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Volume 7 Issue 4, September-October 2007

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COUNTRY FOCUS
Radiology in Estonia

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Editorial

Prof. Iain McCall
Editor-in-Chief
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Audit and Accreditation: Defining Quality for Medical Imaging

Dear readers,

There are a number of definitions of quality. The English dictionary provides three, of which the initial one explains it as the degree of excellence of a thing. However, where medical imaging is concerned, this precise definition needs to be elucidated in order to provide a benchmark for both customers and providers.

Quality of care for diagnostic imaging and image–guided treatment may be defined as timely access to, and delivery of an integrated and appropriate imaging study or therapeutic procedure in a safe and responsive facility. It also entails the prompt delivery of accurately-interpreted reports by capable personnel in an efficient, effective and sustainable manner. Fulfilling a degree of quality obliges departments of radiology to develop these clear standards against which they can rigourously assess their performance and put together an ongoing programme of quality control.

However, to ensure the quality of service in an individual medical imaging department, these standards have to be robust and comparable with those considered appropriate by ones' peers. The standards must also engender confidence for the patient who wishes high quality treatment and the purchaser who wishes to buy on the patient's behalf, a highly efficient and efficacious service.

It is therefore important that respected peer organisations set up these standards in conjunction with patient and purchaser representatives and create a structure whereby departments can measure their performance against these standards. The implementation of this process then requires its success to be tested, which leads to audit. The audit cycle involves the assessment of any process, accuracy of diagnosis or therapeutic intervention in a structured way against a defined standard, identifying the quality of one's own performance and identifying potential reasons for limitations of performance.

This is then followed by implementing changes to raise the level to the expected standard and then re-audit to define whether these changes have been successful. Audit is therefore an ongoing and continuous process which must involve all personnel in the department to ensure total ownership by the team. Finally, the public and purchasers need to be reassured that the quality of care given by a department is robust in order for them to choose where they have their diagnosis or treatment. This inevitably leads to a formal accreditation process to provide an independent external review and seal of approval.

The value of audit and accreditation is not universally understood or practiced in radiology departments. It is hoped that this edition will raise the profile of these processes and identify the developments in this field.

We welcome your thoughts and feedback on any or all of the articles within the journal. Please send your responses to myself or to Managing Editor Dervla Gleeson at ***editorial@imagingmanagement.org.***

Prof. Iain McCall

HAVE YOUR SAY!

Letters to the Editor at editorial@imagingmanagement.org

Annual MIR Congress Programme Highlights

Join an International Audience of Management Experts!

Dr Nicola Strickland
Chairman

Given the discussion-provoking and even controversial views presented at last year's edition, this year's annual Management in Radiology (MIR) conference, set to take place in Oxford, England from Wednesday, October 10, to Saturday, October 13, 2007, promises to raise even greater awareness of the importance of sharing management practices and ideas across the medical imaging community. Here we present you with a snapshot of some of the highlights that will take place.

Opening Sessions: Imaging Management in the UK

The first lecture of the opening session will set the scene, as the Warden of the Royal College of Radiologists (RCR), Dr David Linsell, discusses imaging management issues in Oxfordshire, the county of which the ancient university city of Oxford is capital. The Dean of the RCR, Dr Gillian Markham, will then highlight the major current imaging management issues to which the RCR in its efforts has been a model for the rest of Europe. The remainder of this first session will be devoted to management issues related to PACS, including clinical risk.

Image Study Coding a Top Priority

The second Wednesday afternoon session addresses the important topic of image study coding, a session instigated by popular European request. Speakers from England, Scotland and The Netherlands will discuss their approaches and outcomes in this area, which will have important repercussions for radiologists and imaging departments when 'payment by results' is universally introduced as, most would argue, it inevitably will be.

Imaging IT and Performance

Thursday's morning session is devoted to "Imaging IT and Performance". One of MIR's keynote speakers this year is Prof. Michael Pentecost who will give two lectures in this session. His first "How the Electronic Medical Record Influences Radiology Management" is followed by a number of interesting proffered papers concentrating on the use of IT in imaging management. Prof. Pentecost's second lecture is entitled "Pay for Performance in American Medicine" and should provoke some comparisons with how imaging is practiced in Europe. Prof. Bruce Hillman will speak on a similar theme, "Pay for Performance and Consumerism - Newest Fads or the Wave of the Future?"

Ten Commandments for Managing an Imaging Department

Thursday afternoon sees an innovative and fun session, devised by Prof. Philip Gishen, and entitled "The Ten Commandments for Managing an Imaging Department". Each of six senior international radiologists from the UK, France, the US, Estonia, Denmark and Singapore, will enumerate his ten priorities or 'commandments' to guide the successful management of an imaging department. Prof. Gishen and Dr Strickland will then lead a summary and open discussion session with general audience participation.

Teleradiology and Emerging Business Models

The whole of the Friday morning session is given over to the extremely topical subject of teleradiology. Another of this year's keynote speakers, Prof. Seong Ki Mun (from Georgetown University Medical Centre in Washington DC), will talk about "Teleradiology and Emerging Business Models" and there are a host of proffered papers giving data on this theme. MIR's keynote speaker from Singapore, Prof. Tchoyoson Lim discusses "Cluster Enterprise Teleradiology: Potential or Pitfall", based on their experience of, and reaction to, being on the 'receiving end' of imposed outsourced teleradiology on a grand scale.

Managing the Future of Imaging

Friday afternoon's session, "Managing the Future of Imaging", addresses a number of future challenges, tackled by Prof. Michel Claudon, Prof. Henrik Thomsen and Dr David Kessel, amongst others, covering issues as diverse as the management of radiology training in vascular imaging, and management issues arising from the occurrence of nephrogenic systemic fibroisis induced by gadolinium MR contrast agents.

The final half-day of the 2007 MIR conference is dedicated largely to AUR-E. The session commences with Prof. Mun's second invited lecture, "Open Source Software: the Key to Research Management?". Prof. Hans Blickman answers the question "Why is Imaging Research Important to Managing the Future of our Specialty?", closely followed by Prof. Georg Bongartz, who will present his views on "How can an Imaging Department Encourage both Research and Clinical Productivity: Management Models".

Throughout the MIR conference programme there will also be several chosen speakers from companies sponsoring the MIR congress, relating to the importance of partnership between vendors and practitioners in the management of imaging today.

There is no question that the MIR 2007 Congress is not to be missed!

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Update from 25th Annual EuroPACS Congress

The recently-held 25th Annual International EuroPACS Meeting, held in conjunction with the CARS congress, from June 27 – 30, 2007, in Berlin, Germany, addressed a wide range of information technologies and related topics. With cutting-edge themes ranging from regional PACS and teleradiology, to architecture, workstations and archiving, the conference proved once again that it is the central gathering point for specialists in medical imaging, digital x-ray, PACS and digital systems for eHealth.

The 25th EuroPACS anniversary lecture on "EuroPACS and the Evolution of PACS in Europe" was given by Dr. Davide Caramella (University of Pisa) and a tutorial on CAD-PACS integration was given by Dr. H.K. Bernie Huang (University of Southern California).

The programme offered a multitude of different scientific lectures, workshops and meetings focused on the latest and most significant developments in clinical practice, research and education within digital radiology. EuroPACS is Europe's most intensive PACS congress, covering all the important subjects that are useful not just for healthcare IT personnel, but for all those concerned with efficient workflow management and the latest IT developments involving radiology. Sessions were chaired by expert topic leaders, including Dr Jarmo Reponen, Prof. Peter Mildenberger, Prof. Davide Caramella and Prof. Berthold Wein.

www.europacs.org

IHE-Europe Announces Eighth Oxford Connectathon

Registration for next year's eighth instalment of the IHE-Europe Oxford Connectathon, to be held at St Catherine's College in the centre of Oxford, UK, will open on September 15, 2007 and close December 7, 2007. Participants will benefit from the success of previous events, to ensure that interoperability remains a hot topic and to ensure the future success of their systems with regards to interoperability.

The Connectathon itself will take place Monday, April 7 to Friday, April 11, 2008, while the traditional participants' workshop will be held on both February 6 and 7, 2008.

Further Update: IHE-UK has some big plans for 2008!

- Important XDS event for purchasers and users at Connectathon venue
- Several XDS demonstrations during 2008 at prestigious meetings
- UK VIP groups to visit Connectathon

www.ihe-europe.org

CARS 21st International Congress & Exhibition Successfully Held

The 21st International Congress and Exhibition of CARS 2007 (Computer Assisted Radiology and Surgery) was successfully held at the International Conference Centre in Berlin with 945 Registrants from 46 countries. The CARS meeting was also home to the 11th Annual Conference of the International Society for Computer Aided Surgery; the 9th International Workshop on Computer-Aided Diagnosis; the 25th International EuroPACS Meeting; as well as the 13th Computed Maxillofacial Imaging Congress.

Highlights from the Congress

The opening day of the 21st International Congress and Exhibition began with what will become a "new tradition" for CARS: A Clinical Day. The day's presentations were focused on the expanding role of diagnostic imaging into the realm of medical therapeutics.

The keynote speech at the CARS opening ceremonies was given by Dr. Madjid Samii (International Neuroscience Institute, Hanover, Germany), who was also this year's Honorary President of CARS 2007. Dr. Samii's lecture, entitled "Innovation, Interdisciplinary, and Internationality in Surgery", highlighted the philosophy, technology, and achievements that have been achieved in neurosurgery through the interchange of information and cooperation of a wide variety of medical and technical disciplines.

The 9th Annual Conference of the Society of Computer-Aided Diagnosis, under the leadership of Professor Kunio Doi, Chairman (University of Chicago Hospitals) and Dr. Ulrich Bick, Co-Chairman (University Hospital Charité, Berlin) was held at the CARS 2007 meeting. Special sessions focusing on advancements in the areas of breast, abdominal and brain and thoracic CAD were held.

The International Society of Computer Aided Surgery held its 11th Annual Conference at CARS 2007, under the guidance of this year's President, Professor Takeyoshi Dohi (University of Tokyo). A tutorial on computer assisted surgery was presented by Dr. J. Thomas Lambrecht (University of Basle), and sessions on surgical modelling, simulation, navigation robot-

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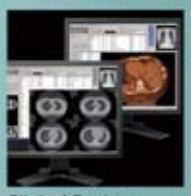

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ics, and image processing and visualisation were held.

The 13th Annual Computed Maxillofacial Imaging Congress under the chairmanship of Dr. Allan Farman (University of Louisville, Kentucky) was also held at CARS 2007. A tutorial on maxillofacial imaging was conducted by Dr. Stefan Hassfeld (University Hospital Dortmund) and Dr. Georg Eggers (University Hospital, Heidelberg). Sessions on 3D maxillofacial imaging and maxillofacial surgical navigation were held.

In addition to the opening day sessions, the Computer Assisted Radiology section of CARS, under the guidance of Dr. Stanley Baum, Chairman (University of Pennsylvania) and Dr. Bernd Hamm, Co-Chairman, (Charité, Humboldt University, Berlin) included sessions on medical and angiographic imaging, computer assisted radiation therapy, workstations and eHealth, image processing and visualisation, and workflow.

