lizlynne.org.uk/news/000710.html?PHPSESSID=801ceb21
http://www.parliament.the-stationery-office.co.uk/pa/cm200506/cmselect/cmsctech/1030/103005.htm
http://66.102.9.104/search?q=cache:HjAQpak7p4J:www.senseaboutscience.org.uk/pdf/BriefingDocument.pdf+mri+directive+hospitals&hl=en&ct=clnk&cd=1&gl=nl

Industry News

Boston Scientific

Boston Scientific Acquires EndoTex Interventional

Boston Scientific Corporation has acquired EndoTex Interventional Systems. The acquisition follows the FDA approval of the NexStent Carotid Stent System, which was studied in the CABERNET trial along with the Boston Scientific FilterWire EZ Embolic Protection System. Terms of the acquisition were not disclosed. "Combining the resources of these two organisations demonstrates Boston Scientific's commitment to treating carotid artery disease," said John Pedersen, president of Boston Scientific's Peripheral Interventions business. EndoTex is a privately held, development stage medical device company focused on a less-invasive solution to treating carotid artery disease. The company develops interventional vascular therapeutic systems designed to reduce the need for re-intervention, thereby providing improved quality of life, while reducing the cost of patient care.

Philips

Philips and Ascent Profit Sign $27 million Contract

Royal Philips Electronics and Ascent Profit, a Chinese medical equipment wholesaler, announced that they have signed an agreement that will bring 200 high-end radiography systems to hospitals in China. The $27 million contract will enable healthcare facilities across the country to take advantage of Philips' advanced radiography solutions.

Growing at rate of approximately 11 percent each year, the Chinese healthcare market is currently one of the most rapidly expanding in the world. Digital radiography solutions are now being broadly implemented in the country's major hospitals. Through the agreement with Ascent Profit, Chinese hospitals now have access to Philips DigitalDiagnost and Philips Essenta DR, designed to provide small- and medium-sized hospitals with advanced digital X-ray capabilities and more efficient digital image workflow.

Agfa HealthCare

First Phase of Germany's Largest Hospital IT Project Complete

Agfa HealthCare announced that it has successfully completed the initial phase of the ORBIS Hospital Information System (HIS) implementation at the Vivantes Netzwerk für Gesundheit GmbH, Germany's largest municipal hospital group. Two years after the contract was signed in September 2004, ORBIS is in operation in all nine Vivantes healthcare institutions. Before the start of the project, the individual hospitals and clinics of the group worked with systems from different manufacturers or with self-programmed software systems. The aim of the project was to standardise the existing heterogeneous system arena by replacing it with a centralised Hospital Information System (HIS), a Picture Archiving and Communication System (PACS), and a Radiology Information System (RIS), all from a single source.

Matrox

Chi Lin Technology Co. Partners with Matrox

Matrox Graphics Inc. have announced that Chi Lin Technology Co., a Taiwanese display manufacturer, has worked with Matrox to develop medical display technology that works with Matrox display controller boards designed for medical imaging. Chi Lin's High View Series, Mega View Series and HD View Series medical displays all ship bundled with Matrox MED™ Series display controller boards.

The Chi Lin High View Series with front sensor offers medical displays ranging from 2 through 5 MP grayscale displays, while its Mega View Series of displays offer radiologists 1 through 5 MP displays capable of colour and grayscale outputs. The HD View Series by Chi Lin is a High Definition Series with 42-inch and 47-inch colour displays.

E-Z-EM

E-Z-EM has Solid Fiscal Q2

E-Z-EM has announced financial results for the fiscal 2007 Q2 with net sales from continuing operations at $34.2 million, up one percent compared with $33.8 million for the quarter ended December 3, 2005. The company attributed the increase in net sales to continued growth in CT imaging product sales, price increases and favourable foreign currency exchange rates, which were offset by declines in contract manufacturing, x-ray fluoroscopy and RSDL skin decontamination product sales. Gross profit for Q2 improved to $15.3 million from $15.1 million for the prior-year quarter, and as a percentage of net sales was 45 percent for both quarters. Increased costs for finished goods and raw materials were offset by decreased provision for inventory

reserves and price increases. Operating expenses for the fiscal 2007 second quarter were $13 million, up three percent from $12.6 million for the comparable prior-year quarter.

Fujifilm

Fujifilm Medical Systems Acquires ProSolv

Fujifilm Medical Systems USA Inc will purchase cardiology PACS vendor Problem Solving Concepts Inc (ProSolv). The company will now operate as a wholly-owned subsidiary of Fujifilm called ProSolv Cardio Vascular. Terms of the acquisition were not disclosed.

"The need for more tightly integrated enterprise image and information systems, combined with the growing application of CT and MR into cardiac applications, necessitates that we continually evolve our products and the way we do business," said Makato Kawaguchi, President and CEO of Fujifilm Medical Systems USA. "The acquisition of ProSolv enables Fujifilm to strengthen our existing product portfolio and our foundation for growth."

Varian

Varian to Acquire ACCEL Instruments GmbH

Varian Medical Systems Inc, recently announced its pending acquisition of ACCEL Instruments GmbH, Cologne, Germany. The purchase of ACCEL, a privately held supplier of proton-therapy systems, will enable Varian to offer products for delivering image-guided, intensity modulated proton therapy.

Varian will invest around $30 million to acquire ACCEL, including assumption of debt. The transaction is expected to close in late January, pending the receipt of certain regulatory approvals.

Siemens

Siemens Acquires Gesellschaft für Systemforschung und Dienstleistungen im Gesundheitswesen (GSD)

Siemens Medical Solutions has taken over Gesellschaft für Systemforschung und Dienstleistungen im Gesundheitswesen mbH (GSD), headquartered in Berlin. With more than 300 customers in 14 countries, GSD is active in the area of health information systems (HIS). The acquisition is still subject to approval by the anti-trust authorities.

GSD generated revenue of 25.6 million EUR and employed 168 people in fiscal year 2005 (ended December 31). GSD will be a wholly owned subsidiary of Siemens Medical Solutions as part of the Health Services division.

FLEXIBLE MOBILE IMAGING SOLUTIONS

Developments in medicine over recent years have meant that hospitals in Europe must increasingly rely on state-of-the-art technologies. Patients have come to expect the best, not only in terms of a fast diagnosis, but also in the use of the most up-to-date technologies.

This article explains some of the benefits that mobile imaging requirements can bring to public and private healthcare providers

Mobile Imaging

Many hospitals across Europe are turning to mobile imaging solutions. In turn, mobile imaging is becoming ever more flexible and comprehensive.

Indeed, the development of increasingly sophisticated mobile units and cross-sectional technologies (CT, MRI, PET and PET/CT, Cardiac Cath labs) offers a very wide choice of imaging systems, all of which can be tailored to the individual hospital's clinical needs and budget. Such services are especially important when hospitals are upgrading existing systems or installing new ones, testing potential systems to help make a purchase decision or when they are involved in special projects.

The use of a mobile interim service ensures that hospitals can respond quickly to developing situations in an economical manner, with units being used only for the required amount of time. Furthermore, as hospitals can use their own staff in the units, they can be sure of maximum continuity of systems, with minimum impact on budgets.

Where imaging demand does not justify a new system installation, or where imaging demand is permanently high, fully managed mobile services with highly trained radiographers, either as a one-off solution or a long-term aid, can also be provided.

Conclusions

Whether fully managed or operated by existing hospital staff, mobile imaging provides hospitals with a flexible solution tailored to their needs. With the expansion of the EU, hospitals in new EU-member states are increasingly opening their doors to the technologies and mobile services that are becoming central to healthcare in Western Europe.

For further information, please contact:
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KEY ELEMENTS OF A SUCCESSFUL PACS IMPLEMENTATION

The Experience in England

In October 2003, the government in England established a national IT programme for the National Health Service (NHS), to establish a standardised approach to IT support in England and to develop a universal patient record. The national programme, now known as 'Connecting For Health', (CFH), recognised early on the significant advantages of PACS as part of the overall IT strategy in supporting patient care and, as a result, established a tight schedule for the national implementation of PACS throughout England, with completion expected towards the end of 2007. This review highlights the lessons learned from this implementation and explores the results of the programme.

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There are several key elements that will help ensure that all benefits that can be derived from PACS are realised, through continuing appropriate management and support of the system. Prior to the national programme, considerable experience had been gained through various PACS implementation projects and the lessons learned form the current basis of advice to new users and to those managing an existing system.

Organisational Change Management

Most PACS solutions constitute a ready-to-use Commercial Off the Shelf Solution (COTS), which, when the instructions on the tin are adhered to, works. Indeed, evolving PACS solutions are blurring the margins between how images are viewed and manipulated in the radiology department, wards and clinics, creating a seamless solution for the whole healthcare organisation. However, there is a significant degree of organisational preparation required to facilitate acceptance of the system by all clinicians and to promote understanding of the changes to working practice that will take place.

Changes to working practice clearly depend upon the final hardware solution defined in the business case, which should be reached through early involvement of all members of the healthcare organisation. This can take at least twelve months preparation.

The formation of a Clinical Advisory/Advocacy Group is strongly recommended with all key stakeholders involved. More often than not, the main detractors for the project become the true advocates. There is probably no point in implementing PACS or any other IT 'solution' if members of the organisation do not understand that there is a problem to be resolved or there are better ways of doing things that the 'solution' is meant to facilitate.

Benefits Realisation

To facilitate the preparation process, it is beneficial to promulgate the benefits of PACS, which should have been clearly identified in the business case. How quickly the benefits are realised will depend upon such factors as the transition period from a film-based to a digital environment, the rate at which PACS is made available to the whole of the organisation and willingness to change working practices.

Types of benefits fall into three broad categories: Cash Releasing such as savings on chemical; Quantitative such as improved efficiency in reporting because of improved workflow; and Qualitative derived from the universal and instant availability of images to inform clinical decision-making processes or the ease of access to prior imaging to better inform the current radiology report.

Overall success of the project can be judged on how many of the identified benefits have been realised. In terms of the strategic benefits, in the context of a national implementation programme, it is essential to understand the future impact of the ability to share images with other organisations and the potential to separate the acquisition of the images from the site of reporting.

PACS Workflow Integration

One of the major benefits of PACS, improved workflow and reporting quality, can only be realistically achieved through full integration with the Radiology Information System (RIS). The RIS should ideally be integrated with the organisation's Patient Administration System (PAS). Standards exist that allow easy integration of these systems and the functionality required by the users of the integrated systems is defined in the framework known as 'Integrating the Healthcare Enterprise' (IHE). Understanding how worklists generated on the RIS can drive more efficient ways of working is essential in defining the requirements of the business case in terms of system integration. IHE requirements should be incorporated into the business case with the help of specialist advice.

Further benefits can be derived by the addition of value-added PACS components such as electronic requesting for diagnostic tests, which can feed into the reporting worklists with the presentation of the clinical referral in electronic form. A greater benefit perhaps in significantly improving the time reports reach the requesting clinicians is the incorporation of digital dictation systems into the PACS implementation. Integrated Voice Recognition software now means that a fully verified report can be sent directly to the referrer upon completion.

IT Infrastructure and Environment

Failure or delay in the delivery of the images to the end user is unacceptable. There should be clear requirements in the business case for a robust and well-managed IT infrastructure that supports a sufficiently high bandwidth and a clearly defined management structure to ensure 24-hour support. Also important are environmental conditions in which images are viewed, such as placing a bright high-definition monitor under bright lights results in poor image quality. Much thought needs to be given in designing a hospital-wide PACS for optimal viewing conditions and there is an ideal opportunity to incorporate these into new hospital designs.

Training and Education

Considerable time and resources are required to enable the successful introduction of a PACS in terms of training and education for all end users. This involves the deployment of a lead trainer, usually the PACS administrator, and key trainers throughout the organisation that will include a variety of people such as nursing staff and radiographers who will cascade the skills required to operate PACS.

The IT department may be required to identify staff who need basic PC and keyboard training. Time allocated for training in Computerised Radiography (CR), is critical to ensure minimal disruption to the imaging service at the time of full PACS implementation. Some organisations may introduce digital acquisition prior to full go-live, to establish a digital archive and to provide training requirements. In terms of training end-users, the timing of this is critical to success; too early and much may be forgotten and leaving it to the last minute will disrupt the process. Training needs should be incorporated into the business case including training rooms and backfill for training staff and, most importantly, time!

System Support

Once the system is fully operational, one requirement is to ensure ongoing training for current and new

members of staff. This role is undertaken by a PACS administrator and support staff to enable round the clock system management. Some aspects of system management will clearly be a contractual requirement with the PACS vendor, but in addition, the organisation's IT department needs to give year-round infrastructure support. It is one of the key roles of the PACS administrator to coordinate these areas. One of the most system-critical functions of the administrator's role is to keep the PACS database clean, such as ensuring that all images obtained for a patient study are properly associated with the event entry on the RIS. This is one of many daily housekeeping tasks that enable an efficient and patient-safe PACS.

Results of the Programme

The national PACS implementation is supported by the deployment of five central data stores that will manage and archive all image data. Individual hospitals will have enough local storage to support one year's image data online. The central data store system will support image sharing between organisations across the country. The benefits of the data-sharing architecture must be balanced against the frequency at which image data is accessed locally or by another healthcare organisation over the ensuing years. Currently assessing dataflow and retrieval will inform how best to manage the large amount of image data being produced and stored on the five central data stores.

As of the 8 January 2007, 64% of NHS hospitals in England are using PACS, including 42 Trusts that already had PACS before the national programme. Just over 50% of the NHS CFH PACS deployments have been achieved. It is anticipated that by spring 2007, the majority of the 129 NHS hospitals in England will have signed off their business cases for the NHS CFH PACS.

Finally, there is an acknowledgement within the programme that the financial benefits of PACS outweigh overall initial investment, which may vary from £2 - 5 million, depending on the size of the hospital. The impact of PACS on the overall efficiency of delivering imaging services has been calculated to reduce the cost per image produced in the face of increasing demand for the service. Moreover, it has been stated that the national programme has negotiated substantial reductions in the capital outlay for a PACS implementation. ⏭

NATIONAL PACS PROGRAMME IN ESTONIA

Results and Successes

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On June 12th 2006, an Estonian PACS programme (Eesti Tervishoiu Pildipank) was co-founded by Tartu University Hospital and the North Estonia Medical Centre. In this article, we will give an overview of the recent history of this process, key factors that facilitated this development, as well as the future of PACS in Estonia.