And finally, the 7th CARS/SPIE Joint Workshop on Surgical PACS and the Digital Operating Room, chaired by Professor Heinz Lemke (University of Southern California) and Dr. Osman Ratib (University of Geneva) was held on the closing day of CARS 2007.

www.cars-int.org

ECRI Institute
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Institute Investigates MRI Plus X-ray Mammography in Breast Cancer Detection

For women at high risk of breast cancer, use of magnetic resonance imaging (MRI) plus x-ray mammography for screening will detect more breast cancers than mammography alone, says ECRI Institute in a new technology assessment report. But the number of false positives - indicating a problem where none exists - will rise significantly also. The report aimed to determine whether the combination of MRI and mammography was more accurate than mammography alone in finding breast cancer.

The TARGET™ emerging technology evidence report is published by ECRI Institute, by Wendy Bruening, a senior research analyst. Her analysis of the evidence showed that MRI detected more cases of cancer than x-ray mammography. These findings, in fact, are consistent with the current guidelines of leading cancer organisations, such as the American Cancer Institute and the American Society of Breast Disease, that recommend screening that includes MRI, x-ray mammography and ultrasound for patients at high risk of breast cancer.

www.ecri.org.uk

CIRSE

Last Call for Participants at CIRSE 2007!

CIRSE 2007 will take place September 8-12, Athens, Greece at the Megaron Athens International Conference Centre. Highlights of the scientific programme are outlined below.

Scientific Programme

For CIRSE 2007, the programme has been designed around five main themes. This years main topics are:

- Vascular intervention;
- Transcatheter embolisation;
- Non-vascular intervention;
- Interventional oncology, and
- Clinical practice development.

Foundation Courses

Foundation Courses cover a specific area of interventional radiology, focusing on basic principles and illustrating the procedure in a step-by-step fashion. They are designed for radiologists in training, new consultants and/or experienced consultants who require a refresher course on the subject. There will be plenty of time for questions and discussion. Each session lasts one hour. This year the courses will cover the topics "Embolisation" and "Peripheral vascular disease".

CIRSE meets China

CIRSE 2007 will host of the Chinese Society of Interventional Radiology in a CIRSE meets China session. The society will have the opportunity to present topics of special importance to China to the European interventional radiological community during the specially dedicated session.

www.cirse.org

EU CAMPAIGN TARGETS SAFETY AND HEALTH AT WORK

Focus on Musculoskeletal Disorders

Dervla Gleeson
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The European 'Lighten the Load' campaign has been initiated to promote an integrated management approach to tackle musculoskeletal disorders (MSDs) embracing prevention of MSDs, and the retention, rehabilitation and reintegration of workers who already suffer from MSDs. Run by the European Agency for Safety and Health at Work, the campaign culminates in the European Week of Safety and Health at Work from 22 - 26 October 2007.

Background of the Campaign

The overall aim of the European campaign on musculoskeletal disorders (MSDs) is to support employers, workers, safety representatives, practitioners, preventative services, policy makers and other stakeholders in improving MSD prevention at workplace level by taking forward European action on MSDs initiated by the first European Week for Safety and Health at Work in 2000 and involving all Member States and EFTA countries in campaign activities. The integrated management approach includes three key elements:

- Employers, employees and government working together to tackle MSDs;
- Addressing the whole load on the body leading to MSDs; and,
- Managing the retention, rehabilitation and return to work of those who suffer, or have suffered, MSDs.

A special focus should be placed on multidisciplinary approaches where the prevention side is working with the rehabilitation side. Particularly important is the role of social and organisational support in enabling workers both to return to work and subsequently to sustain employment when experiencing MSDs.

Get Involved!

The European campaign on musculoskeletal disorders (MSDs) is an opportunity to make workplaces safer and healthier. Everyone is invited to join in, however big or small their participation may be.

Ideas about how you can get involved in the campaign include:

- Risk assessments;
- DSE assessments;
- Lifting and manual handling training;
- Training events, seminars and workshops;
- Poster competitions and quizzes;
- Film, video and multimedia; and,
- Advertising and promotion campaigns.

Industry News

GE Healthcare

GE Healthcare Centricity RIS-IC Earns Certification

GE Healthcare's Integrated IT Solutions (IITS) business has announced that its Centricity RIS-IC services organisation has achieved certification under the Service Capability & Performance (SCP) Standards programme.

GE Healthcare's IITS business achieved certification under the SCP Support Standard after an extensive audit of its Burlington, Vermont support centre. SCP Standards quantify the effectiveness of customer service and support and represent best practices in the industry.

The Service Capability & Performance (SCP) Standards are designed to improve the quality and effectiveness of technology service and support operations. A consortium of leading technology companies, along with the Association for Services Management International and Service Strategies Corporation, created the internationally recognised standards, which define best practices, quantify performance levels and establish a foundation to build on existing quality processes. Certification against the standards requires comprehensive audits and annual recertification to confirm that companies continue to meet the requirements of the programme.

Carestream Health

Carestream Health Establishes Founding Board Of Directors

Carestream Health, Inc. has announced members of its Founding Board of Directors, in order to drive the company's growth as an independent healthcare technology leader. The new Board is charged with overseeing the company's strategy and supporting its vision "to change the landscape of healthcare by providing solutions that dramatically improve the quality and cost of care."

Robert M. Le Blanc, a Managing Director of Onex Corporation, will serve as the Board's Chairman. Other Board members are Robert M. Haft, Kevin J. Hobert, James T. Kelly, Michael C. Pomeroy, and Eliot L. Siegel, M.D.

Carestream Health began operations as a standalone entity in May this year, when Onex Corporation acquired Eastman Kodak Company's Health Group in a transaction valued at US$2.35 billion. Onex, with annual consolidated revenues of US$27 billion, is one of Canada's largest corporations, with operating companies in a variety of industries, including electronics manufacturing services, aerostructures manufacturing, healthcare, financial services and more. Carestream Health today is a health imaging and IT company with more than US$2.5 billion in revenue and approximately 8,100 employees worldwide.

Barco

Barco Partners with Medicsight

Barco and Medicsight PLC, a developer of Computer-Aided Detection (CAD) technologies, have signed a partnership agreement to incorporate Medicsight's 'ColonCAD' image analysis software tools within Barco's 'Voxar 3D ColonMetrix' virtual colonography application. This enables Barco to expand the functionality of its ColonMetrix software solution, thereby enabling faster and more efficient recognition of suspect lesions during virtual colonography.

Medicsight's ColonCAD is an image analysis software tool designed to be used with CT colonography (virtual colonoscopy) scans designed to support the detection and segmentation of abnormalities within the colon that may potentially be adenomatous polyps. ColonCAD can be seamlessly integrated within advanced 3D visualisation and PACS platforms of imaging equipment partners.

Agfa-Gevaert

Agfa-Gevaert Announces Management Changes in HealthCare

In view of the second quarter results of its HealthCare business group, the Board of Directors of Agfa-Gevaert has decided to end its collaboration with Philippe Houssiau, President Agfa HealthCare, effective immediately. Carl Verstraelen will join the company as Vice President Finance and Controlling.

An executive search process for the replacement of Philippe Houssiau has been started, which will consider internal as well as external candidates. To assure continuity, Andrea Fiumicelli, Executive Vice President IT Solutions, and Luc Thijs, Executive Vice President Imaging, will report to the Group's Executive Committee. Their focus will be on growing the business while improving operational performance.

Furthermore, the HealthCare management team will be strengthened by the appointment of Carl Verstraelen as Vice President Finance and Controlling. He will

functionally report to the Group's Chief Financial Officer until the planned demerger of the Group. It is intended that he will be proposed for appointment as Chief Financial Officer (CFO) in Agfa HealthCare's Executive Committee after the demerger.

Hologic

Hologic Announces Third Quarter Operating Results

Hologic, Inc. has announced its results for the quarter ended June 30, 2007. Highlights of the quarter include:

- Record revenues of $191.5 million.
- Record earnings of $24.7 million.
- Record 328 Selenia® full field digital mammography systems installed and recognised as revenue.
- Record backlog of $222.1 million.
- Cash balance increases to $93.8 million.

Third quarter fiscal 2007 revenues totaled $191,505,000, a 60% increase when compared to revenues of $119,685,000 in the third quarter of fiscal 2006. For the third quarter of fiscal 2007, Hologic reported net income of $24,748,000, or $0.45 per diluted share, compared with net income of $12,017,000, or $0.25 per diluted share, in the third quarter of fiscal 2006. The improvement in quarterly earnings primarily reflects the increase in product sales of Selenia® full-field digital mammography systems in the current quarter as compared to the third quarter of fiscal 2006. Included in the current quarter's results are the operations of (i) AEG Elektrofotografie ("AEG"), acquired on May 2, 2006, (ii) R2 Technology, Inc. ("R2"), acquired on July 13, 2006, and (iii) Suros Surgical Systems, Inc. ("Suros"), acquired on July 27, 2006.

Siemens

Siemens Collaborates on Imaging Biomarker Study

Siemens Medical Solutions announced that it has been granted an Investigational New Drug (IND) Exemption by the US Food and Drug Administration (FDA) to conduct a Phase I clinical trial of [F-18] 3'-fluoro-3'-deoxythymidine (FLT), a molecular imaging biomarker that has shown promise in monitoring the proliferation of cancer cells, which could help physicians quickly determine the effectiveness of cancer therapies.

To broaden the scope of FLT research, Siemens will support the FLT Phase I clinical trial that will be conducted at Memorial Sloan-Kettering Cancer Centre located in New York City, with whom Siemens has signed a research collaboration agreement focused on the co-development of imaging biomarkers that will be used in PET imaging.

FLT may allow researchers and physicians to detect the rate of the proliferation of cancerous cells through a molecular imaging technique like PET/CT by enabling visualisation of key steps in the replication of DNA, which precedes cell division.

Cytyc

Cytyc & Xoft Settle Intellectual Property Dispute

Cytyc, a provider of surgical and diagnostic products targeting women's health and cancer diagnostics, and Xoft, a point-of-care radiation therapy company, said they have settled an intellectual property dispute involving balloon-based brachytherapy technologies developed by both companies for the treatment of breast cancer patients.

Although specific financial terms were not disclosed, the agreement calls for Xoft to make royalty payments to Cytyc. The agreement allows Xoft freedom of operation in the ongoing sales of its Axxent electronic brachytherapy system. The companies reported that they have also agreed to discuss potential collaboration in the development of technologies in several areas, including women's health.

Philips Medical

Philips Medical to Acquire XIMIS

Philips Medical Systems has announced that it will acquire El Paso, Texas-based RIS developer XIMIS with the transaction expected to close in the third quarter this year. Financial details of the transaction were undisclosed. XIMIS will be incorporated into Philips' Healthcare Informatics business group upon completion of the transaction.

XIMIS' key product is XIRIS (Extended Internet Radiology Information System), a multilingual RIS capable of scaling from community hospitals up to multiple facility healthcare systems. Philips said the XIRIS product is complementary to its iSite PACS offering and will further strengthen the firm's iSite PACS market position.

Matrox Imaging

Matrox Imaging Releases Iris E-Series

Matrox Imaging has announced the Matrox Iris E-Series with Design Assistant, a smart camera/software package. "The Matrox E-Series with Design Assistant allows OEMs and systems integrators to develop vision and imaging applications without programming," says Fabio Perelli, Product Manager, Matrox Imaging.

The Matrox Iris E-Series is a family of smart cameras that support the flexibility of PC-based machine vision systems, and feature hardware for image sensing as well as software for image capture, processing, and analysis. Matrox Iris E-Series is powered by an Ultra Low Power (ULP) Celeron®, an embedded Intel® architecture processor, and runs the Windows® CE .NET real-time operating system. Available as a single body or remote head plus processor design, Matrox Iris E-Series smart cameras offer customers a number of options for camera resolution, sensor type, and speed.

UK IMAGING ACCREDITATION PILOT PROGRAMME

Planning for Nationwide Rollout

Healthcare in the UK is undergoing a major restructuring. New untested independent healthcare providers are appearing on the scene, especially in medical imaging, making it crucial that clinical standards are implemented and improved. A leading UK accreditation programme is being jointly developed by the Royal College of Radiologists (RCR) and the Society and College of Radiographers (SCoR) to address this.

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The programme is funded jointly by the RCR and SCoR, along with grants from BUPA, the Department of Health (England), the Nuffield Trust and Philips Medical Systems. These have enabled the project to go on from the initial scoping exercise in Autumn 2005 to subsequent pilot testing, which commenced in April 2007 and finally, UK-wide rollout is planned for early 2008.

Background of the Radiology Accreditation Programme

Why is the medical imaging community so concerned with accreditation of quality? Previously, UK radiology departments benefited tangentially from visits by the RCR Training Assessment Committees (TACs). Although primarily focused on training of radiologists, these visits acted as a powerful driver to change, particularly where facilities and equipment were unsatisfactory. The establishment of the Postgraduate Medical Education and Training Board (PMETB) ended these regular visits and the consensus is that the new system is less likely to identify issues related to both service and training within radiology departments.

Moreover, following the publication of the NHS Plan (2000) and Cancer Plan (2001), the English government indicate that 15% of "diagnostics" will be delivered by independent sector providers from 2007. PACS is being installed across England and likely to be complete by the end of 2007. Payment by Results (PBR), a new method of reimbursement, will have a significant effect on radiology departments. Furthermore, patient choice is becoming an important driver for change in the NHS.

In order to respond effectively to these changes, the RCR developed the Radiology Accreditation Programme as a centralised, structured way of ensuring quality in this new environment.

How is the Programme Evolving?

The accreditation programme is voluntary and professionally-led, having attracted wide stakeholder involvement from the English Healthcare Commission, the NHS Confederation, the General Medical Council (GMC) and the Institute of Physics and Engineering in Medicine (IPEM). Financial and other support has been forthcoming from various bodies including industry and private health providers and insurers.

Since September 2006 workstreams, consisting of a range of relevant professionals with significant input from patients, have been developing accreditation standards. These are currently being edited and cross-checked against existing requirements (for example with the HCC standards, which form part of the annu-

al health check required for all English hospitals) in order to reduce the burden of data collection.

How will the Programme be Structured?

Currently, it is intended that the accreditation programme will involve a three-year cycle. After registering with the programme, departments start applying the standards. After a period of between 6 and 12 months, a self-assessment against the standards will be completed and, together with a completed portfolio of evidence, will be submitted to the accrediting body. This will be followed by a peer review visit to validate the self-assessment. The visit will be followed by a report in three forms.

Firstly, a detailed report including areas requiring development will be given to the department. A less detailed, higher level report will be sent to the commissioners who purchase the service and a third report will be published on the web which can be accessed by patients of the service. This is intended to help inform patient choice. In order to maintain accreditation, the department will be required to submit an annual self assessment to ensure that standards are being maintained. Following the third year, the cycle recommences with a further peer review visit. As the system matures, it is expected that self assessment will be expanded and the burden of repeat visits reduced.

How are Standards being Developed?

In September 2006, twenty workstream leads were recruited to set up expert groups to develop standards. Each was multidisciplinary and involved patient representatives. Standards were originally commissioned under four major headings: Patient Safety, Patient Experience, Clinical Outcomes and Resource Efficiency. Further headings have subsequently been added to reflect underpinning aspects of a radiology service including management, audit and other governance issues. The standards are currently being edited to ensure consistency. Draft standards, now on the RCR website, will be finalised towards the end of 2007.

One of the features of this programme, is the use of developmental standards. The precise format of the standards is being re-evaluated but it is expected that a department working with the standards will be in a position to understand what is required to achieve excellence in each area of practice.

Wherever possible, the standards are designed as a series of statements of practice, often with four levels of achievement. The top line statement is aspirational, representing an exemplar of practice. Below this level will be up to three further levels of compliance reflecting good, fair and poor compliance.

Some standards, particularly those relating to legislation, will be straightforward. Others will focus on outcome measures rather than being process-driven. For example, to comply with an individual standard, it will usually be insufficient to have a policy in place; the standards are generally constructed to require evidence of policy implementation. This places a greater burden on the department but, increasingly, many accreditation programmes are moving to an outcome-based system.

One of the aims of the programme is to encourage and assist departments to improve the standards of their clinical service. This will be done partly through the developmental standards that highlight how individual departments comply with each area of performance. The assessment will be underpinned by development support. Precisely what this "support" will look like is being scoped at this time. One option would be to develop a web-based signposting system, linked to individual standards which could direct departments to key resources which will help them address areas of weakness or non-compliance.

Conclusion

It is anticipated that, in order to maintain a degree of independence from the two colleges, an independent accrediting body will be established. This will be closely linked to the two colleges who are likely to be tasked with on-going standard review and ensuring that new and appropriate standards are developed to reflect changes in legislation and emerging clinical practice. It is expected that the programme will have a positive effect on clinical standards in radiology service provision across the UK. The scope of the programme extends beyond purely technical and professional standards with an emphasis on process optimisation within departments linked to a realignment of the clinical service to reflect the patient's needs and expectations.

Further Reading

1. The NHS Plan: a plan for investment, a plan for reform, July 2000, HMSO, London

2. The NHS Cancer Plan: a plan for investment, a plan for reform, September 2000, HMSO, London

3. *www.rcr.ac.uk* - follow the link to the radiology accreditation programme

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CLINICAL AUDIT

How Simple can we Make it?

AUTHOR

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Clinical audit is a continuous improvement process that seeks to improve patient care and outcomes through systematic review of care against explicit criteria and the implementation of change. A cyclical approach to comparison of practice against the standard with implementation of changes has led to the audit spiral concept, leading onwards and upwards to the eventual attainment of the standard, and presumably nirvana.

Clinical audit is defined in the UK government white paper Working for Patients (1989) as: "the systematic critical analysis of the quality of medical care, including the procedures used for diagnosis and treatment, the use of resources and the resulting outcome and quality of life for the patient". This inclusive approach to providing evidence of quality of care was begun in 1993 when the concept of 'clinical audit' superseded 'medical audit'. The Health Act of 1999 set up the framework of 'Clinical Governance' through which 'NHS organisations were to be accountable for continually improving the quality of their services and safeguarding high standards of care'. Clinical audit forms an integral part of governance.

During the years of the NHS internal market, clinical audit was of paramount importance to providers to show evidence of quality to purchasers. In recent years the emphasis has shifted to support the use of evidence-based practice, a trend which has proved useful in patient care and popular amongst clinicians. Sadly,

the evidence base for many standards in imaging is lacking but the worm is starting to turn and the need for auditable standards now drives research.

Types of Audit

- Audit of structure: How is the service set up and is this optimal?
- Process audit: How do we provide a service and is this up to standard?
- Outcome audit: How do we influence patients' health and is this in line with best practice?

Although structure and process audits are simplest to carry out and are powerful tools for securing scarce resources, outcome audit is essential to show improvement in patient health and is favoured by proponents of evidence-based practice. This type of audit, although feasible and frequently performed for interventional radiology, is difficult in diagnostic imaging. Accuracy of diagnoses and staging or biopsy success are often regarded as outcome audit.

Sources of Audit Standards

Guidelines for good practice have proliferated in recent years. Many are evidence-based but some also take cost-effectiveness into consideration. UK national bodies such as Scottish Intercollegiate Guidelines Network (SIGN) and the National Institute for Health and Clinical Excellence (NICE) in England and Wales, the Healthcare Commission, and the Department of Health have developed, commissioned and adopted guidelines which are freely available through their websites.

Radiological referral guidelines are available through learned bodies such as the Royal College of Radiologists, the American College of Radiology and the Royal Australian and New Zealand College of Radiologists. Frequently, appropriate standards do not exist globally, nationally or in world literature, in which case a local standard may be derived.

Audit Methodology

Once the standard has been identified, an indicator (measurable quantity related to the target), such as the percentage of cancer patients staged within two weeks, is measured for a sample of patients. The sample size should be related to the target percentage and statistical advice may be needed here for national audits or larger departmental or hospital audits.

Recommendations	Action Agreed	Date of implementation (or reason for not implementing)
Job plans should be reviewed in the light of departmental needs	27.9.06	29.3.07
Report in room without interruptions		27.9.06 29.3.07
Secretarial/clerical support	27.9.06	No funding
Re-audit within 1 year	27.9.06	Re-audit Sep 07

Fig. 1. Example of a final slide in an audit presentation.

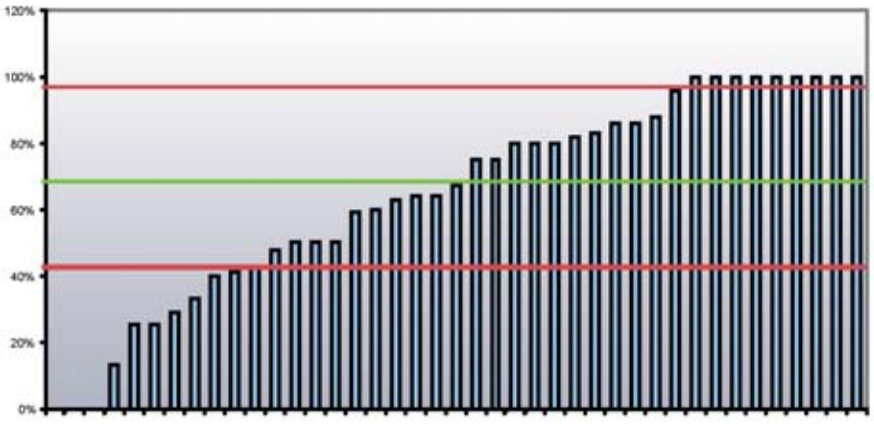

Fig. 2. National audit league table (ranked histogram) illustrating examinations scanned and reported within two weeks. Benchmarking with quartiles (red lines) and median (green line). Error bars could further add to statistical rigour.

On the whole, the selection of "the last sixty patients" is better for analysis than "last month's patients". Results may be as simple as either "standard achieved" or "standard not achieved", the former resulting in reassurance and proof for doubters while the latter will lead correctly to the recommendation of changes. Re-audit marks the closure of the audit loop and is particularly relevant following implementation of change but is also important for reassurance, albeit at a longer interval from the first audit. This cycle or spiral leading to proof of ideal practice underpins the principle of good audit.

Scheduling Audits

Around two half-days are required for most departmental audits, including data gathering, analysis and preparing the presentation. Medical staff should have time identified in their job plans, often 2 - 4 hours per week. A half-day per month is often allocated by many Trusts for audit meetings. Consultants are expected to attend at least 70% of meetings. Management should be

represented at all meetings. Audit facilitators are employed by many UK Trusts to advise and coordinate larger audits.