The national Estonian PACS dates back to the Baltic International Telemedicine NETwork (BitNet) project, launched in 1999 at the initiative of the University of Uppsala, Sweden. As part of this project, ISDN-based links were established between the Uppsala University Hospital and four hospitals in Estonia: Tartu University Hospital, the North Estonia Medical Centre, the Ida-Viru Central Hospital and the Haapsalu Rehabilitation Hospital.

Initially, up to four dial-up connections were simultaneously used for audio-video conferencing, covering the conferencing process, physical examination of the patient, demonstration of medical records and films on light boxes. In the late Nineties, the number of devices with digital image output increased in Estonia and digital archiving on offline media began. The first CR system was installed at the North Estonia Medical Centre in 1997, but printouts were still predominantly in use for reporting and long-term archiving. In 1998, the East Tallinn Central Hospital started to archive ultrasound images offline on MODs, marking a trend for digital archiving of non-3D studies.

In 2001 a mini-PACS was instituted at Tartu University Hospital, where two CT, one MR and one CR system were connected to a DICOM server, enabling web-based distribution of images using DICOM workstations. The introduction of devices with digital image output, offline digital archiving and implementation of the first mini-PACS in Estonia was

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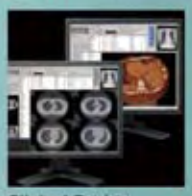

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a result of local hospital level initiatives rather than any governmental decisions.

Role of the National Society in Estonia

One of the key forces behind these initiatives was the Estonian Society of Radiology, a non-profit and non-governmental organisation aimed at the improvement in quality of radiological services. During the Nineties, at least one educational event was organised monthly to promote new radiology technologies and practices. In 1998, the Radiology Development Board of the Society stated the need for the establishment of a central archive for radiological images. In 2000, the Development Plan for Estonian Radiology for the period of 2000 - 2015 was issued, stating the need for the establishment of a country-wide PACS. This goal was achieved in 2006.

Cooperation Key to National PACS

For the establishment of nationwide PACS, a critical number of collaborating healthcare providers had to be reached. A de facto cooperation between Tartu University Hospital and other Estonian hospitals in 2002 aimed at archiving and accessing all imaging studies at one central PACS. For four-and-a-half years the PACS service was free of charge, easing the initial introduction of the system to customers. A significant number of customers stayed loyal after the fee for archiving (approx. 1 EUR per study) was applied. Radiologists worked to familiarise clinical partners with a digital imaging environment, teaching them how to use PACS in their daily work.

Taking Steps Towards Digitisation

There were two extremely important factors facilitating the process of the establishment of nationwide PACS in Estonia. Firstly, during the Nineties in Estonia a good infrastructure for telecommunication was created, enabling 1 Gbit network for almost all healthcare providers. Secondly, in the framework of the hospital reform of 2001 – 2002, formerly independent hospitals were merged. This created the necessity of networking with the aim at communication and resource-sharing. At this point the aspirations of local radiology managers met with the needs of managers at the level of hospital and national governance. Another factor was that digital archiving became gradually cheaper and is now the most feasible storage option.

In 2003, another local mini-PACS was installed at East Tallinn Central Hospital, where one CT, one angiograph, one ultrasound system and three CR systems were connected to a DICOM server, enabling web distribution of images and using DICOM workstations.

In 2003 and 2004, the North Estonia Medical Centre proposed to all healthcare institutions in the neighbourhood of Tallinn to establish a joint PACS by co-sharing the costs proportionally to the volume of archived data. Unfortunately this attempt was not successful mainly due to the lack of cooperation between the institutions. Among the underlying reasons were the lack of investment power of some counterparts, and the fear of some partners of being under supervision of the quality and the case mix of their clinical work. Consecutively, the North Estonia Regional Hospital initiated two processes – it started procurement for its own PACS devices and joined the Tartu University PACS. This merger assured the vast majority of diagnostic images produced in Estonia to be managed in one single PACS.

Tartu University Hospital and the North Estonia Medical Centre are the two major hospitals in Estonia, sharing about the half of the budget allocated for specialised healthcare services, including for imaging, in Estonia. Estonian PACS consists of two mirrored archives physically located 180km from each other in Tartu and Tallinn. It has the total capacity of 18 TB. It receives images from more than 80 imaging units from 21 healthcare institutions (78% of the current imaging capacity of the country). The amount of daily archived data is on average 125 GB.

It offers the opportunity to view images at 24 healthcare institutions. Healthcare providers that do not submit images to this PACS and practically all general practitioners also have access to Estonian PACS via the secure web interface. General practitioners may access images and reports at their workplace, which has created a prerequisite for Estonia to become a filmless country. Today, many GP practices have become paperless and strongly support filmless solutions provided by PACS. At the present, the countrywide Radiology Information System (RIS) is being developed. It will become an integrated and inseparable part of the Estonian PACS. Estonia has very strict data protection legislation. Therefore Estonian PACS is under strong self monitoring and under the supervision of the National Data Protection Agency.

From a legal standpoint, the Estonian PACS is a non-profit foundation. There is a Council over our national PACS, consisting of the members nominated by the two co-founding hospitals and the invited members from Ministry of Social Affairs and the Estonian eHealth Foundation.

» *continued on p.41*

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The essentials of imaging

IMPACT OF PACS ON RADIOLOGIST WORKFLOW

Increased Specialisation in Radiology Due to PACS

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Greater access to digital images, enabled by PACS, has empowered clinicians outside the radiology department to view and interpret their patients' exams. The role of the radiologist has thus shifted from an isolated position of authority with sole access to images, to that of a specialised consultant as part of an overall network. It has also led to greater involvement of the radiologist in patient care and treatment. In this article, we summarise the results of a qualitative study that monitored a select group of radiologists who were in the process of transitioning from film to digital, and examine changes in radiologists' profession, diagnostic practice and workflow functionality.

Structure of the Study

A senior administrator at Lund University Hospital selected the participants for the study from the total of 57 radiologists at the four participating hospital departments in the Skane region using PACS. The three main interview categories were defined as: professional role, clinical practice and technology in use. All interviewees were asked the same questions in the same order in three areas: technology in use, practice related to technology in use, and professional skills and learning processes.

The questions were:
1) How did you prepare yourself for the transition to PACS?
2) How were you educated in the new technology?
3) How were the groups divided during this training?
4) How has your work practice changed?
5) How has it changed in relation to the interpretation of images, professional skills, image processing, prestige in work?
6) Has the professional radiology paradigm shifted, in relation to either threats or opportunities?
7) How has learning and diagnostic knowledge changed?
8) What trends of changes in diagnostic practice might be identified?
9) Why have these changes occurred?
10) What were the indicators of change?

Changes in Radiologists' Work Practice: 1999 - 2005

The results of this study show trends of central changes in the radiologists' work practice, translating from films to digital images. Firstly, let us examine the situation in 1999.

Professional Role

In 1999, a central issue concerning radiologists was how the transition from film to digital images would be in practice. Fear of change was noticeable among the senior radiologists, in contrast to the junior radiologists, who identified improved possibilities to offer new and better services in the future. Junior radiologists became expert users, acting as the senior radiologists' tutors in the digital environment.

Diagnostic Practice

In the world of analogue technology, radiologists describe the work of analysing film images as an art form, requiring considerable time and experience. Could PACS threaten this core competence? No evidence to suggest that this might be the case was found in the present study. It became clear from the interviews that the diagnostic practice at this time was strongly related to the physical object and the art of reading it.

Technology in use

As films became digital images, they also became distributed in the sense that there was no longer one original film. Digital images could be accessed in as many 'originals' as were wanted. This in turn gave clinicians in other disciplines the opportunity to read the images themselves. As radiology's ownership dissolved, would the demand for their services decrease? The interviews showed digital technology lessened the relationship to the physical object.

2000

In the second interviews, conducted after one year had passed, the radiologists had all gained experience of PACS. The general finding of these interviews was that the radiologists' professional role was still strongly related to the individual's professional expertise and performance.

Professional Role

Radiologists described the core of their skill as being able to discern the relevant information in the image, and being able to understand how the image is produced and manipulated. Since the skill of professional expertise is only acquired through long experience, the respondents were not able to see any significant changes at this early stage. The interviews indicated that that this was the first real shift of focus, as the diagnostic practice shifted from an art-form to intense and necessary technical discussions.

Diagnostic Practice

Radiologists had not yet fully learned to exploit or manipulate the new technology, as it takes time to learn to use this facility, and radiologists may have been unable to recognise the value inherent in this option. There was a risk that the focus had shifted from diagnosis to technical discussions. The interviews showed that the quality of digital images had become a central focus. The contextual framework of diagnosing images had changed.

Technology in use

Changes in the mental approach in the interpretation of the digital examination were a challenge. Radiologists were critical of changes from analogue to digital image format, and they complained about the image limitations:. "…the radiologist takes the X-ray film from the light box, holds it up and turns it to examine it from different angles. This is not possible on a 21-inch monitor". The contextual framework of diagnosing images had been changed.

2002

Professional Role

In 2002, a generational difference became apparent between the senior and junior radiologists concerning their view of the new workflow. Junior radiologists did not see the new workflow as threatening, and saw potential in the new workflow for the simplification of consulting and closer contact with the customer/clinicians. Senior radiologists saw the new technology as a threat to their skills and independence. The radiologists' professional role shifted to more of a consulting role, with a focus on discussion and on visions for new services to be offered by the radiology department.

Diagnostic Practice

At this third interview, an assimilation of the new workflow began to emerge. This is true of radiologists at both smaller and larger clinics. At smaller clinics they saw the potential for professional exchange through rapid access to radiologists and specialists by distributing the images and discussing them over the telephone, as both parties are able to have the image in front of them at the same time. The finding was that the focus on diagnostic practice, at this stage, was related to the many opportunities which had become available.

Technology in use

At the larger clinics, clinical meetings took on new dimensions due to images being accessible to everyone. Respondents appreciated the option of manipulating images infinitely, showing greater detail in the images, and an improved level of communication with other disciplines. At this stage the radiologists had more fully realised the opportunities provided by digital technology.

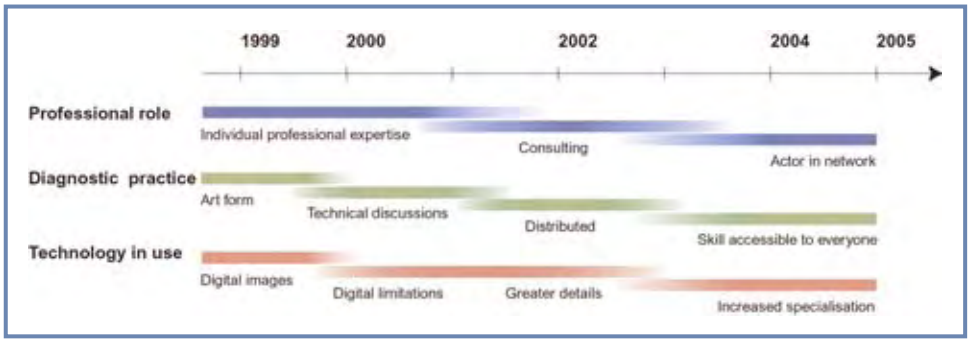

Table 2: The trends of changes in the radiologists' work practice from 1999 to 2005 using PACS

2005

Two years had passed since the last round of interviews. The system had been updated several times and had become more stable and reliable. The radiologists felt more secure using the system, and that the advantages were greater than the disadvantages.

Professional Role

Previously, radiologists were not as involved as they are today in the treatment of patients. The use of PACS has led to a re-conceptualisation of the clinical workflow, allowing for a deeper understanding of the interaction between technology and organisations, which transforms the individual in an organisation into an actor in a network and a more actively engaged discussion partner for the clinicians.

Diagnostic Practice

The radiologists identified three features that affected clinical practice: easy access to images, new capacity to show the images to clinicians over the internet, and the 3D tool that made it possible to interpret and show large image materials in volumes instead of as separate images. As the technology was refined, the skills and the reading and interpreting of the images were available to everyone in clinical practice accessing this new distributed radiology workflow.

Technology in use

The improvements made by PACS to the radiology service came about through easy access to images, which meant that clinicians could perform interpretations themselves. This created opportunities for the radiologists to engage in more complex diagnostic problems, and supported an increase of specialisation within radiology. An increase in services offered to the clinicians also became apparent, due to the new workflow. It allowed more detailed questions to be posed to the radiologists. This made radiologists feel more engaged in the overall treatment and diagnostic care of the patient.

Summary

Professional role

It has taken time to discover and reflect on how the new distribution radiology workflow has changed the radiologist's professional role. In practice, the flow of images has taken new routes, thus creating new relationships between the actors in the network. In 1999, when clinicians met with the radiologist in clinical meetings, the radiologist was the professional expert with experience in reading films. However, over time, as the clinicians obtained access to images, their ability

» *continued on p.44*

MOLECULAR IMAGING AND RADIOLOGY

Ensuring Our Future

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Due largely to its early recognition of the emerging field of molecular imaging as the key to the future of medicine, radiology in the US has taken the lead over Europe in developing Molecular Imaging. In the US, the significance of molecular imaging was recognised much sooner, as an essential key to unlocking the mysteries of disease and therefore to prevention and treatment. As a result, the necessary funding was put in place much sooner than in Europe, and it is therefore already far advanced. As a result of less highly developed emphasis on European imaging research, as well as greater fragmentation within European radiology, radiologists here have difficulty in advocating for the incorporation of molecular imaging in a new programme or persuading their decision makers that such a long-term prospect has immediate advantages.

Three years ago at Erasmus MC, the Board of Directors was advised to look into molecular imaging, to examine not only what projects and developments were underway, but what could be made possible by it. As leader of this inquiry, I produced an advisory paper on how and to what extent medical schools should invest in research into this new and emerging field.

I also had to assess existing research and other endeavours in the field of molecular imaging, to provide information on what might be a good direction or focus for ourselves. Thus, a university-wide cooperative programme on molecular imaging was established, of which I am Steering Committee Chair, which includes heads from all involved departments, e.g. cellular biology, molecular biology, nuclear medicine and other clinical departments where molecular imaging will inevitably bring major medical advances.