Presenting an Audit

Departmental audit meetings are the appropriate forum for presentation and when audits are inter-departmental, the other departments should be invited to participate at an early stage. This has the double advantage of helping with data gathering and facilitating changes which may cross boundaries. Ownership of audits remains with the lead auditor, usually a radiologist or other health professional. A departmental slide template is useful for presentations. Such a template would include:

- Title slide with the lead auditor and co-workers as well as the department (of use when audits are collated and shared with others within the organisation).
- Background. Why is this audit worth doing?
- Standards: National or local? Evidence-based?
- Results
- Discussion and conclusions. Do we meet the target? If not, why not?
- Recommendations. This is best kept brief and feasible and should include recommendation for re-audit, if appropriate. When tabulated as a last slide (see Fig.1, page 16), these recommendations may be coupled with a column for agreement by management and a third column for date of implementation (or reason for not implementing).

Statistical Considerations

The need for sample size estimates and for statistical comparisons when re-auditing will depend on the size and scope of the project. This is often necessary for national audits. Of more practical use is the display of results. Although while for most departmental and personal audits, simply achieving or not achieving the target is sufficient, it is helpful in national audits to benchmark departments giving median and quartiles (see Fig. 2, page 16). Anonymising departments is essential both for confidentiality and to ensure participation.

How Simple can we make Clinical Audit?

Whether you are designing an audit to support your appraisal folder, producing an audit programme for your department of radiology or advising on a national audit, the same principles apply:

- Choose a relevant topic which is either badly done and could be improved or well done but not recognised;
- Adopt a standard which is widely agreed and preferably evidence-based;
- Keep it simple. A complicated methodology will put off many otherwise enthusiastic participants; and,
- Be brutally brief with statistical analyses. The questions to be answered are simple and usually binary. Are patients given the best care and are they better?

The departmental annual audit programme should aim to:

- Be inclusive of all sections and professional groups;
- Mix presentations of projects with medical interest, often outcome audits, with those with wider interest, often process audits;
- Ensure all projects are interesting, relevant and preferably topical;
- Be produced three months before the first audit presentation;
- Be distributed to all presenters at least one month in advance; and
- Ideas for audit projects can be from members of staff, national guidelines (eg NICE, SIGN), patient safety agencies (e.g., National Patient Safety Agency NPSA) and patient liaison groups as well as publications.

QUALITY IMPROVEMENT IN RADIOLOGY

The Australian Experience

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The Quality Use of Diagnostic Imaging (QUDI) programme is an initiative administered by the Royal Australia and New Zealand College of Radiologists (RANZCR) on behalf of the profession and funded by the Australian government to systematically collect and disseminate evidence to inform quality improvement in radiology. It is one of a three-part quality strategy including the RANZCR practice accreditation programme and the International Radiology Quality Network (IRQN).

Australia's health system is largely funded by the national government through the medicare universal health insurance scheme. Expenditure on radiology is governed by a capped Memorandum of Understanding (MOU) between the RANZCR, the Australian Diagnostic Imaging Association (ADIA) representing the owners of radiology practices (many of whom in Australia are now corporate entities) and the government. The programme was initially funded for five years at 0.1% of the total radiology budget (AUS$3 million). A national strategy for the programme was developed by the RANZCR in consultation with the government. From the national strategy, annual work plans and specific projects are developed.

Quality Sub-programmes

The following are sub-programmes, each with different objectives:

- **Quality Consumer Services (CS)**: Develops consumer-focused, accessible and coordinated services.
- **Quality Referrals/Ordering (QR)**: Supports evidence-based referrals that facilitate the most appropriate diagnostic imaging service provision.
- **Quality Assured Services/Accredited Providers (QS)**: Ensures professional practice standards and supervision requirements, through uniform standards, practice guidelines and accreditation.
- **Economically Sustainable Services (ES)**: Provides cost benefit studies and develops cost-effective practices, services and referral and review platforms.
- **Quality Into Action (QIA)**: Facilitates implementation of the findings of QUDI projects into practice and policy, including the annual research seminar, key stakeholder briefings and project development workshops.
- **Evaluation Programme**: Reviews the appropriateness of systems, processes and documentation in place for the administration of the grants, to determine whether programme resources are applied effectively.

Who is Responsible for Carrying out Objectives?

The Radiology Management Committee (RMC), which manages the radiology MOU and includes representatives from the college, the ADIA and the government is responsible for determining the extent and nature of the programme.

RANZCR is responsible for:

- Developing and implementing the programme framework, outline work plan and annual work plans;
- Commissioning, supporting and monitoring of projects within the annual work plans;
- Evaluating and reporting on the outcomes of the programme; and,
- Administering and acquitting programme funding.

The **QUDI Advisory Group** includes representatives of public and private sector providers, academic radiologists, primary care and specialist referrers and consumers. It is responsible for:

- Providing advice on, and assistance with, the development of the programme;
- The outline work plan, annual work plans and all projects and budgets over the life of the QUDI Agreement; and,
- Advising RANZCR on programme evaluation and making a final report to the government.

The **QUDI Technical Reference Group** includes radiologists with specific expertise in one or more areas of radiology and is responsible for:

- Providing the programme manager with technical advice, and,
- Assisting in the design, development and implementation of sub-programmes and projects within the programme outline work plan and annual work plans.

» *continued on p.39*

ACCREDITATION OF MEDICAL IMAGING IN KOREA

Developing a System for Better Healthcare

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Lack of Quality Management Hits Patients

In 2000, changes in the national medical reimbursement system allowed the rate of self-referrals to increase. Also, the abolition of government restrictions on the installation of radiological equipment resulted in an increased rate of bad-quality images made by unchecked secondhand units. Besides this, many physicians and radiologists were unaware of the concept of quality management. In 2001, a nationwide survey of the quality of radiological imaging performed by the Korean Food and Drug Administration (KFDA) and the Korean Radiological Society (KRS) showed a significant failure rate for CT, mammography and MR imaging (see Fig. 1).

On January 19, 2001, the National Assembly of Korea approved Acts on quality management for these underperforming imaging modalities. By these Acts, quality management of specific medical equipment was launched by the Ministry of Health and Welfare (MHW). In collaboration with the Korean government, the KRS developed guidelines and standards of quality management, including test procedures, test frequencies and limiting values for clinical image and phantom examination.

The Acts defined five areas for inspection, that is, personnel requirements, equipment and facility, quality control records, phantom images and clinical images. Annual inspection requires participating facilities to meet minimum quality standards. Also reviewed are records for personnel requirements, equipment and facility, quality control sheets and inspection of phantom images. Every three years, an on-site survey and evaluation of clinical images are added. New equipment must be certified prior to commencing operations.

Government's Role in Monitoring Quality

The Korean government now prohibits the use of failed equipment. For the operation of MRI, a facility must employ a full-time radiologist and technologist. CT and mammography require at least part-time radiologists for supervising the quality management of equipment (see table 1). Facilities must perform scheduled quality control tests, that is, daily/weekly, monthly, quarterly, semi-annual, and annual tests, and document the results on quality control log sheets. Standard phantom testing is used for evaluation of the efficiency of equipment, of phantom images, and of either film records or onsite survey. For clinical image tests, each facility submits typical clinical images for review and evaluation.
Further, the KRS established the Korean Institute for the Accreditation of Medical Imaging (KIAMI), a government-authorised agency for medical image accreditation. KIAMI's mission is to improve the quality of patient care through improvement of the quality of

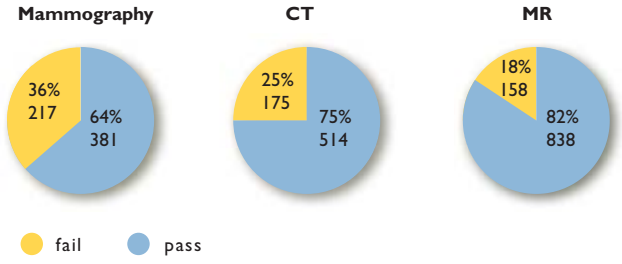


Fig 1. Failure rate of radiological imaging at nationwide survey in 2001

	Radiologist	RT
MRI	Full time	Full time
CT	Full time or part time	Full time
Mammography	Full time or part time	Full time or part time

Table 1. Personnel requirement

medical imaging. KIAMI is composed of over 200 volunteer radiologists working as inspectors. All mammography, CT, and MRI units in Korea must be inspected by KIAMI to be accredited and certified by the MHW every year. Medical equipment that does not meet the quality standards of KIAMI is banned from use by the government.

Rates of Quality Inspection

In 2005, of 4,236 medical imaging units, 3,773 underwent quality inspection; this includes 1630 mammography, 1547 CT, and 596 MRI units. In 2006, of 4,648 medical equipments, 4,038 underwent quality inspection; this includes 1804 mammography, 1586 CT, and 648 MRI units. 463 (i.e., 11%) in 2005 and 610 (i.e., 13%) in 2006 of the tested units did not receive inspection due to withdrawal or disuse.

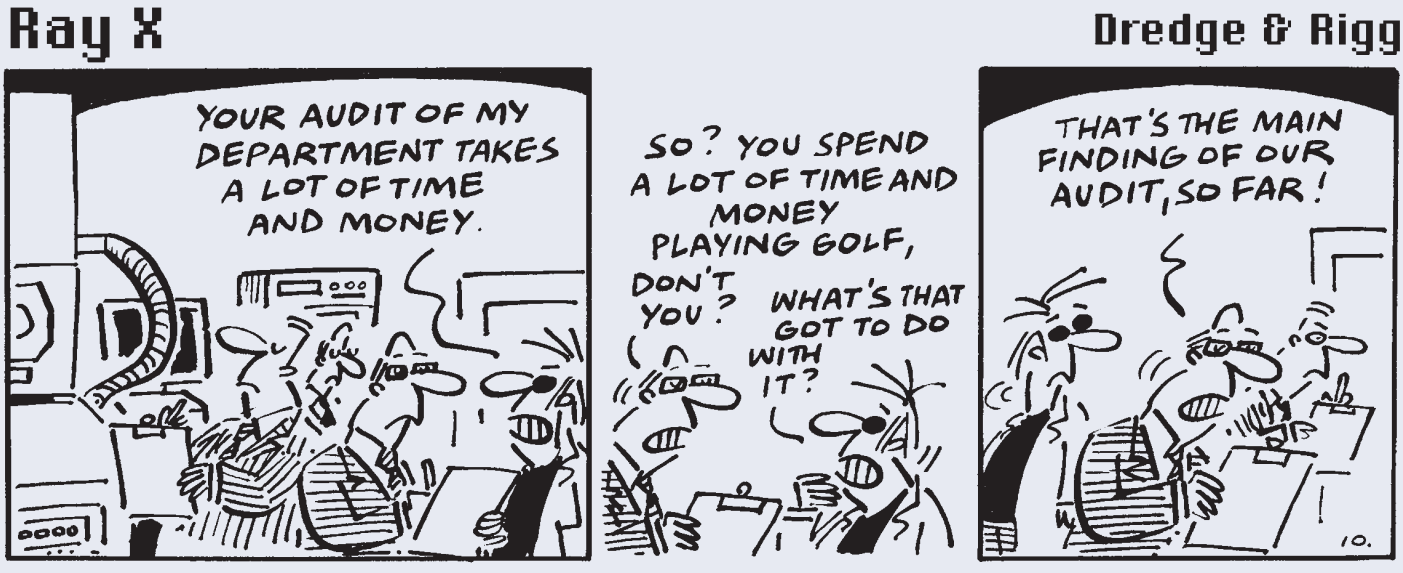
The failure rate was 8.75 % (327/3773) in 2005 and 11.5 % (468/4038), in 2006 respectively. The failure rate of pilot studies prior to launching an accreditation programme was about 25 - 30%. In 2005, the failure rate of clinics, hospitals and general (tertiary) hospitals was 7.8% (128/1662), 10.0% (121/1211) and 3.8% (39/1035), respectively. Of the 327 failed units, 135 were accredited at second or third trials. However, 120 (3.2%) were withdrawn, and 72 were suspended for use. Total disuse rate was 15% (615/4196).

The number of obsolete imaging units manufactured more than ten years ago or with an unknown manufacturing date was 1760 (47%) in 2005, and 1535 (38%) in 2006, respectively. The failure rate of second-hand or obsolete equipment was much higher than that of new equipment.

Remaining Problems with Accreditation System

Considering the fact that the failure rates had been much higher on our nationwide survey performed before the launch of quality management on 2001, this result implicates improvement of the quality of medical imaging performed at certified units. Elimination of poor quality second-hand equipment has led to decreased reexamination rate, results in decreased medical fees and the radiation exposure of patients. We expect that the quality of medical imaging will be further improved after our next scheduled inspection (on-site survey and evaluation of clinical images) starting during the course of 2007.

However, we still have several problems to be solved. Still we have a conflict of interest among the stakeholders, medical consumers (insurance payer), government (operating medical insurance), radiologists and referring doctors. To elicit a consensus for the quality control of medical imaging among stakeholders is our continuing mission. To overcome internal conflict within the radiological society is another mission. Our future perspective includes: propagation of social agreement on quality management, training and education of specialists in quality management, expansion of the field of quality inspection for other radiological equipment, and establishment of standard protocols for clinical imaging.



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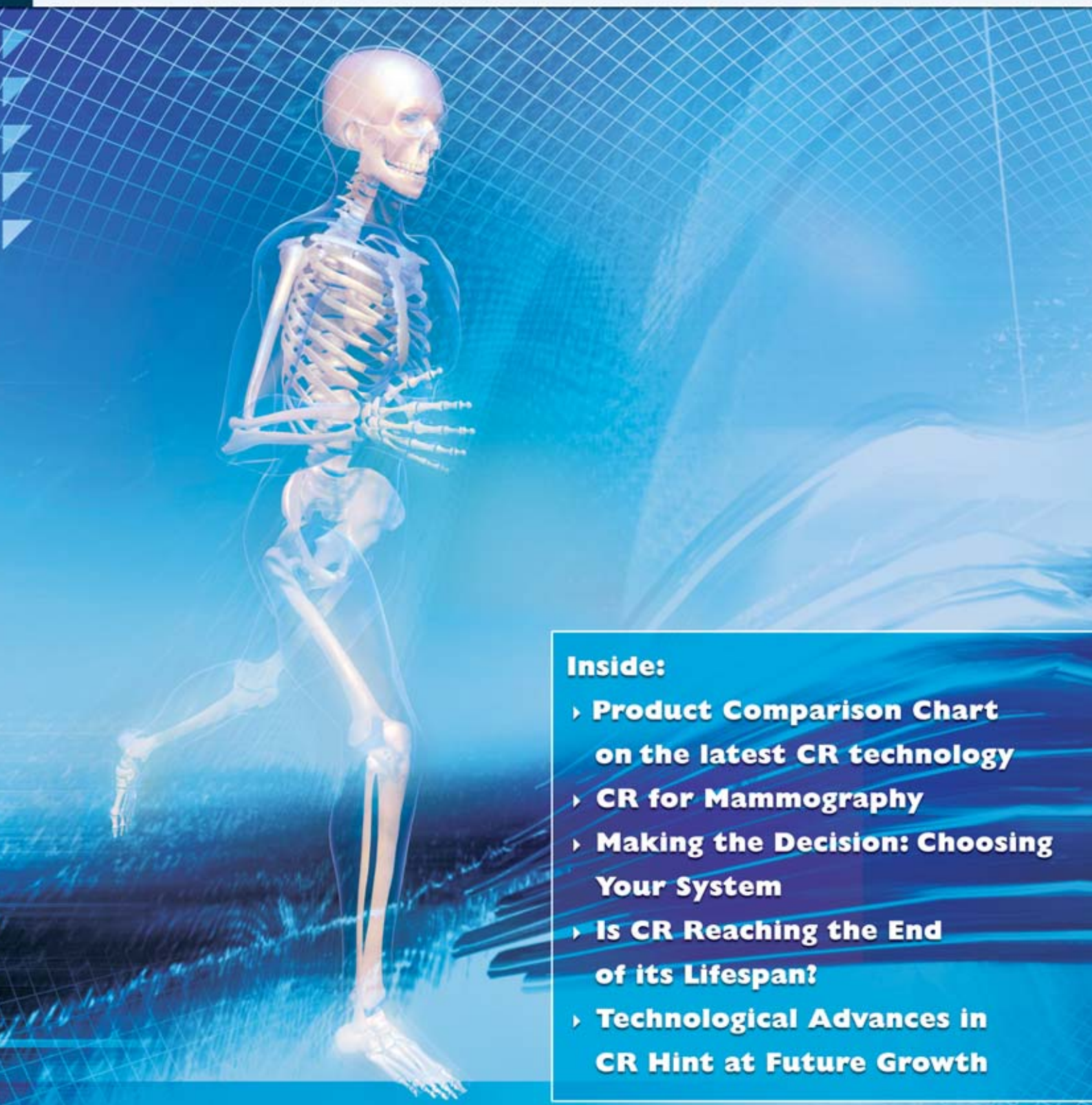

Inside:

- Product Comparison Chart on the latest CR technology
- CR for Mammography
- Making the Decision: Choosing Your System
- Is CR Reaching the End of its Lifespan?
- Technological Advances in CR Hint at Future Growth

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IS CR DEAD?

Guest Editor

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Decreasing radiation dosage and increasing workflow efficiency are the twin technology drivers in medical imaging today. Globally, the trend of understaffed departments necessitated the revolution of machine taking over from man. One of the most significant technological changes has been the move from analogue to digital imaging. There are two most common approaches to digitisation – computed radiology (CR) and digital radiology (DR). The outcome of both approaches is in the form of a digital image, for storage in a Picture Archival and Communication System (PACS).

The Digital Divide

Hospitals are often faced with the challenge of choosing between a CR and a DR system. Radiologists and other decision-makers have to be attuned to the end result: is installation necessary due to workflow pressures or to the need to integrate into a PACS? The answer to this question should 'guide' the end user to choose between the two options. A CR system is the best option available if the aim of the hospital is to retrofit their existing analogue systems to be compatible with PACS. However, for larger facilities, patient throughput and workflow pressures need to be tackled. DR solutions provide the best option in this case, allowing quicker turnaround of patients.

Standing the Test of Time

One of the major points that advocates of DR technology use is the extremely short time interval between image acquisition and display. With newer and improved DR systems being developed by companies such as Carestream Health, AGFA, FUJI etc., the time taken to display a full resolution image is about seven seconds. The amount of time saved is tremendous, especially for centres with a higher workload.

However, CR systems today are in a race to close this gap. CR systems by Fuji provide a full resolution image in about twenty seconds. Nevertheless, with the use of CR, technologists have to move the plate to the scanner and back, adding to the workload. Therefore in terms of technologist's preference, DR systems score significantly over CR systems. Having said that, when the decision is based on flexibility of movement, CR systems score higher, as the cassette can be taken to the patient's side and can be transferred to the reader by the technician. With DR systems this flexibility is unavailable.

Discerning Points

Dual side image viewing, minimal image display time (almost comparable to DR systems) and compact systems are the distinguishing factors of CR. The rate of technology development and the rapid succession with which these systems are inundating the market is a far cry from the fear of extinction that CR systems are weathering.

Cost Vs. Image Quality

A major factor that is helping CR stand its ground is the fact that it is easier to use, as cassettes offer the technologist the flexibility of placing the cassette depending on the positioning of the patient. DR systems are known to be 'unwieldy' in this respect. Another factor supporting CR systems is the costs involved in the replacement of cassettes. The replacement of a digital imaging plate could be up to $50,000 compared to a measly $1000 to replace a phosphor plate for CR.

DR systems were touted to have better spatial resolution and about four years ago it was predicted that DR systems could replace CR owing to speed and image quality factors. Significant improvements for CR systems make them almost comparable to DR systems. Technologies such as AGFA's patented storage phosphor technology have helped raise the bar for image quality in cassette-based systems.

In 2003/4, when DR systems were just picking up, the greatest restraint to its uptake was said to be cost. While a CR system was priced at $50,000, DR systems easily cost about $200,000. This was because installation of a DR system meant redoing the entire radiology room. This led to DR systems being installed only by large hospitals that could afford these systems. However, presently the prices of DR systems are falling and are expected to become more affordable.

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The essentials of imaging

Is CR Dead? The Argument Continues...

DR and CR systems have identified their target markets and while the former caters to large hospitals with high patient flow, the latter caters to smaller institutions where patient throughput is not of the utmost consideration. This market delineation is allowing companies to develop unique products and address the specific requirements of the targeted segments. A debate on the longevity of CR in comparison to DR is inevitable, but it is premature now. CR is likely to see lesser takers than it currently enjoys in the next five to ten years, and until then the market for CR is likely to remain strong.

MAKING THE DECISION: HOW TO CHOOSE YOUR SYSTEM

Advice from Todd Minnigh

INTERVIEWEE

Todd Minnigh
Director of Marketing
Carestream Health

What recent evidence of CR image quality sheds light on its comparison to DR?

We expect that storage-phosphor-based CR will lag behind aSi/CsI flat panel DR in image quality for the foreseeable future. But CR technology will continue to close the gap by better management of noise and exposure than we currently see with CR. Often, more dose than necessary is used in CR imaging as the result of a natural need by users to make fewer mistakes. Studies have measured this dose creep issue and shown that management and monitoring of dose significantly reduce the problem.

Administrative reporting software also helps department managers oversee exposure use by radiographers across all CR and DR devices in the department. Such operational metrics are very valuable in tracking and improving dose performance department-wide. Recently the British Journal of Radiology (BJR) published an article reporting on a hospital's dose audit and found excellent examples of where such software would help.

How does CR improve the management process in the imaging department?

Because the image data is digital, the ability to automatically reprocess or manually adjust images means that over-exposed, under-exposed, mislabeled and sometimes wrongly-positioned images can be salvaged, assuming the anatomy in question is actually in the image. That said, it is also possible to track repeat exams automatically and use department-wide administrative reporting functions to look at the whole digital x-ray department and understand who needs support in which areas, or to even focus techs on areas where they achieve the best results and the fewest errors. A fundamental of good management is to discover who is most and least productive, then follow up accordingly. Easy access to information is the key to making such operational decisions.

How does the US differ to Europe in adoption of CR/DR?