Why Should Radiologists Care?

In the years to come, molecular imaging will have a profound impact on areas like the provision of personalised healthcare and the stratification of risk. In my opinion, it is a fundamental necessity, to be able to visualise a disease or condition at cellular level and radiologists are obliged to recognise the importance that they incorporate this new science into their own repertoire of services, in whatsoever applications arise from it. As the molecular basis for disease is becoming an ever greater player in medicine, we need to be able to translate this into clinical practices. More and more professionals are getting involved for instance in cellular and molecular imaging, specifically with the actual visualisation or imaging of these processes. If we assume a position of leadership now, radiologists can take this opportunity to make their mark.

From Research to Clinical Applications

Oncology is the primary area where molecular imaging will have a massive impact. At present, molecular imaging is in the research phase and therefore clinical applications are not yet fully realised. For example, in PET/SPECT, which is in existence for the last two to three decades active in nuclear visualisation of e.g. enzymes and peptides, new probes are being created so the uses of it are increasing. For instance, visualising angiogenesis at a cellular level or the effects of anti-angiogenic therapies to monitor at cellular level the pathologic processes are already one practical use of molecular imaging. It is also useful in imaging, labelling and tracking the development of injected stem cells which can be used as a possible therapy or for tissue engineering.

Developing the Right Tools

For molecular imaging to realise its practical applications, very sensitive imaging tools that provide a clear and accurate image are an essential requirement, but have yet to be developed. This is not the only problem area. For example, in optical imaging, which already has one of the most sensitive tools available in the field of molecular imaging, the depths of penetration achieved so far are miniscule and we can't penetrate very deeply under the surface with current tools. The development of tiny probes is required and these will not be applicable to human organs for a long time. Another problem exists in nuclear medicine, particularly PET/SPECT. Here, the drawback is not the sensitivity of the imaging device but the spatial resolution,

meaning that we can see quite well but are not able to identify exactly where we are seeing.

Therefore, hybrid techniques are needed for PET or SPECT CT for example, where tools are combined so that they are both sensitive and spatially accurate. Presently, the only one method to provide both is in MR which, in itself, has the potential to become a good tool for molecular imaging. Many new probes need to be developed to visualise these processes with a good image quality. As MR is exclusively in the hands of radiologists unlike PET/SPECT, this could be a valuable entry point for radiologists to take a leading role in the development of this emerging science. Since molecular imaging is still mainly in the research phase, should an academic department of radiology want to explore this field, the best way in my opinion to do so, is to install high field animal imaging MR systems.

Conclusion

The optimistic view is that it will be a few years before the clinical possibilities of molecular imaging are fully comprehended. There are broad areas emerging in animal research that will facilitate the applications of the future. The main task for the moment that hinders the development of molecular imaging is the development of the various necessary tools and also the development of the drugs that will be used as probes. As these have to be approved and registered for use, this is a lengthy and costly process. By putting pressure on this process, we hope to speed it up, once governments and authorities realise the importance of personalised medicine.

Also, education for radiologists in molecular imaging must be incorporated, if the next generation are to seize this opportunity. The issue at present is that there is no grounding in molecular biology included in the curricula of trainee radiologists. In order for the next generation of radiologists to understand the molecular basis for disease, this must be addressed, or we as a profession will lose out. At Erasmus, we already have some molecular imaging and molecular biology courses that are in the early stages of creation. Also, it is important for the ESR to recognise their responsibility in harmonising this curriculum across Europe, including training in molecular imaging and molecular biology.

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MEDICAL PRACTICE DRIVEN BY FEAR OF LEGAL LIABILITY

Is Europe Catching the American Ailment?

An infection is spreading across Europe, exported from the shores of our transatlantic neighbours, creating a climate of doubt and apprehension. In the United States, litigation as a result of medical malpractice is now akin to the common cold in its ubiquity. Just like the common cold, preventative measures offer some hope of avoiding this deeply unpleasant experience, but may often be the cause of further complaint.

In 1960, in the United States, only one in seven physicians was sued throughout his or her entire career. Today, one in seven physicians is sued every year. In the last three decades, the median indemnification in the United States for medical malpractice lawsuits has reached $1 million, with the average award being $4 million. American juries in medical malpractice cases occasionally award payments of up to $50 million.

In addition, legal costs to defend these claims average in excess of $50,000 for those that are settled and $113,000 for those that are resolved at trial. In concert with the increase in dollars paid out by medical malpractice insurance companies, the average cost of malpractice insurance premiums paid by physicians in the US has risen significantly. In many American States, premiums for medical malpractice insurance for radiologists exceed $50,000 per year.

What is 'Defensive Medicine'?

The ubiquity in the US of medical malpractice litigation has resulted in a new type of medicine, called 'defensive medicine'. Defined as "the ordering of expensive tests and procedures that are not indicated medically, but the absence of which may render physicians vulnerable in a medical malpractice lawsuit", it refers to the ordering of tests and procedures that are of marginal or no medical benefit, primarily for the purpose of reducing medico-legal risk. Surveys have revealed that more than 90% of American physicians admit engaging in defensive medicine, at an annual cost to the US estimated to be as high as $126 billion.

Medical malpractice litigation and its associated defensive medicine have now invaded the European community. "We find systematic evidence of defensive medicine - medical practice based on fear of legal liability rather than on patients' best interests," recently observed The Lancet. Similar sentiments were expressed by the Editor of the Journal of Irish Medicine: "In US medicine, it is being increasing stated that the clinical exam on its own is insufficient, because it cannot hold up in court. Consultation needs to be supported by objective and often expensive tests. Irish medicine is heading down the same road."

Over-reading Exams

Defensive medicine by non-radiologic physicians is manifested by their ordering unnecessary imaging exams, most commonly CT, mammography and sonography. One recently published study of trauma cases disclosed that CT exams of the head, cervical spine, abdomen, and pelvis were ordered by emergency department physicians just as frequently in patients who sustained obvious minor injuries as those who sustained clinically obvious major injuries.

Defensive medicine practiced by radiologists is manifested by over-reading radiologic studies and by suggesting unnecessary follow-up studies and/or interventional procedures. One example of radiologic defensive medicine is the over-reading of mammograms. In the US, the recall rate among radiologists interpreting mammography averages more than 14%, twice that of the recall rate in the UK, with no difference in degree of cancer detection. Interestingly, the over-reading of radiologic studies and the performance of unnecessary biopsies and other invasive procedures appears to be welcomed by the American public. A recent survey of women undergoing mammography revealed that 97% would continue future mammography despite false-positive recalls, and 82% would be willing to undergo a biopsy so as to increase the chance of earlier cancer detection.

The prevalence of defensive medicine in the US has been summed up quite realistically by the CEO of a medical malpractice insurance company: "The real guidelines physicians follow are ones judged to be the standard of care by jurors in medical liability trials. Medical standards have migrated to legal standards. A trial lawyer can always make the case for why you should have gotten additional data. I have not heard of a lawsuit because of over-testing."

'Failure to Diagnose' Causes Most Litigation

Data accumulated by medical malpractice insurance companies in the US reveal that the most prevalent and expensive cause of medical malpractice claims is errors in diagnosis. More specifically, the allegation of "failure to diagnose" is the number-one allegation in medical liability lawsuits in the US, accounting for more than one third of all lawsuits. Because delaying or missing a correct diagnosis in the patient quite frequently involves an incorrect interpretation of an imaging study, radiologists are frequent defendants in such cases.

Radiologic literature is replete with articles quantifying and analysing radiologic errors. Numerous studies dating back to the 1950s and continuing through the present have revealed that there is an approximate 30% error rate among radiologists. It has been repeatedly shown that radiologists who are presented with a "stack" of abnormal radiologic examinations will consistently "miss" the abnormality in 30% of the cases. This is true for chest, bone, and GI radiographs, as well as CTs, MRs, sonograms, and mammography.

Of course, in the everyday practice of radiology, studies harbouring significant pathology represent a relatively small percentage of examinations interpreted by radiologists. Thus, the true error rate depends on what denominator is utilised; i.e., if a radiologist is presented with ten abnormal studies, and makes an erroneous diagnosis in three of them, the error rate will be calculated as 30%. On the other hand, if the same ten abnormal studies are intermingled with 90 normal studies, and the radiologist makes the same three erroneous diagnoses, the error rate will then be calculated as 3%.

Interestingly, several recently published articles containing performance improvement data of radiologists have revealed that the average error rate of radiologists falls in the three to five percent range. It is also of interest to point out that once a carcinoma is observed on a chest film or in a mammogram, it can be seen in retrospect in up to 90% of chest radiographs and 75% of mammograms obtained earlier and initially interpreted as normal by the radiologist.

Lest non-radiologic physicians believe that only radiologists commit errors, the medical literature has reported that experienced faculty observers commit errors in their assessment of 32% of physician examination skills. One study documented a 44% miss rate among good clinicians of abdominal ascites by clinical examination. Reviews of autopsies have shown that the error rate among specific diagnostic categories is approximately 25%.

Reducing Error Rates

How can radiologists reduce the likelihood of their committing an error? To begin with, clinical informa-

tion is important in improving accuracy, as is comparison with previous studies. The interpreting radiologist should be apprised of all previous studies and interpretations, but should not become biased or attach greater weight to them than with other clinical information. Radiologists should always ask, "Is there any diagnosis other than the one I or my predecessor has made that can explain the findings?" In addition, if the radiologist has an opportunity to review a radiologic examination, previously read as normal a second time with a consulting physician or a colleague, the radiologist should do so, for it is very possible that with a second look, an earlier error will be discovered and can be corrected before causing injury to the patient.

Will Computed Assisted Detection (CAD) reduce the error rate? A number of studies over the past several years have shown that CAD does increase the sensitivity of mammograms and chest radiographs among moderately experienced radiologists, but is of questionable value among highly-experienced radiologists. In some studies, CAD has been shown to increase breast cancer detection in mammography but its ultimate value is yet to be determined. The error rate in radiology has not changed significantly in the past five decades. Whether computers, with their omnipresence in CAD, digital radiography, and PACS, will eventually reduce radiologic error rates remains to be seen. ⏭

In the next issue:
Part 2: 'Failure to Communicate'

Whereas failure to diagnose is the commonest cause of medical malpractice litigation involving radiologists, failure to communicate is a close second. It is a causative factor, if not the primary one, in 80% of medical malpractice lawsuits. Part 2 of this series delves into this potential landmine.

CHALLENGES OF THE NEW MOBILE AGE

How Will It Affect the Radiologist?

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The reporting of a radiogram is, in fact, the task of a logical-minded and experienced detective. Similarly to Sherlock Holmes solving his cases, a radiologist works with the method of analysis, induction and deduction. He observes a summary picture of the chest (that is, the "lung X-ray"). His wide-ranging medical experience in physics, chemistry and biology tells him the causes of the opacity and clearing and what is the presumed tissue composition. And of course, using his knowledge of topographical anatomy, he knows precisely the anatomy of the individual organs in the human body, the relations of these organs and can convert them into a two-dimensional picture.

The Art of Imaging

At this stage, the radiologist (you may visualise him in "action", sitting comfortably in his leather-upholstered armchair with a glass of Pétrus 89, while the rich taste of the wine fills his senses) already knows that a round opacification in the right upper lung area, which is homogenous with a caudal concave margin (its density is higher than that of the lung) and attacks mediastinum (retractive process – probable indication of fibrosis or atelectasis) is localised in the lung parenchyma.

Our radiologist grabs the related paperwork, placing his glass on the mahogany cover of his desk, the aesthetic effect of which is only marginally sullied by the presence of a computer monitor, and from the data stated on the forms discovers that that the patient, a 63-year old man, has been suffering from a dry cough for some time, without raised temperature and high sedimentation. Reflexively, he smells at the form that the patient held in his 63-year old hands and detects the soft aroma of Caledonian Highland Cream: "Elementary, my dear Watson – a heavy smoker, with good taste", he declares. After a short while, he calls in his secretary and begins to dictate the now evident, though sad diagnosis: Pancoast carcinoma.

However, offices are rarely filled with mahogany tables, but rather grim, monochrome furniture, alcohol is not permitted during working hours and in any case, very few doctors can afford to indulge a love of rare vintages. But that wonderful feeling of cogitation, the 'eureka' moment when things start to fit together and stop being just data that we have to memorise, that can still be experienced. Nevertheless, deep theoretical knowledge is necessary for that. And its basis is a detailed understanding of anatomy.

More than Mere 'Reading'

With the development of display methods, there comes an ever more precise displaying of individual organs of a human body which increases the demands on anatomy during the evaluation of film documentation of the patient. With slight hyperbole, it is possible to say that the description of X-rays is a demonstration of excellent knowledge of anatomy. What is "additional" in the picture is a pathological finding then. While evaluating a radiogram, we demonstrate daily how much the quality of a doctor depends on the deep knowledge of pre-clinical and clinical domains.

These days, radiology can be divided into:

- **Diagnostic radiology**, where the aim is to determine the most accurate diagnosis from a carried-out standardised exam. The radiologist makes an assessment based on image documentation rather than the exam itself;
- **Interventional radiology**, where the aim is to carry out a therapeutic or diagnostic operation. The image documents this operation;
- **Virtual radiology**, where the radiologist processes acquired data by various computer programmes to reach the most accurate findings and new views of the organs (virtual colonoscopy).

The classic notion of a radiologist running around the dark room, the exam room and the description room has disappeared. This development is mainly due to digitisation, DICOM, PACS, HIS, RIS, and the universal usage of English as the communication language – software is mostly in English these days as is manipulation with equipment using manuals and software in English for both radiologists and radiological assistants. The result of two hundred years of development is the increasing mobility of radiology and radiologists. This mobility has several levels.

Teleradiology

The essential benefit of teleradiology is the possibility to consult with specialists anywhere in the world within a few minutes. Complex cases can be solved much faster in such instances, which certainly brings a significant quality leap in the treatment and care of the patient.

A radiologist need not always be physically present at the workplace. Though the possibilities of "on-line description" have no boundaries, it brings certain hazards.

A radiologist from an underdeveloped country is willing to describe the radiogram for much less than a radiologist from an economically strong country, devaluing his role. It becomes not a result of clinical-radiological correlation or decisions of indication boards in combination with the knowledge of the state of the patient, but a mere description of pictures. The radiologist him/herself gives up the possibility to communicate with the patient and the doctor and taking an active part in the treatment. That wonderful 'eureka' moment described earlier is no longer a possibility.