There are many differences between the US and European markets, driven by the vastly different reimbursement systems. Much of the common ground we find is in the clinical applications and cutting-edge technologies available. With regards to CR and DR, I believe you will see storage phosphor CR become obsolete when DR capture technology fits inside a DIN standard 35x43cm cassette. This has been the 'Holy Grail' of DR for some time. Even without such a disruptive technology, much of general x-ray will be DR within 10 - 12 years as the trend to replace traditional general x-ray rooms with high performance DR rooms is the 'new norm'.

How should a CR purchaser decide on the best solution for his/her department?

Addressing productivity first and all other needs second is a good basis. A CR purchaser should understand why they want to purchase CR in the first place - perhaps an application of "the five whys" are in order, to find the root cause. When they get to the last "why" they will probably determine that they need to examine more patients in less time with fewer radiographers. Operating parallel film and CR

» *continued on p.15*

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Medical Doctors (respond below)

1. What is your occupation? (check only one)
   - ❑ Diagnostic Radiologist
   - ❑ Other Physician (please specify)

1a. What is your radiology sub-specialty? (check only one)
   - ❑ General Radiology
   - ❑ Neuroradiology
   - ❑ Nuclear Medicine
   - ❑ Vascular & Interventional
   - ❑ Nuclear Radiology
   - ❑ Cardiovascular Diseases
   - ❑ Paediatric Radiology
   - ❑ Other (please specify)

1b. I am Chief of my Department
   - ❑ Yes
   - ❑ No

Non-physician professionals (respond below)

1c. What is your occupation? (check only one)

Administrator/Manager:
- ❑ Radiology Administrator
- ❑ Radiology Business Manager
- ❑ PACS Administrator

Executive
- ❑ Chief Information Officer / IT Manager
- ❑ Chairman / Managing Director / Executive Director
- ❑ Chief Financial Officer / other executive titles

Other
- ❑ Medical Physicist
- ❑ Academic
- ❑ Chief Technologist / Senior Radiographer
- ❑ Manufacturer
- ❑ Business Consultant
- ❑ Distributor / Dealer

All respondents reply to the questions below

2. In what type of facility do you work? (check only one)
   - ❑ Private clinic
   - ❑ Hospital (check number of beds)
   - ❑ More than 500 beds
   - ❑ 400-499 beds
   - ❑ 300-399 beds

3. With what technologies or disciplines do you work? (check all that apply)
   - ❑ Diagnostic X-ray
   - ❑ Nuclear Imaging
   - ❑ Interventional Radiology
   - ❑ CT
   - ❑ Ultrasound
   - ❑ MRI
   - ❑ Mammography
   - ❑ Bone Densitometry
   - ❑ PACS/Teleradiology
   - ❑ Cardiac Imaging
   - ❑ PET
   - ❑ Echography
   - ❑ Angio/Fluoroscopy

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ECRI Institute
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COMPUTED RADIOGRAPHIC SYSTEMS
PRODUCT COMPARISON CHART

ECRI Institute, a non-profit organisation, dedicates itself to bringing the discipline of applied scientific research in healthcare to uncover the best approaches to improving patient care. As pioneers in this science for nearly 40 years, ECRI Institute marries experience and independence with the objectivity of evidence-based research.

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.

More than 5,000 healthcare organisations worldwide rely on ECRI Institute's expertise in patient safety improvement, risk and quality management, healthcare processes, devices, procedures and drug technology. ECRI Institute is one of only a handful of organisations designated as both a Collaborating Centre of the World Health Organisation and an evidence-based practice centre by the US Agency for healthcare research and quality.

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	ECRI[1]	PROTEC medical systems
MODEL	**High-throughput, general-purpose**	**PROSCAN 35E**
WHERE MARKETED		Worldwide
FDA CLEARANCE		No
CE MARK (MDD)		Yes
SYSTEM COMPONENTS		PROSCAN 35E IP reader with integrated erasing function, set of imaging plates, protection sleeves, CONAXX Image Acquisition Software
READER/DIGITIZER		
Throughput per hour (cassette sizes)	100 (all sizes)	51 imaging plates/h, 35 x 43 cm (14 x 17") 110 imaging plates/h, 18 x 24 cm (8 x 10")
Power requirements		100-240 VAC; 50/60 Hz
Power consumption	2 kW	120W
PIXEL MATRIX SIZE		
35 x 43 cm cassette	1750 x 2150	3500 x 4300
35 x 35 cm cassette	1750 x 1750	3500 x 3500
14 x 17 in cassette	1750 x 2150	3500 x 4300
14 x 14 in cassette	1750 x 1750	3500 x 3500
CASSETTE LIFE	2-year warranty	5,000-10,000 cycles
PATIENT ID	Manual entry, barcode, DICOM modality worklist	DICOM communication, worklist, text file, GDT/BDT interface, manual entry
WORKSTATION(S)		
CPU/components	PC, distributed wall-mountable exam entry terminals	System requirements include Windows Vista, XP or 2000, 2.0 GHz clock rate, 1 GB main memory (RAM)
Image storage	40 GB	80 GB /via PROMIS server >400 GB is recommended
INTERFACES	PACS, printer	DICOM communication to PACS, DICOM print to printer, patient CD; GDT/BDT
DICOM CONFORMANCE	DICOM 3.0: CD IOD, print (SCU), MWL, MPPS	Yes: DICOM 3.0 (incl. Send (SCU), WL (SCU), MPPS, Print (SCU), Query (SCU))
OPTIONS	Orthopedic image tools, oversized image plates	PROMIS medical imaging software (PACS) is option, software modules to make the system adaptable from single workstation to a multi modality PACS solution

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 IHE Scheduled Workflow Software, Procedure Mapping and Enhanced Trauma Software, Administrative Analysis Reporting Software, Security Audit Log Software, Low Exposure Optimization Software, DIRECTVIEW Capture Link System, CR Mammography feature, Total Quality Tool package, Total quality tool for Mammography.
3 OSTEOGRAM® System Package; Kodak Workstation Viewer Software; Kodak Multi-Modality Workstation Viewer Software; Kodak Modality Worklist Software

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

PHILIPS	PHILIPS	PHILIPS	PHILIPS	PHILIPS
PCR Eleva Corado	**PCR Eleva CosimaX**	**PCR Eleva S**	**PCR Eleva S Hi-res**	**PCR Eleva S Plus**
Worldwide	Worldwide	Worldwide	Worldwide	Worldwide
Yes	Yes	Yes	Yes	Yes
Yes	Yes	Yes	Yes	Yes
PCR Eleva workspot and Eleva Corado reader	PCR Eleva terminal and Eleva CosimaX reader	PCR Eleva workspot and Eleva S reader	PCR Eleva terminal and Eleva S Hi-res reader	PCR Eleva workspot and Eleva S Plus reader
90-165, depending on plate size and type	65-165, depending on plate size and type	48-78, depending on plate size	46-94, depending on plate size	64-97, depending on plate size
100-120, 50/60 Hz	100-120; 50/60 Hz	100-120, 50/60 Hz	100-240; 50/60 Hz	100-120, 50/60 Hz
800 VA	800 VA	200 VA	800 VA	290 VA
3520 × 4280, 1760 × 2140	3520 × 4280, 1760 × 2140	3520 × 4280	3520 × 4280, 1760 × 2140	3520 × 4280, 1760 × 2140
3520 × 3520, 1760 × 1760	3520 × 3520, 1760 × 1760	3520 × 3520	3520 × 3520, 1760 × 1760	3520 × 3520, 1760 × 1760
3520 × 4280, 1760 × 2140	3520 × 4280, 1760 × 2140	3520 × 4280	3520 × 4280, 1760 × 2140	3520 × 4280, 1760 × 2140
3520 × 3520, 1760 × 1760	3520 × 3520, 1760 × 1760	3520 × 3520	3520 × 3520, 1760 × 1760	3520 × 3520, 1760 × 1760
IP average 3-5 years	IP average 3-5 years	IP average 3-5 years	IP average 3-5 years	IP average 3-5 years
DICOM MWL, FTP interface, bar code scan or manual entry	DICOM MWL, FTP interface, bar code scan or manual entry	DICOM MWL, FTP interface, bar code scan or manual entry	DICOM MWL, FTP interface, bar code scan or manual entry	DICOM MWL, FTP interface, bar code scan or manual entry
PC, keyboard, mouse, 17" LCD with optional touchscreen, optional additional workspots	PC, keyboard, mouse, 17" LCD monitor with optional touchscreen, optional additional workspots	PC, keyboard, mouse, 17" LCD with optional touchscreen, optional additional workspots	PC, keyboard, mouse, 17" LCD monitor with optional touchscreen, optional additional workspots	PC, keyboard, mouse, 17" LCD with optional touchscreen, optional additional workspots
1.5 GB RAM, 60 GB image partition for 2,000 to 5,000 images depending on size	1.5 GB RAM, 60 GB image partition for 2,000 to 5,000 images depending on size	1.5 GB RAM, 60 GB image partition for 2,000 to 5,000 images depending on size	1.5 GB RAM, 60 GB image partition for 2,000 to 5,000 images depending on size	1.5 GB RAM, 60 GB image partition for 2,000 to 5,000 images depending on size
DICOM MWL, DICOM MPPS, DICOM store, DICOM commit, DICOM print, DICOM interchange media	DICOM MWL, DICOM MPPS, DICOM Store, DICOM storage commit, DICOM print, DICOM interchange media	DICOM MWL, DICOM MPPS, DICOM store, DICOM commit, DICOM print, DICOM interchange media	DICOM MWL, DICOM MPPS, DICOM Store, DICOM storage commit, DICOM print, DICOM interchange media	DICOM MWL, DICOM MPPS, DICOM store, DICOM commit, DICOM print, DICOM interchange media
DICOM 3.0: Verification (SCU/SCP), Image Storage (SCU), Storage Commit (SCU), MWL (SCU), MPPS (SCU), Print (SCU), CD-R Interchange (FSC/FSR)	DICOM 3.0: Verification (SCU/SCP), Image Storage (SCU), Storage Commit (SCU), MWL (SCU), MPPS (SCU), Print (SCU), CD-R Interchange (FSC/FSR)	DICOM 3.0: Verification (SCU/SCP), Image Storage (SCU), Storage Commit (SCU), MWL (SCU), MPPS (SCU), Print (SCU), CD-R Interchange (FSC/FSR)	DICOM 3.0: Verification (SCU/SCP), Image Storage (SCU), Storage Commit (SCU), MWL (SCU), MPPS (SCU), Print (SCU), CD-R Interchange (FSC/FSR)	DICOM 3.0: Verification (SCU/SCP), Image Storage (SCU), Storage Commit (SCU), MWL (SCU), MPPS (SCU), Print (SCU), CD-R Interchange (FSC/FSR)
DICOM MWL and Classic RIS connection, DICOM MPPS, DICOM Image Export, DICOM Print, DICOM CD Media, Automatic image stitching, Clinical QC, Reader sharing, iSite Integration, Quality Control kit, Wallmount kit for workspot, mShield (network security firewall).	DICOM MWL and Classic RIS connection, DICOM MPPS, DICOM Image Export, DICOM Print, DICOM CD Media, Automatic image stitching, Clinical QC, Reader sharing, iSite Integration, Quality Control kit, Wallmount kit for workspot, mShield (network security firewall)	DICOM MWL and Classic RIS connection, DICOM MPPS, DICOM Image Export, DICOM Print, DICOM CD Media, Automatic image stitching, Clinical QC, Reader sharing, iSite Integration, Quality Control kit, Wallmount kit for workspot, mShield (network security firewall).	DICOM MWL and Classic RIS connection, DICOM MPPS, DICOM Image Export, DICOM Print, DICOM CD Media, Automatic image stitching, Clinical QC, Reader sharing, iSite Integration, Quality Control kit, Wallmount kit for workspot, mShield (network security firewall)	DICOM MWL and Classic RIS connection, DICOM MPPS, DICOM Image Export, DICOM Print, DICOM CD Media, Automatic image stitching, Clinical QC, Reader sharing, iSite Integration, Quality Control kit, Wallmount kit for workspot, mShield (network security firewall).