Mobility of Documentation

The common image from the movies, when the doctor carries a hard-copy radiogram and observes it against the light is now a matter of the past. The radiogram as such is now deposited in electronic databases of hospitals and the doctor can inspect it practically from any place in the hospital or outside of it. With the aid of portable computers and wireless networks (Wi-Fi) it is possible to open any data from the patient. So it often takes only seconds between the making of a radiogram and the moment when it is possible to examine it on a PC.

This way, documentation mobility can be divided into two classes. The first is radiograms for radiological evaluation, when the common standard these days is the fact that at his diagnostic station, a radiologist can evaluate the pictorial documentation from several modalities that are located in various places in the hospital (or outside of it). The other class consists of radiograms made for an attending physician, whether an internist or surgeon at the operating theatre. It is the combination of wireless networks with the ever-increasing display quality on portable computers, "tablet PC", PDA or MDA also enables the clinician to have the pictorial documentation right at the patient's bed during the ward rounds. It is a state similar to the carrying of films around, but today the essential advantage is the direct connection with the digital archive and therefore the possibility of displaying an arbitrary snapshot of a patient (for example five years old), without the necessity to fill in complicated forms for the radiological ward.

What Does 'Mobility' Mean in Practice?

I am spending my holiday in Turkey. At noon, my family is resting in the hotel room. I have connected my notebook PC and am going through some interesting exams from our hospital in Brno. Then I consult the pictorial documentation of a patient from Vyokov responding to the request concerning the most suitable treatment procedure. I prepare this article and send out a poster to the radiological congress. I also attend to the correspondence in our hospital network. And that is the other exasperating cheek of mobility in radiology – freedom on the one hand, on the other hand – work will catch me anywhere in the world.

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TRANSITIONING TO DIGITAL MAMMOGRAPHY FOR SCREENING

Maximising Cost Benefits

Due to its associated high costs and comparative newness, very few breast screening units in the UK use digital systems. Here, the budget for the breast screening programme, including the actual cost of screening, is approximately £52 million per year. As one of the pioneers of digital mammography in the UK, our Breast Screening Unit (BSU) has had a chance to experience the complexities encountered in transitioning from a film-based to a digital system.

I joined the University Hospital at Coventry & Warwickshire to set up the Warwickshire, Solihull & Coventry Breast Screening Programme, just as the UK's National Breast Screening Programme (NHSBSP) was being rolled out. Every three years we invite a population of 150,000 women from the local area to attend screening. In view of the known advantages of digital mammography (image manipulation, storage and transferability) we agreed to pilot a full field digital system on a mobile unit in 2005 for the (NHSBSP). We therefore replaced one of our existing three film-based mobile screening units with a full-field digital mammography unit. We also run two peripheral hospital centres and a static unit that runs all assessment and administration for the screening programme.

Our mobile van was fitted with Sectra's digital 'Micro Dose Mammography' system, with a mammography mini PACS. Collaborating on the pilot allowed us to perform the physics and clinical testing of the equipment that prompted our subsequent decision to implement the equipment long term. We ran the testing on patients who were being recalled for follow up studies, to compare the new digital and old film-based systems, which demonstrated that they were equivalent in image quality. Following the pilot, we took a three-year lease of the equipment. Before this, we were completely film-based.

Justifying the High Cost

One of our first goals was to test claims for improvement in throughput and if we could reduce the standard six-minute appointment times. We offered training to radiographers in the use of the new digital equipment and then evaluated seven, six, five and four-minute appointments. While the new equipment coped well with four-minute appointments, the patients were not satisfied and felt the process was too hurried. Finally, five-minute screenings proved acceptable to patients and radiographers which allowed us to offer two extra appointments per hour, an improved rate of 20%.

However, the high expense of the equipment cannot justify itself by high throughput alone. We are now looking at extending the operating hours of the mobile units through to the evenings, in order to fully realise potential benefits. This also gives patients more options when scheduling appointments. We are now planning to invest in digital mammography equipment for our two peripheral hospital locations, which also run surgical referral clinics, resulting in increased workflow on these fixed sites as well as the vans. This will enable us to reduce the number of mobile vans from three (one digital, two film-based) to two digital vans. This will go to a tendering process and enable significant cost benefits. It will also allow for reduced film and storage costs, for both symptomatic and screening, as well as improving patient services.

One of the biggest workflow issues for film based mammography is, of course, the time and costs of getting the previous films from storage and loading the multiviewer. As our established patients still have a film-based history, we are currently in a sort of halfway-house requiring the use of multi-viewers. It will take one screening round (three years) for majority of patients to have a fully digital record.

Transitioning to Digital in the UK

The NHSBSP provides free breast screening for all women in England aged 50 to 70 years. Over 1.5 million women are now screened in the UK each year. The NHSBSP relies on its computer system, the National Breast Screening System (NBSS), to run call/recall, patient management, data collection and to provide standard statistical returns for monitoring and analysis of the programme. NBSS does not currently have a RIS functionality, so results still have to be separately entered onto both PACS and NBSS. This means the

» *continued on p.39*

IMAGE QUALITY OF CR MAMMOGRAPHY

Andrew P. Smith, Ph.D.

Computed radiography (CR) is an accepted method of performing general digital radiography for applications requiring moderate productivity, resolution, and dose performance. Because of certain technical limitations, however, CR systems do not offer the resolution performance of advanced flat panel image receptors used in full field digital mammography (FFDM). CR Mammography works similarly to CR as used in the radiology department.

HOW DOES IT WORK?

A special cassette, containing a charge storage phosphor, is used in place of the conventional x-ray screen-film cassette. It is exposed to radiation using standard techniques, and then the technologist feeds the cassette through a scanner. The scanner contains a laser beam that is directed to a small location on the phosphor. When the laser beam strikes the phosphor, it stimulates the emission of light, which is detected using two photosensitive elements, one on each side of the plate. The amount of light that is emitted at a given location on the cassette is proportional to the amount of x-ray radiation that that location was exposed to during the acquisition. By scanning the laser beam in a raster motion across the phosphor, and by recording the quantity of light emitted at each location, the scanner assembles a digital image. This entire scanning process takes about one minute per cassette.

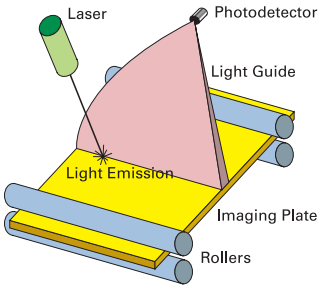

Fig. 1: Schematic of CR reader

PHYSICS OF CR MAMMOGRAPHY

CR is one of a class of image receptors known as indirect conversion detectors. Other detectors that use this technology are amorphous silicon cesium iodide flat panel detectors such as employed in the GE Senographe series FFDM systems. Indirect conversion detectors involve the diffusion of light as part of the x-ray detection process, and this degrades the spatial resolution and makes it difficult to achieve good dose efficiency. When an incident x-ray is absorbed in the scintillation layer, typically cesium iodide, the energy of the x-ray is converted into a cloud of low energy visible light photons. These photons diffuse through the scintillator, until they are collected by the photodiodes, which form the top of each pixel. The diffusion is the reason for the resolution loss- many pixels receive a signal from even a single incoming x-ray.

Physicists would describe this by saying that the point spread function is broad. It is important to understand that the inherent resolution of the system is determined by this light spread, and not by the pixel pitch. In particular, making the pixels smaller will not create an image with superior resolution, and we shall see the implications of this for CR Mammography.

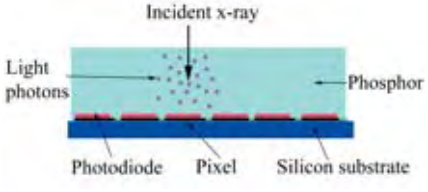

Fig. 2: Indirect conversion detectors work by absorbing x-rays, which give off light scintillations that are detected by photodiodes

INCREASING DOSE EFFICIENCY

Another characteristic of indirect conversion systems relates to dose efficiency. Dose efficiency in its simplest form relates to how efficiently the detector uses the radiation that impinges upon it. Clearly, if the radiation passes through the detector without being absorbed, it does not contribute to the image while it did contribute to increasing the patient dose. The solution to this is to make the detection layer thicker, to increase the probability of absorption of the x-ray. This increases the dose efficiency.

TECHNICAL CHALLENGES FOR CR

Just like indirect conversion flat panel detectors, the x-ray is absorbed in the phosphor, however with CR, there is no immediate scintillation of light. Rather, the light energy is stored in the screen by exciting electrons into a metastable energy state. When the CR plate is put into the CR reader and scanned with the laser beam, the laser beam provides enough energy to release the metastable electrons and we get stimulated emission of light at the locations where we had the metastable

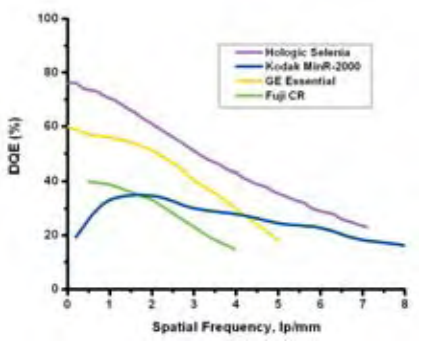

Fig. 3: Dose efficiency as shown by the Detective Quantum Efficiency for Fuji CR, compared to screen-film (Kodak), cesium iodide (GE), and selenium detectors (Hologic)

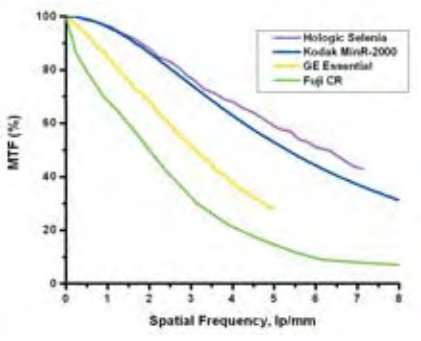

Fig. 4: Resolution performance as shown by the Modulation Transfer Function for Fuji CR, compared to screen-film (Kodak), cesium iodide (GE), and selenium detectors (Hologic)

state. They suffer from light diffusion similarly to indirect conversion flat panel detector. In addition, scatters of laser light inside the CR phosphor provides another source of image blurring that further degrades image sharpness. So, we cannot make the screen too thick because our resolution suffers, however if we make the screen thinner then the x-rays will have a significant probability of not being absorbed and the dose efficiency will suffer. In general for CR detectors, one cannot have both good dose efficiency and high resolution. We shall see that designers of CR systems had to balance these tradeoffs, and have developed systems with resolution significantly inferior to screen-film and competing digital systems. While CR dose efficiency can be made similar to screen-film, it is significantly inferior in comparison to flat panel FFDM detectors.

The dose efficiency of a detector can be characterised using the Detective Quantum Efficiency, or DQE, curve. A DQE of 100% would represent perfect dose efficiency. It can be seen that all detectors have the characteristic that the performance of dose efficiency gets poorer and poorer as the objects get smaller, i.e. larger lp/mm. The direct conversion technology employed in selenium detectors provides both high dose efficiency and superior resolution characteristics. Selenium detectors are the only ones that offer superior resolution performance than screen-film. It is one of the reasons why systems based on these detectors have microcalcification visibility superior to film.

RESOLUTION AND IMAGE SIZE

It is informative to look at the resolution characteristics of CR using another metric, known as the point spread function. The point spread function shows the detector response from a single incident x-ray and characterises the resolution in the x,y detector coordinate system. The point spread function can be calculated from Modulation Transfer Function,(MTF) curves. There is significant signal in many pixels for a single incident x-ray. This represents the inherent resolution limit of CR mammography. Relative to the pixel receiving the largest signal (just under the incoming x-ray), pixels as far away as 3 pixels to the left and right are receiving significant signals. Another way of stating this is there is significant signal in perhaps 49 (7 in the X times 7 in the Y direction) pixels for every x-ray.

One could make the argument that using 50 micron pixels is not optimal. The system could use much coarser pixels without affecting observable image quality because resolution is determined by the broad point spread of the laser beam during readout. As the pixels are made smaller, the image file sizes increase, and this introduces many difficulties such as longer transfer time, larger PACS storage requirements, and inability to display all the pixels on monitors. If the detector has high intrinsic resolution, such as direct conversion selenium detectors do, then there is value in small pixels. The CR system has all the disadvantages associated with small pixels, with none of the gain in image resolution.

However, the light is actually being emitted all the time, even before the screen is put into the reader. This can be thought of as phosphorescence. Immediately following the x-ray exposure, there is a slow, but steady, emission of the stored light signal. The longer the interval between the exposure and the reading, the smaller will be the resultant image signal that the CR reader can detect, and so the poorer the image. If only ten minutes transpires from exposure to readout, approximately 10% of the signal will have been lost.

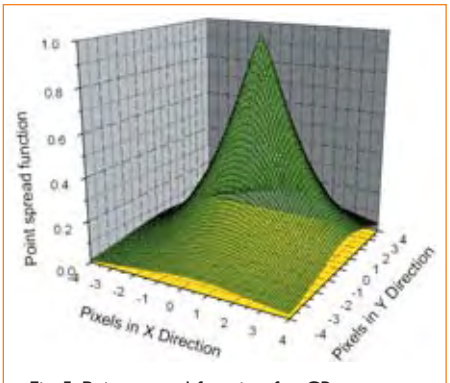

Fig. 5: Point spread function for CR mammography system

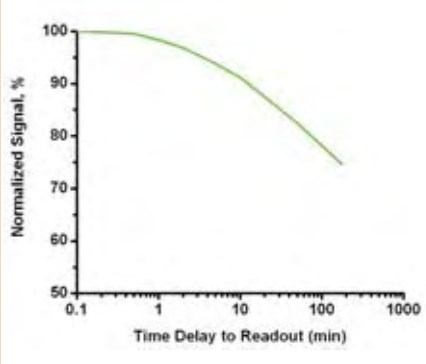

Fig. 5: Signal decay from delay between exposure and readout for CR detectors

Thus, in a mammography screening environment with a patient throughput of one every fifteen minutes, the first image taken in the four-view mammogram series will have suffered the equivalent of having received 10% less radiation and will exhibit increased noise. It is important to remember that the patient received the full radiation; it is just that the image quality does not reflect this.

CLINICAL PERFORMANCE

There have been a number of scientific presentations that attempt to estimate the performance of CR mammography in a variety of imaging tasks. The paper 'Microcalcification detectability for four mammographic detectors: flat-panel, CCD, CR, and screen/film', by Fetterly and Schueler found that CR performed poorer than screen-film, whereas a flat panel detector was superior to both screen-film and CR. They also found the minimum size of detectable microcalcifications to be poorest for CR, and best for flat panel. The paper 'Digital luminescence mammography (CR) versus full-field digital mammography (DR): A phantom study', by R. Schulz-Wendtland et. al. found significantly higher detectability rate of lesions for flat panel full-field digital mammography compared the CR high resolution digital phosphor storage plate in an experimental setting. The paper 'Comparison of full-field digital mammography (FFDM) and CR Mammography: Physical imaging properties and contrast-detail characteristics', by Ideguchi et. al. found that the full field digital mammography system had superior physical imaging properties and contrast-detail characteristics compared to a CR digital mammography system with pixel size of 50 microns. These results are not surprising given the relatively poor resolution and imaging performance of a CR detector, compared to direct-to-digital mammography detectors.

CONCLUSION

The resolution and dose performance of CR mammography is inferior to screen-film and to flat panel detectors. The performance of direct conversion selenium-based systems is significantly superior to CR. In addition, CR offers no productivity advantage compared to screen-film, which is enjoyed by flat panel detectors. And finally, CR is unable to do dynamic imaging, such as tomosynthesis, and this will limit its usefulness and applicability for future applications.

ECRI Europe
A NONPROFIT AGENCY

DIGITAL MAMMOGRAPHIC SYSTEMS

PRODUCT COMPARISON CHART

ECRI is a totally independent non-profit research agency designated as a Collaborating Centre of the World Health Organization (WHO). Such organisations are appointed to contribute to WHO's public health mission by providing specialised knowledge, expertise, and support in the health field to the WHO and its member nations. ECRI is widely recognised as one of the world's leading independent organisations committed to advancing the quality of healthcare with over 240 employees globally.

ECRI's focus is medical device technology, healthcare risk and quality management, and health technology assessment. It provides information services and technical assistance to more than 5,000 hospitals, healthcare organisations, ministries of health, government and planning agencies, voluntary sector organisations and accrediting agencies worldwide. Its databases (over 30), publications, information services and technical assistance services set the standard for the healthcare community.

All of ECRI's products and services are available through the European Office, addressing the special requirements of Europe and the UK. Utilising some of the world's largest health related databases, help, support and guidance can be given to our European clients at a local level.

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www.ecri.org.uk

	ECRI[1]
MODEL	**Digital Mammographic System**
WHERE MARKETED	
FDA CLEARANCE	Yes
CE MARK (MDD)	Yes
GENERATOR TYPE	High-frequency
kV RANGE	22 - 34 (1kV increments)
mAs RANGE	4 - 600
mA range	Up to 100
Time range, sec	0.02 - 8
DIGITAL DETECTOR	
Type	
Detector size, W x H, cm	24 x 30
Max exposure time	
Image bit depth	14
Pixel size, µm	≤50
DQE @ lp/mm	>50% @ 28kV
DQE @ 5 lp/mm	>20% @ 28kV
MTF @ 5 lp/mm	50%
CONTROL MONITOR	
Type	
Size, cm (in)	
HARD DISK STORAGE, GB	100
DICOM 3.0	Yes
AEC DETECTOR	Yes
Parameters controlled	kV, mAs, anode/filter
X-RAY TUBE	
Anode type	Rotating
Heat capacity, HU	300,000
Heat dissipation rate, HU/min	60,000
Target/filter combinations	Mo/Mo, Mo/Rh
Focal-spot size, mm	0.1 and 0.3
POSITIONING ASSEMBLY	
Collimation	Yes
18 x 24 cm	Yes
24 x 30 cm	Yes
Movement locks	Electromagnetic
Assembly movement	
Rotation	-135 to +180
Vertical, cm (in)	100 (39.4)
SID, cm	66
Scale guide	Distance and pressure
RADIATION OUTPUT	
mR/sec @ 28 kVp	≥800
RADIATION SHIELD	
L x W, cm (in)	
Thickness	
COMPRESSION SYSTEM	Manual, automatic, fine adjustment
Force, newtons	200
GRID RATIO	5:01
MAGNIFICATION DEVICE	Yes
H x W x D, cm (in)	
WEIGHT, kg (lb)	
OTHER SPECIFICATIONS	

Footnotes to the Product Comparison Chart

1 These recommendations are the opinions of ECRI's technology experts. ECRI assumes no liability for decisions made based on this data.
2 Refer to system datasheet to get all DQE data and detailed measurement conditions
3 Refer to system datasheet to get all MTF data and detailed measurement conditions
* Marketed in Japan by Shimadzu Corporation
** User-selectable normal AC (mAs) or advanced AEC (mAs, kV); kV and thickness compensated; Flex-AEC automatically selects sensors
*** Complies with IEC 60601-1, IEC 60601-2-45, IEC 60601-1-2 (EMC); and IEC 60601-1-28 (X-ray tube assemblies). Meets requirements of CSA, DHHS, and UL

Publication of all submitted data is not possible: for further information please contact ECRI or editorial@imagingmanagement.org.

	GE Healthcare	GE Healthcare	GE Healthcare	HOLOGIC®
	Senographe 2000D	**Senographe DS**	**Senographe Essential**	**Lorad Selenia Base System**
	Worldwide	Worldwide	Worldwide	Worldwide
	Yes	Yes	Yes	Yes
	Yes	Yes	Yes	Yes
	Single-phase, high-frequency	Single-phase, high-frequency	High-frequency	Constant potential, high-frequency inverter type
	22 - 49	22 - 49 in 1kV increments	22 - 49	20 - 39 in 1 kV increments
	4 - 500	4 - 500	4 - 500	3 - 400
	40 - 100	25 - 100	25 - 100	10 - 100 large focus; 10 - 30 small focus
	0.035 - 6 (20 sec manual)	0.04 - 6	0.04 - 6	0.1 - 4
	A-Si-CsI	A-Si	Amorphous silicon on which cesium iodide	TFT-based aSe direct-capture technology
	19 x 23	19 x 23	24 x 31	24 x 29, single plate
	Not specified	Not specified	Not specified	4 seconds
	14	14	14	14
	100	100	100	70
	Not specified: [2]	Not specified: [2]	Not specified: [2]	>/-50% at 7 mR x-ray exposure or higher
	Not specified: [2]	Not specified: [2]	Not specified: [2]	35%
	Not specified: [3]	Not specified: [3]	Not specified: [3]	68%
	Not specified	High performance black and white LCD technology	High performance black and white LCD technology	20" high-brightness flat-panel display
	Not specified	41 x 34 cm	41 x 34 cm	50.8 (20)
	2 x 20 (40 total)	2 x 73; Ultra 160 SCSI, 14,000 rpm hard disks	2 x 73; Ultra 160 SCSI, 14,000 rpm hard disks	160
	Yes; print, storage, storage commitment, query-retrieve, modality worklist, HIS/RIS, verification, CD-Rom	Yes; print, storage, storage commitment, query-retrieve, modality worklist, HIS/RIS, verification, CD-Rom	Yes, Modality worklist user, Storage provider, Storage commitment user, Query/Retrieve User, Basic Grayscale print user, Verification provider, Dicom compliant CD-R data interchangeable	Store, store commit, print, query, retrieve, scheduled workflow (DICOM worklist)
	Manual and AOP kVP, track, filter, mAs	Manual and AOP AOP-anode track (Mo or Rh), filter (Mo or Rh), kV, mAs	Yes, fully automatic AOP-anode track (Mo or Rh), filter (Mo or Rh), kV, mAs	Yes Auto time, auto kV, auto filter
	Bimetal rotating	Rotating, air cooled, molybdenum and rhodium targets	Rotating, air cooled, molybdenum and rhodium targets	Molybdenum rotating
	Dual-track anode; molybdenum alloyed with vanadium track and rhodium track	357,000	357,000	300,000
	90,000 for anode, 465,000 for housing	354kHU for anode	354kHU for anode	60,000
	Mo/Mo, Mo/Rh, Rh/Rh	Mo/Mo, Mo/Rh, Rh/Rh	Mo/Mo, Mo/Rh, Rh/Rh	Mo/Rh
	0.15 and 0.3	4 focal spots, 0.1 and 0.3; IEC on each	4 focal spots, 0.1 and 0.3; IEC on each	0.1 small, 0.3 large
	Automatic	Automatic or manual	Automatic or manual	Fully automatic
	Flat-panel 19.2 x 23	19.2 x 23	Yes, 19.2 x 23	Automatic, manual override
	N/A	N/A	Yes	Automatic
	Electromagnetic	Electromagnetic	Electromagnetic	Automatic
	Motorized	Motorized	Motorized	
	180, -180	185, -165	-165 / 185	+195 to -150
	76 - 145	65 - 150 (25.6 - 59)	65 - 150	67 - 140 (26.5 - 55)
	60	66	66	66
	Compressed-breast thickness, compressed force, tube-arm support angulation, x-ray field size	Compressed-breast thickness, compressed force, tube-arm support angulation, x-ray field size	Compressed-breast thickness, compressed force, tube-arm support angulation, x-ray field size	Digital display on both sides of compression device
	Not specified	11.5mGy per sec	11.5mGy per sec	>800
	Yes	Yes	Yes	Yes
	220 x 71 (86 x 28)	220 x 71 (86.6 x 28)	220 x 71 (86.6 x 28)	189.2 x 81.3 (74.5 x 32)
	0.3 Pb equivalent @ 49 kV	0.3 Pb equivalent @ 49 KV	0.3 Pb equivalent @ 49 KV	6 mm tempered glass
	Motorized, manual compression adjust; programmable speed, pressure, and automatic release	Motorized, manual compression adjust; programmable speed, pressure, and automatic release	Motorized, manual compression adjust; programmable speed, pressure, and automatic release	Manual and motorized
	0 - 200	0 - 200 motorized, up to 270 manual	0 - 200 motorized, up to 270 manual	178 maximum motorized; 300 maximum manual
	5:1, 31 lp/cm	5:1, 31 lp/cm	5:01	4:1 HTC grid (8:1 cleanup equivalent)
	1.5x and 1.8x	1.5x and 1.8x	1.5x and 1.8x	1.8x plastic platform
	171 x 55 x 122 (67.2 x 21.6 x 48); 132 x 43.2 x 57 (52 x 17 x 22.5) generator	≥193 x 70 x 127 (≥76 x 27.6 x 50) gantry	193//245 x 62 x 127	190 x 65 x 110 (74.8 x 25.6 x 43.3) gantry
	280 (617) column FDA approved for CAD and mobile; image size only 8.8 MB/image for lower archive costs; optimized image system includes aSi detector, AOP, Rh tk/filter for optimal penetration, sharp IQ grid.	450 (992) gantry Advanced ergonomics, intuitive user interface; automatic positioning; ergonomic paddle; minimum time between exposures; 8.8Mb image size; Mo/Rh tube; AOP on the whole detector measuring breast radiological density; up to -40% less dose vs film- FineView and premium-view advanced processing; optional Stereotaxy add-on leveraging same detector.	450 (992) gantry Advanced ergonomics, intuitive user interface; automatic positioning; ergonomic paddle; minimum time between exposures; 8.8Mb to 15Mb image size; Mo/Rh tube; AOP on the whole detector measuring breast radiological density; up to -40% less dose vs film- FineView and premium-view advanced processing; optional Stereotaxy add-on leveraging same detector. Mobile certified.	300 (661.5) Standard Smart Paddles system allows 1 detector to image all breast sizes; HTC grid automatically retracts for geometric magnification views; FlexMonitor allows screen to be positioned for optimal viewing. Prior study reviewing and bidirectional communication available at the acquisition workstation. Selenia with TechMate acquisition station for prior film reviewing in the mammography suite for improved workflow and patient care.