	ECRI[1]	Carestream Health	Carestream Health	Carestream Health
MODEL	**High-throughput, general-purpose**	**KODAK DIRECTVIEW CR 500 System**	**KODAK DIRECTVIEW CR 825 System**	**KODAK DIRECTVIEW CR 850 System**
WHERE MARKETED		Worldwide	Worldwide	Worldwide
FDA CLEARANCE		Yes	Yes	Yes
CE MARK (MDD)		Yes	Yes	Yes
SYSTEM COMPONENTS		Image-plate reader, PC, image processing software, 15" flat-panel touchscreen monitor, UPS, barcode reader	Image-plate reader, PC, image processing software, 17" flat-panel touchscreen monitor, UPS, barcode reader	Image-plate reader, PC, image processing software, 17" flat-panel touchscreen monitor, UPS, barcode reader
READER/DIGITIZER				
Throughput per hour (cassette sizes)	100 (all sizes)	>60 (depending on size)	Up to 62 (depending on size)	Up to 104 (depending on size)
Power requirements		100-127 VAC 5 Amps 50/60 Hz; 200-240 VAC 3 Amps 50/60 Hz; Includes an uninterruptible power supply (UPS)	100-120 VAC 10 Amps 50/60 Hz; 200-240 VAC 5 Amps 50/60 Hz; Includes on-board uninterruptible power supply (UPS)	100-120 VAC 10 Amps 50/60 Hz; 200-240 VAC 5 Amps 50/60 Hz; Includes on-board uninterruptible power supply (UPS)
Power consumption	2 kW	Not specified	Not specified	Not specified
PIXEL MATRIX SIZE				
35 × 43 cm cassette	1750 × 2150	2048 × 2500	2048 × 2500	2048 × 2500
35 × 35 cm cassette	1750 × 1750	2048 × 2048	2048 × 2048	2048 × 2048
14 × 17 in cassette	1750 × 2150	2048 × 2500	2048 × 2500	2048 × 2500
14 × 14 in cassette	1750 × 1750	2048 × 2048	2048 × 2048	2048 × 2048
CASSETTE LIFE	2-year warranty	20,000 actuations	45,000 actuations	45,000 actuations
PATIENT ID	Manual entry, barcode, DICOM modality worklist	DICOM modality worklist (optional), manual entry, remote patient data entry software web based (optional)	DICOM modality worklist (option), manual entry, remote patient data entry software web based (option)	DICOM modality worklist (optional), manual entry, remote patient data entry software web based (optional)
WORKSTATION(S)				
CPU/components	PC, distributed wall-mountable exam entry terminals	Lenovo TM Pentium® IV desktop PC, DIRECTVIEW 19" touchscreen wall-mounted Remote Operation Panel (option) gives technologists the ability to identify patient/exam/cassette and to review and process images of any linked CR system, remotely.	Lenovo TM Pentium IV built-in PC, DIRECTVIEW 19" touchscreen wall-mounted Remote Operation Panel (option) gives technologists the ability to identify patient/exam/cassette and to review and process images of any linked CR system, remotely.	Lenovo TM Pentium® IV built-in PC, DIRECTVIEW 19" touchscreen wall-mounted Remote Operation Panel (option) gives technologists the ability to identify patient/exam/cassette and to review and process images of any linked CR system, remotely.
Image storage	40 GB	160 GB, Up to 4800 images	160 GB, Up to 4800 images	160 GB, Up to 4800 images
INTERFACES	PACS, printer	Ethernet, TCP-IP, DICOM	Ethernet, TCP-IP, DICOM	Ethernet, TCP-IP, DICOM
DICOM CONFORMANCE	DICOM 3.0: CD IOD, print (SCU), MWL, MPPS	DICOM: Storage, Storage commitment, Modality Performance Procedure Step, Print, Modality Worklist	DICOM: Storage, Storage commitment, Modality Performance Procedure Step, Print, Modality Worklist	DICOM: Storage, Storage commitment, Modality Performance Procedure Step, Print, Modality Worklist
OPTIONS	Orthopedic image tools, oversized image plates	DIRECTVIEW EVP Software, Black Surround/Masking Software, DIRECTVIEW CR Long-Length Imaging system, Remote Patient Data Entry Software, DICOM Work List Management Software, DICOM Storage Service Class User Software, Grid Detection and Suppression Software,[2]	DIRECTVIEW EVP Software, Black Surround/Masking Software, DIRECTVIEW CR Long-Length Imaging system, Remote Patient Data Entry Software, DICOM Work List Management Software, DICOM Storage Service Class User Software, Grid Detection and Suppression Software,[2]	DIRECTVIEW EVP Software, Black Surround/Masking Software, DIRECTVIEW CR Long-Length Imaging system, Remote Patient Data Entry Software, DICOM Work List Management Software, DICOM Storage Service Class User Software, Grid Detection and Suppression Software,[2]

KODAK DIRECTVIEW CR 975 System	KODAK Point of Care 120 system	KODAK Point of Care 140 system	KODAK Point of Care 260 system	KODAK CR 2000RT Plus
Worldwide	Worldwide	Worldwide	Worldwide	Worldwide
Yes	Yes	Yes	Yes	Yes
Yes	Yes	Yes	Yes	Yes
Image-plate reader, PC, image processing software, 17" flat-panel touchscreen monitor, UPS, barcode reader	Image plate reader, server PC (acquisition and QC workstation), flat panel monitor, DICOM interfaces, optional Z-cart	Image plate reader, server PC (acquisition and QC workstation), flat panel monitor, DICOM interfaces, optional Z-cart	Image plate reader, server PC (acquisition and QC workstation), flat panel monitor, DICOM interfaces, optional Z-cart	Image plate reader, server PC (acquisition and QC workstation), high resolution monitor, DICOM interfaces
Up to 101 cassettes (depending on size)	20 plates/hr	41 plates/hr	60 plates/hr	Low Resolution Scans: 1K (1,024 pixels/line) > 140 plates/hr. High Resolution Scans: 2K (2,048 pixels/line) > 60 plates/hr.
100-120 VAC 10 Amps 50/60 Hz; 200-240 VAC 5 Amps 50/60 Hz Includes an uninterruptible power supply (UPS)	Single phase 50/60 Hz, 100-240 VAC 2,5 Amps	Single phase 50/60 Hz, 100-240 VAC 2,5 Amps	Single phase 50/60 Hz, 100-240 VAC 2,5 Amps	Single phase 100–120VAC, 50/60 Hz, 4.0 Amps 220–240VAC, 50/60 Hz, 2.0 Amps
Not specified	Not specified	Not specified	Not specified	Not specified
2048 x 2500	2120 x 2548	2120 x 2548	4172 x 5056	Low-Res: 1024 x 1260 High-Res: 2048 x 2500
2048 x 2048	2916 x 2916	2916 x 2916	4172 x 4172	Not Typically used in Oncology, but will scan at: Low-Res: 1024 x 1024 High-Res: 2048 x 2048
2048 x 2500	2120 x 2548	2120 x 2548	4172 x 5056	Low-Res: 1024 x 1260 High-Res: 2048 x 2500
2048 x 2048	2916 x 2916	2916 x 2916	4172 x 4172	Not Typically used in Oncology, but will scan at: Low-Res: 1024 x 1280 High-Res: 2048 x 2560
45,000 actuations	10,000 actuations	10,000 actuations	10,000 actuations	40,000 actuations
DICOM modality worklist (optional), manual entry, remote patient data entry software web based (optional)	DICOM modality worklist (optional), manual entry, remote patient data entry software web based (optional)	DICOM modality worklist (optional), manual entry, remote patient data entry software web based (optional)	DICOM modality worklist (optional), manual entry, remote patient data entry software web based (optional)	DICOM modality worklist (but Gen Rad input lacks some Oncology specific info), manual entry on local server or remote client software
Lenovo TM Pentium® IV built-in PC, DIRECTVIEW 19" touchscreen wall-mounted Remote Operation Panel (option) gives technologists the ability to identify patient/exam/cassette and to review and process images of any linked CR system, remotely.	Recommended Pentium® IV 3.0 Ghz, 17" Colour LCD monitor, 1 GB RAM, 80GB hard disk, Microsoft® Windows® XP Professional Z-Cart configuration requires small form factor PC	Recommended Pentium® IV 3.0 Ghz, 17" Colour LCD monitor, 1 GB RAM, 80GB hard disk, Microsoft® Windows® XP Professional Z-Cart configuration requires small form factor PC	Recommended Pentium® IV 3.0 Ghz, 17" Colour LCD monitor, 1 GB RAM, 80GB hard disk, Microsoft® Windows® XP Professional Z-Cart configuration requires small form factor PC	Server: Provided with system: Pentium® IV 3.6 Ghz or higher, 20.1" 2MPixel MonoChrome monitor, 1 GB RAM, 80GB hard disk, Microsoft® Windows® XP Professional SP2, DVD/CD Burner. Optional Client Workstations: Recommended Pentium® IV 2.8 Ghz or higher, 17" Color LCD monitor (2Mpixel preferred), 1 GB RAM or more (512MB min), 80GB hard disk (10GB free min), Microsoft® Windows® XP SP2 (Microsoft® Windows® 2000 SP4 min).
160 GB, Up to 4800 images	Recommended 80GB	Recommended 80GB	Recommended 80GB	Recommended 80GB
Ethernet, TCP-IP, DICOM	Ethernet, TCP-IP, DICOM, USB	Ethernet, TCP-IP, DICOM, USB	Ethernet, TCP-IP, DICOM, USB	Ethernet, TCP-IP, DICOM, USB
DICOM: Storage, Storage commitment, Modality Performance Procedure Step, Print, Modality Worklist	DICOM: Storage, Storage commitment, Print, Modality Worklist	DICOM: Storage, Storage commitment, Print, Modality Worklist	DICOM: Storage, Storage commitment, Print, Modality Worklist	DICOM: Storage, Print, Modality Worklist, Query/Retrieve Create Patient CD w/DICOM Viewer DICOM image output in DICOM 3.0 CR or RT
DIRECTVIEW EVP Software, Black Surround/Masking Software, DIRECTVIEW CR Long-Length Imaging system, Remote Patient Data Entry Software, DICOM Work List Management Software, DICOM Storage Service Class User Software, Grid Detection and Suppression Software,[2]	Kodak Acquisition Software / Military Package; Kodak Remote Patient Entry Software; Kodak DICOM Print Software; Kodak Custom Print Software; Kodak CD Archive Software; Kodak DVD Archive Software; Kodak Teleradiology Send Software; Kodak Teleradiology Receive Software;[3]	Kodak Acquisition Software / Military Package; Kodak Remote Patient Entry Software; Kodak DICOM Print Software; Kodak Custom Print Software; Kodak CD Archive Software; Kodak DVD Archive Software; Kodak Teleradiology Send Software; Kodak Teleradiology Receive Software;[3]	Kodak Acquisition Software / Military Package; Kodak Remote Patient Entry Software; Kodak DICOM Print Software; Kodak Custom Print Software; Kodak CD Archive Software; Kodak DVD Archive Software; Kodak Teleradiology Send Software; Kodak Teleradiology Receive Software;[3]	Kodak Radiation Beam Dosimetry package: Images dose ranges up to 800cGy, imaging for relative dosimetric tests, IMRT QA, Beam Profiles, Percent Depth Doses / Isodoses, Electron Beam QA, Perform Image-based Physics QA tests, Light vs Radiation, Star Shots, HDR dwell position, Excellent dose response constancy over time. Client Software for remote viewing and image manipulation.