	ECRI[1]	Planmed	SIEMENS
MODEL	**Digital Mammographic System**	**Nuance***	**MAMMOMAT Novation DR**
WHERE MARKETED		Worldwide	Worldwide
FDA CLEARANCE	Yes	Pending FDA clearance	Yes
CE MARK (MDD)	Yes	Yes	Yes
GENERATOR TYPE	High-frequency	Constant potential, high-frequency, 80kHz	High-frequency
kV RANGE	22 - 34 (1kV increments)	20 - 35, 1kV increments	23 - 35
mAs RANGE	4 - 600	1 - 720	2 - 710
mA range	Up to 100	44 small focus, 120 large focus; available with tube that gives 35 mA with small focus and 110 mA with large focus	28 - 188
Time range, sec	0.02 - 8	0.1 - 5 s large focus, 0.1 - 9.9 fine focus	0.010 - 4 (<7 sec in mag)
DIGITAL DETECTOR			
Type		Direct digital amorphous Selenium FPD	aSE
Detector size, W x H, cm	24 x 30	17 x 24 or optional 24 x 30	24 x 29 (3328 x 4084)
Max exposure time		9.9 s	See above
Image bit depth	14	13	14
Pixel size, µm	≤50	85	70
DQE @ lp/mm	>50% @ 28kV	>50% @ 28kV	>60% @ 0
DQE @ 5 lp/mm	>20% @ 28kV	>25% @ 28kV	>15% @ 7
MTF @ 5 lp/mm	50%	>50%	>40% @ 7.1
CONTROL MONITOR		Planmed Nuance AWS	
Type		3 megapixel grayscale TFT	Color TFT
Size, cm (in)		21"	48.3 (19)
HARD DISK STORAGE, GB	100	250	160
DICOM 3.0	Yes	Yes	Yes
AEC DETECTOR	Yes	Yes, proprietary Flex-AEC with 48 detector areas	Yes, integrated
Parameters controlled	kV, mAs, anode/filter	kV, mAs based on true tissue composition**	Recommended kV/mAs
X-RAY TUBE			
Anode type	Rotating	Rotating, oil and fan cooled	Rotating, Tungsten-Mo
Heat capacity, HU	300,000	300,000	Tube unit: 1,500,000
Heat dissipation rate, HU/min	60,000	56,000	Anode: 30,000
Target/filter combinations	Mo/Mo, Mo/Rh	Mo/Mo, Mo/Rh	W/Rh, Mo/Rh, Mo/Mo
Focal-spot size, mm	0.1 and 0.3	0.1 and 0.3	0.3, 0.1
POSITIONING ASSEMBLY		MaxView Breast Positioninig System included	
Collimation	Yes	Yes, automatic motorized	Automatic
18 x 24 cm	Yes	Yes, standard detector	Yes
24 x 30 cm	Yes	Yes, optional large detector	Yes
Movement locks	Electromagnetic	Motorized	Electromechanical
Assembly movement			
Rotation	-135 to +180	-135 to +180 Motorized, isocentric, adjustable speed	135/180
Vertical, cm (in)	100 (39.4)	60 (23.5) motorized, adjustable speed	60 - 135
SID, cm	66	65	65
Scale guide	Distance and pressure	Digital display of force, thickness and angle	Yes
RADIATION OUTPUT			
mR/sec @ 28 kVp	≥800	1300	>800
RADIATION SHIELD		Optional	Yes
L x W, cm (in)		185 x 75 (73 x 30)	450 x 782 x 1961 (177.2 x 307.9 x 772)
Thickness		0.5 or 0.3 mm Pb equivalent	0.1 or 0.3 mm Pb equivalent
COMPRESSION SYSTEM	Manual, automatic, fine adjustment	Motorized, user-adjustable degressive speeds and force; manual compression; automatic or manual release; MaxView Breast Positioning System	Motorized OPCOMP and manual
Force, newtons	200	Selectable to 200	Meets MQSA
GRID RATIO	5:01	5:1, 34 lines/cm	5:1, 31 lines/cm
MAGNIFICATION DEVICE	Yes	Single magnification tower with selectable 1.6, 1.8, or 2.0 magnification factor	1.5 and 1.8
H x W x D, cm (in)		103 x 76 x 100 (40.4 x 29.9 x 39.2)	55 x 212 x 124
WEIGHT, kg (lb)		185 (411.4)	360 (794)
OTHER SPECIFICATIONS		Side Access Patient Positioning System; Dual control panels; Automatic Rh filter selection; Short-fixed or turnable base; Automatic view selection with angle memory; help-code display; Reader-Ready image presentation with dedicated mammography image processing at AWS; Nuance Manager software for system maintenance and Quality Control; DICOM modules (DICOM Storage, DICOM Consult File Creation, DICOM Storage Commitment); Mammography viewing tools and customizable viewing protocols at RWS***	Syngo-based AWS and reading workstation.

Case Study - Codonics Horizon Helps Sports-minded Lisbon Clinic Stay Ahead of the Competition

Written by: Steven Wagner, Freelancer

In a bustling clinic where hundreds of patients are treated each day, medical challenges abound. Clinica de Radiologia e Especialidades Autonomas Relacionadas (CREAR), a thriving practice in Lisbon, Portugal, is no exception.

Each day, an estimated 400 patients are treated at CREAR. Most are imaged using one of 10 medical imaging devices: four ultrasound (with color Doppler), three fluoroscopy, one CT, one MRI and one bone densitometry unit. With a range of imaging devices that broad, a secondary challenge is producing high-quality clinical images fast enough to keep pace with the patient flow.

Until 2004, CREAR used a wet imaging system to print all of the images produced by the various modalities. This required considerable space, could not print 3D reconstructions in color, and was expensive to maintain. Additionally, water and power consumption were substantial, and when service was required, the system was generally down for days at a time. Something had to be done.

After meeting with Codonics representatives, watching the imager in action, and comparing its images with those produced by the clinic's existing system, CREAR was convinced.

"I was very surprised, very joyful at the quality of images I saw," said Luis Fouto, M.D., a senior radiologist, adding, "I wanted a system that could produce diagnostic-quality images from five imaging devices that were all connected and capable of sending data at the same time. The Codonics Horizon did all of this with unparalleled efficiency, and I'm very pleased."

With the high-end Horizons, outstanding images are presented on clear and blue film, grayscale paper, and color paper in a variety of sizes. Horizon imagers generate 35 x 43 cm, 28 x 43 cm and 20 x 25 cm blue and clear film plus grayscale paper prints in 35 x 43 cm, 28 x 43 cm, A and A4 letter sizes, and color in A and A4. The Horizon product line offers models to suit every need and budget.

When it came time to choose imagers around the department, the decision was surprisingly easy. After all, not only did Dr. Fouto find that Horizon prints unmatched color output with quality and vividness that matches a workstation monitor, but its exclusive grayscale paper capability brought about several benefits as well.

He's strengthening his relationships with referring physicians, who appreciate the ability to view images on DirectVista Grayscale Paper in room light. With this exclusive grayscale paper, no view box is necessary. And there's a huge time saving addition. Dr. Fouto and his staff no longer must traverse the clinic throughout the day to visit their centralized system.

"With Horizon we have a package that is much more reliable for our needs," he said. "We get diagnostic-quality images on film, paper and color paper, the systems are reliable, and we save time and space. We chose Horizon for all of those reasons."

"Codonics gives me peace of mind," he said. "It's very important to me knowing I have three systems operating with equal reliability."

With that concern behind him, Dr. Fouto and the 10 or so other radiologists who serve CREAR can concentrate on what they do best: diagnosing patients. While the clinic serves a general population, between 10% and 15% of his business involves sports. In addition to treating Olympic athletes, the clinic treats Portugal's primary soccer and other sports teams, including SLB - Sport Lisboa Benfica - a leading European soccer team and the European champion several times over.

Where that and other teams are concerned, Horizon's value has been immeasurable for one overriding reason: coaches, players and team personnel can view images in room light on their own schedule, evaluating daily what steps must be taken while an injury heals and how soon an athlete might return to action - without the need for a view box.

Codonics Horizon Multi-media Imager prints film, grayscale paper and color - simultaneously

In the realm of sports, Dr. Fouto and his team of radiologists find the consistent image reproduction of the Horizon particularly useful in enabling physicians to evaluate tears of the labrum, a ring of fibrocartilage around the edge of the shoulder socket; torn meniscus (knee cartilage); tendonitis; and torn rotator cuffs (shoulder). Other sports injuries in which Horizon's output of the diagnostic images have been found useful include metarsal stress fractures, Achilles tendon tears, lumbar spine inflammation, and anterior/posterior cruciate ligament tears. Image quality is so superior that Horizon enables physicians to plan the long-term treatment of - and recovery for - high-end athletes without high-cost image processing or special viewing equipment.

Its clinical capabilities aside, Horizon has proved beneficial in numerous other ways. It fits on a desktop, weighs less than 32 kilograms, holds up to 300 sheets of film or paper, and offers the fastest time-to-first print. Additionally, it's the only imager that delivers diagnostic film, color paper, and grayscale paper from the same device. Finally, CREAR's relationships with referring physicians have been enhanced due to Horizon's outstanding image quality and its ability to deliver that quality in the physician's preferred format.

"We're much more efficient because of Horizon," Dr. Fouto said. "And, Horizon rests my mind. Instead of having a somewhat unreliable system that staff had to access from throughout the clinic, I have three reliable imagers that are placed for easy access. And, the images are of the highest quality. Without a doubt, Horizon was the best solution we could have found."

HOW TO...
ORGANISE REPORTING

ADVICE FROM THE TRENCHES

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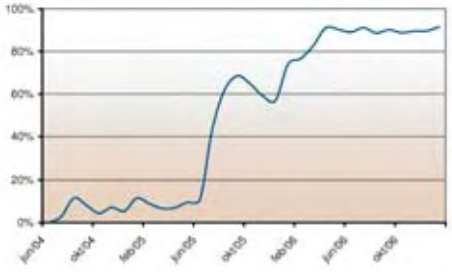
Organising your reporting workflow can lead to important benefits for your imaging services. Not only is it possible to reduce the report turnaround time dramatically, but also errors can be reduced while simultaneously improving report quality. This article offers some insights from Ghent University Hospital, a large university training and research centre where 600 physicians work, of which 37 are radiologists.

Identify Your Process Steps

How does one go about streamlining report workflow? The answer to most operational streamlining and optimisation questions starts with process analysis – simply put, write down all the steps in your reporting process, or processes. Using reporting technology, many steps will become obsolete or will run automatically. The less time a human spends performing the remaining steps, the better your solution will be. Ultimately, what remains should be the core imaging work and nothing more. At our hospital, the mean reporting process time for a chest X-ray was more than six hours using tape recorders and a dictate-distribute-transcribe-print-return-correct-validate workflow. After deploying speech recognition and PACS, the mean process time dropped to mere minutes. The IHE integration profile on reporting workflow can help to identify the process steps and possible bottlenecks.

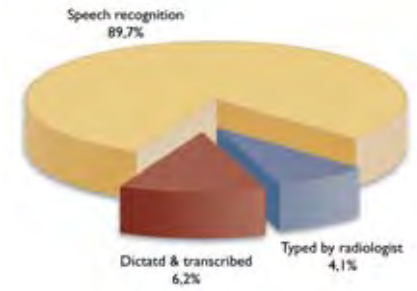
Decide on Reporting Technology

Several types of reporting technology are available today. Choosing the right tool for the job at hand will depend on the situation, your budget, preference, and exam volume. Basically, there are two *modus operandi* dubbed "online" and "offline", the main difference being the aid of human transcribers in case of offline recognition. This technology has clearly matured the last years; not only has the initial training been reduced to a couple of minutes instead of hours, but also both the recognition ratio and the speed have also been improved to usable levels. In 2004, we started using online recognition right away. We used to employ up to twelve transcribers in the past but currently there is less than one full-time equivalent worth of typing left.



Usage of Speech Recognition by Radiologists: Following department-wide introduction a sharp usage increase can be observed. New radiologists and a shortage of workstations temporarily stopped growth. In this typical university hospital, a physician has no financial incentive to use speech recognition, nor did management make the use of it mandatory. In spite of this, we reached 90% usage within one year.

To our surprise, some of the radiologists prefer to manually type in reports and they do so very efficiently by aid of predefined text fragments. The newer "chat" generation of radiologists also does not mind typing in the occasional report. An older form of report technology, automatic distribution of dictations, is widely used. Most of these systems are telephone-based. They save some time because of the freedom to dictate everywhere, but full-time transcribers are still required.



Currently, speech recognition does 90% of our reporting, while some radiologists prefer to type in their reports (4%) with the aid of predefined text fragments. A minority (6%) still gets dictated and transcribed, caused by a soon to be digital mammography service and a couple of unavoidable diehards...

Structured Reporting

Instead of storing reports as free text, report information should be standardised and presented in a clear, organised format. Using "structured reporting", attributes of each finding can be tracked and compared easily without reading through lines and lines of text. This approach requires a meticulously crafted report structure and quite some discipline from the authors. We use structured reporting a lot in cardiac imaging, where it shines as a research tool and a useful addition to the training toolbox. A side effect is improved image quality since it is hard to make a good structured report when not all relevant attributes can be measured or seen.

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Integration Key to Success

The key to success is integrating report technology within existing or new IT systems. Starting a report session should require no more than one click or button. Entering ID's or other already stored information is error-prone and should be avoided at all costs. A good integration requires linking IT systems on two levels. At the back-end, information must flow freely from one system to another so all needed information regarding patients, exams, and status is present and up-to-date. At the front-end, the physician's workstation, all applications should be synchronised so that selecting an exam automatically opens the same exam in all applications. A single vendor solution can simplify the integration process.

The optimal way of reporting happens when a physician finishes the report in one swift move. This way, errors are reduced to a bare minimum since proof-reading a report a couple of days after the exam took place can lead to mistakes. For instance, the one letter difference and similar pronunciation of "one" and "none" can cause a dramatically different outcome.

State-of-the-art Reporting

Due to the success the radiology department had in using speech recognition, we have started deploying a hospital-wide system as we write this. We are currently hooking up multiple departments: orthopaedics, brain surgery, pathology and several others. For some of these specialties the recognition ratio is lower than 90% so off-line recognition – in combination with human transcribers – is used, but even here speech recognition remains a real time saver. Off-line speech recognition also works fine across both wired and wireless phone connections.

Several of the departmental information systems can do multimedia reporting. However, since we send out almost all reports digitally, this leads to problems for our aging hospital information system, as the Belgium-wide network for sending digital medical reports tends to choke on rich multimedia content.

savings on clerical and administrative work have not yet materialised. The NHSBSP aims to offer 90% of attendees a first offered assessment appointment within 3 weeks of attending for screening. Despite the hybrid system of film and digital based equipment, the pilot did not affect our ability to achieve this target.

In the next financial year, we anticipate the national programme will be able to add desktop integration and RIS functionality to NBSS. I am hopeful, once the building blocks are in place, the programme can start to contemplate the costs of new equipment and national data warehousing.

One of the undeniable advantages of digital is the removal of film processing. Apart from the obvious environmental advantages, it is considerably easier to quality control both mammography machines and the work stations. IT solutions for centrally monitoring technical quality are already well advanced in Belgium. Teleradiology might be a mixed blessing. The European Union is currently consulting about safe-guarding patients when they, or their images, cross national boundaries. Monitoring breast screening services is already hard enough when they are self contained. The introduction of cross border film reading will represent a real challenge.

CAD and Digital Mammography

We currently don't have Computer Aided Detection (CAD) attached to the full field digital system, as there is doubt regarding the benefits of CAD over the double-reading system currently in place in the UK. Double reading of mammograms has been shown to improve detection of breast cancer by 9 - 15%. Both the retrospective and prospective studies on CAD have been hard to interpret with very variable results, although it is in almost routine use in the USA where single reading by low volume users is the current practice. In the UK, where there are predominantly large volume users, results are likely to be different. "CADET I" took a prospective look at over 10,000 cases retrospectively, showing a small increase in cancer detection rate, but at the cost of a higher recall rate. The cost of the additional recalls outweighs the savings in film reading time, so it is unclear whether CAD brings real benefits. The follow-up "CADET II" study is randomising 30,000 women to evaluate double-reading versus a single reading with CAD. It is funded by the CRUK and the NHS Breast Screening Programme in Manchester, Coventry and Nottingham. This should answer most of the outstanding questions.

Conclusion

As the surrounding IT infrastructure develops and the cost of equipment becomes more reasonable, digital mammography will become more viable in the UK. We are not sure yet, but on balance, I guess that large population-based screening programmes that use digital mammography will be marginally more expensive to run. In order to keep costs down, we need to significantly increase utilisation of the mammography equipment, which can be a problem in rural areas where it is difficult to find the staff or the volume of patients needed to make it effective.

Homemade Integrated Interface: For fast and easy searching through millions of radiological reports and associated data. We expect equivalent technology to surface in commercial offerings in the future. Implementing indexing on a hospital-wide scale is not always possible due to access restrictions and patient privacy. The indexing system substantially boosted our research output.

THE SWEDISH NATIONAL HEALTHCARE SYSTEM

Public vs. Private: The Debate Continues

The Swedish healthcare system is a regionally based, publicly operated national health service. It is organised on three levels: national, regional and local. The county councils, on the regional level, together with the central government, are the basis of the healthcare system. Overall responsibility for the healthcare sector lies at the national level, with the Ministry of Health and Social Affairs. It is the state's obligation to provide good health and other social services to all residents of Sweden.

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There are 24 county councils in Sweden. These have the authority to tax their citizens and are therefore responsible for the provision of healthcare in their territory. The state, on the other hand, holds responsibility for regulating the quality of the care provided, through the National Board of Health and Welfare and the Department of Social Health and Welfare. Although they do not fund the provision of healthcare, they are responsible for regulating and reporting on the national state of the population's health. 8% of the GNP goes directly into healthcare in this country.

Background

During the 1980s, in accordance with the constitutional reform of 1974, responsibility for all healthcare was decentralised to the county councils. Both university hospitals (the Karolinska Hospital of Stockholm and the Academic Hospital of Uppsala) also passed from state to county council ownership in the early 1980s. The overall objective of the public health services was stated, in the 1982 Healthcare Act, to be the provision of "good healthcare on equal terms for the entire population". The Act gave the county councils full responsibility for health delivery related matters.

The 1982 Healthcare Act formalised a needs-based approach to healthcare planning and made county councils responsible for preventive care and health promotion and constituted the framework for health planning and health activities. The Act requires county councils to promote the health of their residents and to offer equal access to healthcare.

Through the Dagmar Reform of 1985 the county councils were made cost liable; they had the authority to approve which private practices should be reimbursed by national insurance, as well as the number of patients the practices could see per year. The payments were in practice still made from the national insurance to the private practices. However, payments were balanced according to a fixed budget for each county council. If the national insurance payments exceeded the fixed capitation budget, the county councils had to balance the expenditures. County council planning capacity was thereby strengthened, as they could now plan annual budgets for primary care services (publicly and privately provided), using demographic criteria.

Public vs. Private

Sweden mostly operates on a purchasing/selling system. Most 'sellers' of healthcare services are, as already stated, public. The previous government, the Social Democrats, allowed a certain level of private healthcare to flourish, due to the rather large waiting lists caused by the Social Security system, which funds areas such as sick leave and retirement, draining the government's resources. Since three months ago, the new government, who is a conservative, right-wing alliance, has been promoting private healthcare as the solution to the situation. They will increase the percentage of pri-

vate healthcare sellers, despite the fact that most service providers want purchasers (e.g. the county councils), to be public. Also, the general consensus of the population is that free healthcare provision should be funded by tax and should be democratically provided.

In my view, any healthcare system can never totally live up to the expectations of the population because it is financially unfeasible. Since areas of the social security system such as sick leave are draining the amount available for healthcare then clearly the emphasis for the future of the system should be preventative rather than curative. Debate is ongoing here, as to whether the rules for sick leave for example are too liberal, as its costs are ruining the government and increasing costs in the healthcare system. For example, if an individual has back pain, they can be on sick leave for up to six weeks here, waiting for an MRI scan, which costs a mere EUR 500 compared to the EUR 10,000 cost associated with their sick leave.

Quality Control

In Sweden, every individual has a digitalised ten-digit personal social security number, and national records are kept of every individual's healthcare history and demands. Quality registers have been introduced to follow the state of the healthcare system, particularly in surgical specialties, e.g. cardiac infarction. There is also a National Cancer Register to follow survival rates and give information on patients. These initiatives lead to good general controls of healthcare in Sweden. They are certainly factors in the fact that Sweden is second to Japan in the world, for longevity rates and the lowest infant mortality rate, amongst others.

In terms of radiology, the Swedish Society of Medical Radiology monitors the number of working radiologists as well as the level of investigations (e.g. in CT, MRI). This way we can really see the productivity level of the entire system in this area. However, we don't use ISO standards or certifications in departments of radiology or in hospitals here, only perhaps for certain machines. The correctness of diagnosis and the appropriateness of recommended exams is a more important area than productivity: it is easy to say productivity has increased if one does not monitor how it is happening and whether this is in a quality fashion.

Financing Radiology

Another area of importance to radiology in Sweden is the conflict in getting financing. Here, the largest county councils have their own special radiology purchasing/selling boards. But in smaller county councils in smaller cities they only have an integrated and fixed budget with a fixed price list. The problem, therefore, arises in the purchase of new radiological equipment in developing areas like PET/CT, which restricts development. Here, the department itself is never allowed to make a purchasing decision of over EUR 100,000 regardless of whether the money is available in the budget or not. The decision is taken unilaterally by the hospital board who have to put in requests for new equipment.

Brain Drain in Swedish Radiology

In Sweden, radiology is second only to pathology in its unmet demand for qualified staff. We are trying to address this need by educating more radiologists, but due to the restrictions of the public system, the price of educating a radiologist is so high that the university hospitals are generally the ones taking on the financial burden of training radiologists. Education in radiology is certainly a high cost here. There is also an outflux of trained radiologists to, in particular, Norway, Denmark and the UK where they are generally better paid. However, we have an influx of radiology workers from Germany, Poland and Hungary since we joined the EU, who tend to be well trained, though perhaps experience difficulties in adapting to the Swedish working culture.

Conclusion

There is no doubt that the healthcare system is in need of significant and continuous monitoring and reform. In Sweden, access to healthcare is equal, but demand outstrips the availability of public sellers to take care of everyone within the fixed budget allocated them by the county council. The resultant large waiting lists are an ongoing pressure. However, it remains to be seen whether private providers are the real solution.

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Lessons Learned

Finally, one could ask whether the relatively small size of Estonia was an important factor supporting the fast establishment of a nationwide PACS. The answer could be easily "yes". However, one has to recognise that all the organisational and technical requirements are identical for European countries regardless of their size. In smaller populations, the costs per capita may be even higher than in larger populations. Our experience shows also that in a small country there are specific factors that may totally undermine the establishment of a nationwide medical information system, including fear of social transparency regarding loss of data protection or establishment of supervision of quality and case mix by competing healthcare providers.

MR RESEARCH IN SWEDEN

Late-enhancement Cardiac MRI Detects Past Infarctions

Uppsala University Hospital is a research hospital. Advanced clinical research is performed in close cooperation with Uppsala University's Medical Faculty, which gives immediate access to the latest findings in basic research. The hospital also has an extensive collaboration with the pharmaceutical industry. Every year, more than 100 clinical trials of new drugs are started here. The cooperation with Uppsala University also provides an enlarged financial basis for building up advanced technical resources for research, diagnosis and treatment. Uppsala University Hospital is Sweden's oldest university hospital. The hospital is one of the country's most complete regional hospitals, with around 40 departments and over 8,200 employees.

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In the Department of Radiology at Uppsala University Hospital in Sweden, we have 320 employees, of which sixty are medically trained radiologists. We have an extensive range of the most up-to-date imaging equipment, including three 1.5T cameras, a new 3T camera, two PET/CT cameras, ultrasound equipment and interventional labs for peripheral and neurological interventions.

Following discussions between the head of the university and our department, it was decided locally, to purchase a new Philips 3T machine, which we are beginning to incorporate into regular use. The advantage of 3T is that you end up with more signal from tissues and therefore higher spatial resolution. The only downfall of this type of equipment is that any kind of movement (e.g. caused by breathing) can affect the quality of image. However, for examination of stable tissue, for example for spectroscopy looking for metabolites, it is highly superior. Training, which was very necessary as 3T is a much more demanding technology to use, was provided by Philips themselves by sending our technologists and related staff to other sites where 3T was already in use. This way we were able to see at ground level, how the equipment really functions.

Late-enhancement Cardiac MRI Detects Past Infarction

The principal research areas undertaken by our department are in PET, and also the applications of cardiovascular MR, particularly whole-body MRA, for which I am responsible. Five years ago, having developed this technique, our department performed a study on a selected population of 300 70-year olds, where we injected contrast material to visualise the vasculature of the whole body. By adding late-enhancement cardiac MRI we were also able to investigate scars in the myocardium for evidence of past infarction. The basic principal is that ten minutes after injection, the contrast material collects into the infarcted area.

Worryingly, the study revealed that there are many people in this type of population, especially women, who have no other clinical symptoms, but who have gone through infarction nevertheless. We are not yet sure of the whole spectrum of implications of this finding. It is not just simply a matter of providing drugs to these types of risk groups, such as to lower blood fats. With this in mind, we are now re-investigating the same population of people, now 75 year olds, to examine their present state of health.

Getting the Whole Picture

We also included approximately 300 other parameters, such as dietary history, genetic pre-dispositions, etc. that impact on cardiovascular disease, to relate to the findings we already have. In this phase of the project we will expand our parameter areas, by examining changes in the brain with MRI, changes caused by stroke, etc. We also have a team examining fat distribution with MRI (i.e., visceral or subcutaneous), which is important in the development of cardiovascular disease. They will then computerise their findings. All this should enable us to create a more epidemiological report on the factors that increase the risk of this group in developing cardiovascular disease and to help other institutions provide more informed healthcare.

Medical Safety

In order to commence a research project in Sweden, it is essential to involve an Ethical Committee in the research application process. National guidelines here

in Sweden state that if you have agreement from the volunteer study group, then you don't need to submit your application to the Ethical Committee. However, if you are performing invasive or medically challenging procedures or requesting personal information from your study group, then you are obliged to submit a report to the Ethical Committee, regardless of the patients' agreement.

Financing our Research

Obviously, such a large study project causes an equally large financial burden! A rough estimate of the costs of the study so far is around SEK 10m. Although we originally started out with a population group of 1,000, this had to be cut down to a select 300 in order to ensure the future stability of project financing. We are lucky to have received financial input not just from the University hospital itself here in Uppsala, but also the Swedish Medical Research Council, the Swedish Heart and Lung Foundation, and also, AstraZeneca who are very involved in cardiovascular research, particularly into statins.

In terms of financial organisation, the department functions by having two separate heads – one for patient care and the other, myself, who takes care of research and education in radiology. Although both departments are, in principal, integrated, with separate heads and separate budgets set by the university hospital administrators, it allows me to concentrate primarily on the research activities taking place at the hospital. It also removes the types of financial conflicts that commonly occur when there is one head in a radiology department who is responsible for all three branches: patient care, research and education.

INTERVENTIONAL RADIOLOGY IN SWEDEN

Increasing Cooperation for Better Healthcare

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The three years residency in cardiology and one year residency in anaesthesiology that I completed during my medical training were essential ingredients for the clinical background of an interventional radiologist. Indeed, it highlights the fact that as an interventional radiology (IR), one must possess the widest possible range of skills, and yet how can one be a specialist in everything? Here in Sweden, we are promoting a culture of collaboration and teamwork to ensure the best possible results for the patient.

In my own case, I began with Percutaneous Coronary Interventions (PCI) from 1988 - 1992, before moving to peripheral interventional radiology in 1993 and Endovascular Abdominal Aortic Aneurysm (EVAR) repair. I also commenced research in CT and MR and my special interests today are atherosclerotic diseases, EVAR evaluations as well as virtual reality, endovascular simulations and IR curriculums. In 2005, I was awarded the CIRSE Educational Grant for research in vascular radiology, together with one of my PhD students, Max Berry. I have a keen interest in the future development of interventional radiology and am Vice-President of the Swedish Seldinger Vascular and Interventional Society (SSVIR).

Radiologists Not Just Photographers!

Professional understanding of interventional radiology in the context of public society, as well as in the government has been poor in Sweden, mainly due to the layman's common view of radiologists as photographers. In order to be a powerful part of medical society, we need to take more responsibility in terms of leading large departments. If the Chairman of the radiology department or of a merger of a bigger unit consisting of vascular surgery/IR/cardiovascular surgery was a professional IR, we would ultimately play a more dominant role in the government of the hospital, as well as on a larger scale. However, the question remains: Are IRs willing to take this position of leadership?

Increasing Role of Vascular Surgeons

At the moment, 90% of endovascular procedures in Sweden are performed by IRs and the rest by vascular surgeons. I believe that these figures will reverse over the coming years. At present, endovascular procedures are the domain of the department of radiology. Up to twenty hospitals in Sweden offer daytime interventional services on a basic level. EVAR can be performed

across up to twelve hospitals and a full range of 24-hour services are available at seven hospitals. All hospitals in Sweden in the endovascular field are still under the direction of the radiology department, except for at Malmø, which is the most well-known centre in Sweden. In Malmø, they have a special unit, called the 'Endovascular Centrum', which is not a part of the radiology department. However, due to the lack of availability of the radiologist to the patient, it is thought that for this particular procedure the vascular surgeon is better placed to take more comprehensive charge of this role. If this happens, endovascular procedures will certainly not remain under the leadership of the radiology department.

Turf Battles

As demonstrated by the way IRs have welcomed vascular surgeons into their domain, turf battles are not such a problem in Sweden. This high level of cooperative spirit is the ongoing work of both societies in Sweden, the Swedish Vascular Surgeons' Society as well as the SSVIR. Since 2006, we collaborate on endovascular issues, have regular meetings, and both society's annual meetings take place at the same time with the same

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to read images improved. In this process of change, the radiologist received more questions from the clinicians as their interest in and ability to view digital images and reports increased.

This is how the radiologist over time became more of a consultant to the clinical decision-makers. The study illustrates how the radiologist's work became more distributed and physically isolated, and how they, in their role as professionals, were less well 'served' by ancillary staff: the radiologists became their own assistants, secretaries and archive personnel. In practice, certain activities therefore became more time-consuming for the radiologist.

Diagnostic Practice

The radiologists stated that the practice of reading films used to be an art form. However, the introduction of PACS meant the focus was on technology rather than on the skill of reading images. Suddenly, the radiologists' learning shifted to a greater exposure to technology courses rather than interpretative diagnostic techniques. The increasing technical focus created insecurity because radiologists were worried that they would become less skilled readers of images due to the shift in focus from diagnosis to technological learning.

However, the technology improved access to a greater number of comparable cases as well as previous exams of a specific patient. Being an actor in a network, in combination with the ability to give everyone access to the basic interpretive skill through technology, has changed the scope of the radiologist's profession.

Technology in use

In 1999, radiologists could hold X-ray films, feel them, and know that they were looking at the whole image. This allowed them to be relatively confident in the opinions they expressed, since no extra information could be obtained from the image. New workflow allowed wider scope for manipulation of the image, making the radiologist insecure. This study shows that it took about four years for the advantages of the new technology to diminish this insecurity.

Reshaping the Way Radiologists View Their Role

In the present study, an important factor in developing a new mental framework for the new workflow was the emergence of a greater insight into the advantages of the functionalities made possible by the new technology. An important feature of the new technology is its superior ability to illustrate anatomic details in the images by 3D reconstruction. Using X-ray films, the radiologist could create computer images, but 3D-reconstruction images were less informative. Using digital images, it is possible to increase the illustration of details. In this way the radiologist has become, for instance, a new and important advisor in discussions with other specialists. It is likely that there will be a development of increasing expertise in subspecialist areas, leading to better quality of care. We predict that increased specialisation is the future for radiology.

Conclusions

The aim of this study was to analyse and illustrate how PACS changed radiologists' work practice. Work practice was divided into three areas: professional role, diagnostic practice and workflow functionality. The changing trends within the professional role indicated that radiologists moved from distinct professional experts, to an actor in a network. Diagnostic practice changed from the years of training required to read X-ray films in 1999, to the egalitarian empowerment of other clinicians to view digital images and share this former 'art form'. The change in workflow functionality as a result of the shift to digital images led to an increased specialisation of the radiologist.

local organisation. After the success in Stockholm 2006, we in the local organising committee in Gøteborg are looking forward to this ongoing work of better understanding and mutual education in this field. We need each other's expertise, and the hospital environment seems to support us.

Educational Initiatives

In order to stay on top in the endovascular field you have to have some clinical background in it and also be able to discuss with patients, alternative interventions, as well as best medical treatment. We are working to get the whole field of IRs to understand and to approve this, which is not a problem. However, sometimes heads of radiology departments are reluctant to understand the new demands in this field.

> *"We need each other's expertise"*

There are two practical courses for vascular surgeons and radiologists annually in Sweden, one in Malmø and one in Gøteborg and both include endovascular simulations using machines from Mentice. I also work in collaboration with Mentice and Boston Scientific to organise four annual workshops in endovascular virtual reality training.

Vascular surgery is an entity of its own in Sweden, and in the programme for education endovascular training has a major role. This means that there is a demand from the vascular surgery community for education and training in these procedures. This obviously calls for discussions and probably new logistic pathways for patient referrals as well as a new way of thinking IRs, vascular surgeons and for the heads of their departments. We should not forget that an integration of interventional cardiology also calls for an open discussion.

Protecting the Profession of Radiology

Throughout Europe, there is concern that the profession of the radiologist is being eroded, due to the increasing handover of their traditional responsibilities, to other medical professionals. This is a worldwide debate, often discussed in Sweden. We must remember that the patients' wellbeing is the utmost goal for us and therefore, a mature collaboration is a must. To become an endovascular specialist you need:

- Clinical skills
- Imaging skills
- Anaesthesiology skills
- Endovascular skills
- Operative skills

Therefore, I believe that the group around the endovascular specialist must have these skills within the group, not necessarily within each and every person. The most fruitful environments are where you respect patients and know that opinions are just opinions.

REFORMING EDUCATION IN RADIOLOGY

Role of the Swedish Society of Medical Radiology

The Swedish Society of Medical Radiology

The Swedish Society of Medical Radiology (SFMR) was founded in 1919 by Gösta Forsell, who became the first Professor of radiology in the world. He thereafter started 'Acta Radiologica' in 1921. Today, the society has 1150 members, a big increase on the original 49 members that joined when the society was founded in 1921.

The SFMR is a section of both the Swedish Medical Association and the Swedish Society of Medicine. A new governing board is elected every second year. The Annual General Assembly is held during the society's annual conference, the "Röntgenveckan". Annual conferences have been held during almost the entire existence of the SFMR. During the last decade, the annual conference changed and is now a joint meeting for different categories working in radiology. Last year,

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there were 1600 attendees at the meeting. Its goals are to:

- Promote the development of radiology by arranging scientific conferences and discussions and to distribute research results in the field;
- Promote education in radiology;
- Collaborate internationally for scientific and educational issues;
- Develop diagnostic and therapeutic radiology in medicine; and
- Cover professional issues in radiology for members in the society.

Two of its committees bear especial mention. The first, the quality committee, aims to work for increasing quality and knowledge about quality in radiology. The second, the education committee, is developing a new training charter and core curriculum for the new specialty, which I will explain further in the article.

Education of Radiologists in Sweden

In Sweden, physicians are trained at the six medical schools of the Universities of Lund, Gothenburg, Linkoping, Stockholm (Karolinska Institutet), Uppsala and Umeå. Medical education is entirely financed by the state and is linked to the university hospitals and other parts of the health services, such as primary healthcare. The number of medical students is limited and every year some 900 students begin medical training. To become a registered physician a student must successfully complete a programme of study of five and a half years, followed by a 21-month training period in general medical care, and a written examination. On registration a physician is authorised to practice, but almost all physicians choose to continue their studies in order to qualify as a specialist. This requires five years of service in one of the 60 recognised specialist fields. To become a consultant or head of department, a physician needs five years of postgraduate specialist training.

On average, a radiologic trainee spends 40 hours a week in classes and is obliged to perform on call duty after one to two years. During training, the responsibility increases according to the personal development. During the entire residency, a personal tutor is assigned to the resident.

The SFMR is involved in the planning of the new curriculum and training charter. The main institute involved is IPULS, for the professional development of physicians in Sweden. IPULS' principal task is to support the continuing professional development and postgraduate education of physicians in Sweden. The institute critically reviews and certifies education of relevance to this target group, according to a defined standard. Educational courses approved by the institute are brought together and published in a "physicians´ online educational catalogue", which is readily accessible and searchable on the institute's website (www.ipuls.se). On this site, most of the courses are collected and certified. The radiologists are responsible for their own CME but the employer usually covers the cost.

Assessing Performance

Performance is assessed in residents and fellows through continuous supervision by a personal tutor. However, after graduation, their qualification is not officially assessed at an examination but there is a possibility to voluntarily participate in one. Some leadership education is provided during medical school and also an introduction course in hospital management arranged by the SFMR.

Reforming Education in Radiology

As part of its mission to continuously improve the standard of training of radiologists, and therefore the provision of healthcare in Sweden, the SFMR is heavily involved in the revision of the old medical curriculum. As part of these reforms, the old specialties, namely medical radiology, neuroradiology, nuclear medicine and clinical physiology, will be joined under one new speciality named "image and functional medicine" (bild och funktionsmedicin).

The new reform will increase the amount of theoretical training and science provided during residency. Furthermore, the assessment of competence for fulfilling specialist education will be done not only at the hospital but also at a national level. Finally, it has been possible to obtain credit from residency to research studies and vice versa. The reform will not effect the current process in a formal way. The workload during residency will be altered with more physiology and nuclear medicine but also with more theoretical and scientific input.

PROF. DR NICHOLAS GOURTSOYIANNIS, ESR PRESIDENT

on the future of the European Society of Radiology, as well as the Annual Congress

What have been the most recent areas of growth for the Society?

Amongst many continuing achievements, the European Institute for Biomedical Imaging Research (EIBIR) has grown to a successful close of its first year of existence. It is gaining momentum and enjoys continuous support from our constituencies, as well as industry partners. EIBIR has launched a number of activities, one of which, currently being set up, is EuroAIM, the European Centre for Technology Assessment in diagnostic imaging and image guided interventions, which will facilitate the organisation and performance of multicentre clinical imaging trials across Europe. Other initiatives currently in the preliminary stages include a chemistry platform for the development of new probes, an image processing network for the development of imaging biomarkers, and a network of expert centres involved in MRI-based cell imaging to prepare the submission of a grant proposal within the EU Framework Programme 7.

Another major mission of ESR will be the extension of teaching activities throughout Europe, as well as to places beyond European boundaries, unified in the European School of Radiology (ESOR). ESOR is best described as a programme that aspires to extend teaching resources in Europe and worldwide and to raise standards in the field of scientific radiology through global e-learning initiatives.

ESOR will certainly meet with great approval throughout the radiological community and help young radiologists to achieve knowledge and skills to fulfil tomorrow's requirements. Within the framework of ESOR the GALEN project focused on foundation courses and scheduled to facilitate the implementation of the European Training Curricula has already been in operation since November 2006. Four visiting schools within the GALEN project are scheduled for 2007.

Also, the first ESOR in-house course on management in radiology took place at the beginning of December 2006 in Vienna and was received with great enthusiasm by the fifty participants. A second ESOR in-house course on molecular imaging is planned for 2007.

In addition, the first ESR fellowship structured jointly with the European Society of Cardiac Radiology (ESCR) and the first AIMS programme organised jointly with the Chinese Society of Radiology will kick off immediately after ECR '07.

Are you concerned by the fragmentation of the roles of the radiologist to other professions?

During my leadership of European radiology, at what I consider to be a most challenging time, we witnessed the sorts of radical changes that can and do take place. Technology continues to alter the medical profession as a whole at an incredible pace, but despite this, I am very optimistic for the future of our specialty and for the future role of European Radiologists among other medical specialists. I believe radiology as an integrated clinical specialty will continue to take a central place in the provision of healthcare across Europe.

What does the future hold for the ESR?

The establishment of ESR provides very clear evidence that European radiology can accept challenges and can reshape its organisation to provide radiologists with better opportunities and enable them to be ahead of their time. The growth the society has enjoyed already in its first year of existence is in itself very optimistic. It is envisioned that the growth will continue, thousands of European radiologists will multiple its voice and strength as members, the educational role of ESR will be structural in supplementing the national societies and research opportunities in radiology will be multiplied and better coordinated. The ESR's role in raising the profile of radiologists in Europe and worldwide will be instrumental.

How have such programmes benefited from partnership and support?

The ESR receives great support and enjoys fruitful partnership within the industry in implementing such programmes, which are aiming to serve better and raise the profile of radiology and radiologists in Europe and worldwide. Innovation and vision is a common ground for industry supporting radiology and ESR. To reach our goals it is of utmost importance that the ESR is supported also by radiologists from all European countries as well as from partners from outside Europe. The ESR will evolve into an organisation that will allow for the realisation of many cherished ambitions of our discipline.

Key Seminars & Conferences

MARCH 2007

8 — European Society of Breast Imaging (EUSOBI) Congress
Vienna, Austria
www.eusobi.org

9 – 13 — European Congress of Radiology
Vienna, Austria
www.ecr.org

15 – 20 — 32nd Annual Society of Interventional Radiology (SIR) Meeting
Washington DC, United States
www.sirweb.org

19 – 21 — British Nuclear Medicine Society Spring Meeting 2007
Manchester, United Kingdom
www.bnms.org.uk

20 – 23 — PACS 2007 Annual Conference
San Antonio, Texas, United States
www.urmc.rochester.edu/pacs2007

APRIL 2007

2 – 5 — 6th Asian & Oceanian Congress of Neuroradiology and Head & Neck Radiology (AOCNHNR) 2007
Singapore, Singapore
www.aur.org

10 – 12 — MEDITEC 2007 Annual Healthcare Technology Trade Fair
Hyderabad, India
www.meditecinternational.com

17 – 22 — SPIE Medical Imaging
San Diego, United States
www.spie.org

25 – 28 — Association of University Radiologists (AUR) 55th Annual Meeting
Denver, Colorado, United States
www.aur.org

MAY 2007

9 – 12 — 57th Annual Nordic Radiological Congress
Malmo, Sweden
www.nordiccongress.org

16 – 19 — German Radiology Society (DRG) Annual Meeting
Berlin, Germany
www.roentgenkongress.de

19 – 25 — ISMRM/ESMRMB Joint Annual Meeting
Berlin, Germany
www.ismrm.org

JUNE 2007

3 – 7 — 44th Annual European Society of Paediatric Radiology Meeting
Barcelona, Spain
www.espr2007.info

11 – 13 — UK Radiological Congress 2007
Birmingham, United Kingdom
www.ukrc.org.uk

12 – 15 — European Society of Gastrointestinal and Abdominal Radiology (ESGAR)
Lisbon, Portugal
www.esgar.org

27 – 30 — 25th EuroPACS Annual Congress
Berlin, Germany
www.europacs.org

27 – 30 — 21stCARS 2007 Annual Congress
Berlin, Germany
www.cars-int.org

SEPTEMBER 2007

8 – 12 — Cardiovascular and Interventional Radiological Society of Europe (CIRSE) Annual Congress
Athens, Greece
www.cirse.org

12 – 13 — ESGAR – 7th Workshop on CT Colonography
Malmo, Sweden
www.esgar.org

13 – 15 — ESMRMB School of MRI – Advanced Course on Applied MR Techniques
Innsbruck, Austria
www.esmrmb.org

OCTOBER 2007

1 – 3 — ESMRMB School of MRI – Advanced Course on Breast & Pelvis MR Imaging
Madrid, Spain
www.esmrmb.org

7 – 11 — 17th World Congress on Ultrasound in Obstetrics & Gynaecology
Florence, Italy
www.isuog2007.com

15 – 17 — 8TH International Symposium on Virtual Colonoscopy
Boston, United States
http://www.bu.edu/cme/seminars/VC07/index.html

18 – 20 — European Society of Cardiac Radiology (ESCR) 2007 Annual Scientific Meeting
Rome, Italy
www.escr.org

24 – 27 — EUROSON 2007 19th Congress
Leipzig, Germany
www.euroson2007.de

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