	ECRI[1]	KONICA MINOLTA	KONICA MINOLTA	KONICA MINOLTA	
MODEL	**High-throughput, general-purpose**	**REGIUS MODEL 110**	**REGIUS MODEL 190**	**REGIUS MODEL 370**	
WHERE MARKETED		Worldwide	Worldwide	Worldwide	
FDA CLEARANCE		Yes	Yes	Yes	
CE MARK (MDD)		Yes	Yes	Yes	
SYSTEM COMPONENTS		Image-plate reader, imaging cassettes, imaging plates, control station	Image-plate reader, imaging cassettes, imaging plates, control station	Image-plate reader, built in imaging plate	
READER/DIGITIZER					
Throughput per hour (cassette sizes)	100 (all sizes)	80, 62 HR (14 x 17"); 84, 63 HR (14 x 14"); 83, 63 HR (11 x 14"); 86, 66 HR (10 x 12"); 88, 70 HR (8 x 10"); 86, 66 HR (24 x 30cm); 89, 70 HR (18 x 24cm); 96, 78 HR (15 x 30cm)	85, 66 HR (14 x 17"); 94, 74 HR (14 x 14"); 93, 73 HR (11 x 14"); 99, 79 HR (10 x 12"); 102, 84 HR (8 x 10"); 99, 80 HR (24 x 30cm); 103, 86 HR (18 x 24cm); 128, 108 HR (15 x 30cm)	210 (All size)	
Power requirements		100-240 ±10% VAC; 50/60 Hz	100-240 ±10% VAC; 50/60 Hz	100-240 ±10% VAC; 50/60 Hz	
Power consumption	2 kW	0.8 kW	1.1 kW	1.0 kW	
PIXEL MATRIX SIZE					
35 x 43 cm cassette	1750 x 2150	N/A	N/A	N/A	
35 x 35 cm cassette	1750 x 1750	N/A	N/A	N/A	
14 x 17 in cassette	1750 x 2150	2010 x 2446, 175 µm; 4020 x 4892, 87.5 µm	2010 x 2446, 175 µm; 4020 x 4892, 87.5 µm	2048 x 2430, 175 µm; 4096 x 4860, 87.5 µm	
14 x 14 in cassette	1750 x 1750	2010 x 2010, 175 µm; 4020 x 4020, 87.5 µm	2010 x 2010, 175 µm; 4020 x 4020, 87.5 µm	2048 x 2048, 175 µm; 4096 x 4096, 87.5 µm	
CASSETTE LIFE	2-year warranty	2-year plate life regardless of number of exposures	2-year plate life regardless of number of exposures	2-year plate life regardless of number of exposures	
PATIENT ID	Manual entry, barcode, DICOM modality worklist	Autoselection via modality worklist, manual data entry	Autoselection via modality worklist, manual data entry	Autoselection via modality worklist, manual data entry	
WORKSTATION(S)					
CPU/components	PC, distributed wall-mountable exam entry terminals	Pentium IV processor, CS-2/3 control station with QA functions	Pentium IV processor, CS-2/3 control station with QA functions	Pentium IV processor, CS-2/3 control station with QA functions	
Image storage	40 GB	130 GB	130 GB	130 GB	
INTERFACES	PACS, printer	HIS-/RIS- and PACS-supporting DICOM	HIS-/RIS- and PACS-supporting DICOM	HIS-/RIS- and PACS-supporting DICOM	
DICOM CONFORMANCE	DICOM 3.0: CD IOD, print (SCU), MWL, MPPS	DICOM store, print, modality worklist, modality performed procedure steps, grayscale presentation state and storage commitment	DICOM store, print, modality worklist, modality performed procedure steps, grayscale presentation state and storage commitment	DICOM store, print, modality worklist, modality performed procedure steps, grayscale presentation state and storage commitment	
OPTIONS	Orthopedic image tools, oversized image plates	Portable assistant (PDA) for registering cassettes at bedsides	Portable assistant (PDA) for registering cassettes at bedsides	Portable assistant (PDA) for registering cassettes at bedsides	

AGFA HealthCare	AGFA HealthCare	AGFA HealthCare	FUJIFILM	FUJIFILM
CR 30-X	**CR 35-X**	**CR 85-X**	**FCR PROFECT CS**	**FCR CAPSULA XLII**
Worldwide	Worldwide	Worldwide	Worldwide	Worldwide
Yes	Yes	Yes	Yes	Yes, excluding mammography
Yes	Yes	Yes	Yes	Yes
Image-plate reader, cassettes, image plates and Windows XP based acquisition station with CD Burner	Image-plate reader, cassettes, image plates and Windows XP based acquisition station with CD Burner	Image-plate reader, cassettes, image plates and Windows XP based acquisition station with CD Burner	Multiplate reader & CR console PC	Single reader & CR console PC
Up to 82 (depending on size and application)	Up to 71 (depending on size and application)	Up to 112 (depending on size and application)	120-140 (35 x 43cm, 35 x 35cm with 200 micron reading) 103-165 (35 x 43cm - 18 x 24cm with 100 micron reading) when ST-VI exposed at 25mR 65-80 (18 x 24cm, 24 x 30cm with 50 micron dual-side reading) when ST-BD exposed at 25mR, HR-BD exposed at 600mR	87-94 (35 x 43cm, 35 x 35cm with 200 micron reading) 62-92 (35 x 43cm - 18 x 24cm with 100 micron reading) when ST-VI exposed at 25mR 61-70 (24 x 30cm, 18 x 24cm with 50 micron reading) when exposed HR-V at 600 mR (Optional)
100, 240 VAC; 50/60 Hz; 15/16 A; single-phase	100, 240 VAC; 50/60 Hz; 15/16 A; single-phase	200, 208, 230-240 VAC; 50/60 Hz; 15/16 A; single-phase	120, 240 VAC ±10%; 50/60 Hz; single-phase	120, 240 VAC ±10%; 50/60 Hz; single-phase
320 W	2kW	2kW	7 A maximum	5 A maximum
3480 x 4248 HR	2320 x 2828; 3480 x 4240 HR	2320 x 2828; 3480 x 4240 HR	1760 x 2140, 3520 x 4280	1760 x 2140, 3520 x 4280
N/A	2320 x 2320; 3480 x 3480 HR	2320 x 2320; 3480 x 3480 HR	1760 x 1760, 3520 X 3520	1760 x 1760, 3520 x 3520
3480 x 4248 HR	2320 x 2828; 3480 x 4240 HR	2320 x 2828; 3480 x 4240 HR	1760 x 2140, 3520 x 4280	1760 x 2140, 3520 x 4280
N/A	2320 x 2320; 2480 x 2480 HR	2320 x 2320; 3480 x 3480 HR	1760 x 1760, 3520 x 3520	1760 x 1760, 3520 x 3520
2 year	2 year	2 year	Ave. 3-5 years	Ave. 3-5 years
Embedded memory chip, RIS interface for patient list and query by accession number, RIS-link tool kit for standard and nonstandard RIS, DICOM worklist query	Embedded memory chip, RIS interface for patient list and query by accession number, RIS-link tool kit for standard and nonstandard RIS, DICOM worklist query	Embedded memory chip, RIS interface for patient list and query by accession number, RIS-link tool kit for standard and nonstandard RIS, DICOM worklist query	Manual entry from keyboard, barcode scanning, magnetic card reading or selected from RIS worklist	Manual entry from keyboard, barcode scanning, magnetic card reading or selected from RIS worklist
PC systems with 2 GB RAM, Windows XP; standard high-brightness or touchscreen monitor options; modem cables, UPS	PC systems with 2 GB RAM, Windows XP; standard high-brightness or touchscreen monitor options; modem cables, UPS	PC systems with 2 GB RAM, Windows XP; standard high-brightness or touchscreen monitor options; modem cables, UPS	15" 1-megapixel touchscreen / 21" 2-megapixel / 21" 3-megapixel flat-panel display, P4 CPU, 3.2GHz, keyboard and mouse, barcode scanner	15" 1-megapixel touchscreen / 21" 2-megapixel / 21" 3-megapixel flat-panel display, P4 CPU, 3.2GHz, keyboard and mouse, barcode scanner
160 GB	160 GB	160 GB	~2,000 at each CR console	~2,000 at each CR console
DICOM print, store; RIS-link tool kit with modality worklist, soft-copy tool kit (for non-DICOM PACS), MPPS, Storage commit, GSDF	DICOM print, store; RIS-link tool kit with modality worklist, soft-copy tool kit (for non-DICOM PACS), MPPS, Storage commit, GSDF	DICOM print, store; RIS-link tool kit with modality worklist, soft-copy tool kit (for non-DICOM PACS), MPPS, Storage commit, GSDF	DICOM 3.0, FCR direct (FUJIFILM original)	DICOM 3.0, FCR direct (FUJIFILM original)
DICOM 3.0 SCU and print class, MPPS, DMWL, DICOM Storage Commit	DICOM 3.0 SCU and print class, MPPS, DMWL, DICOM Storage Commit	DICOM 3.0 SCU and print class, MPPS, DMWL, DICOM Storage Commit	DICOM 3.0, Basic Grayscale Print Management, CR Storage, MG Storage, MWM, MPP, Storage Commitment	DICOM 3.0, Basic Grayscale Print Management, CR Storage, MWM, MPP, Storage Commitment
Test phantoms and auto QC software, dose consistency program; full-leg/-spine software; advanced annotation, advanced measurements, black border, repeat/reject program, Musica^2, grid line suppression, square marker, prior viewing, peadiatric age groups	Test phantoms and auto QC software, dose consistency program; full-leg/-spine software; advanced annotation, advanced measurements, black border, repeat/reject program, Musica^2, grid line suppression, square marker, prior viewing, peadiatric age groups	Test phantoms and auto QC software, dose consistency program; full-leg/-spine software; advanced annotation, advanced measurements, black border, repeat/reject program, Musica^2, grid line suppression, square marker, prior viewing, peadiatric age groups	IP Cassettes; Type CC(General), CH(for HR-V), LC(Long-view), DS(for ST-BD), DM(for HR-BD) Imaging Plates; ST-VI, HR-V, ST-BD(Dual-side reading), HR-BD(Dual-side reading) Additional CR Consoles & Imagers	IP Cassettes; Type CC(General), CH(for HR-V), LC(Long-view) Imaging Plates; ST-VI, HR-V Additional CR Consoles & Imagers 50 micron 20pixels/mm imaging

CR FOR MAMMOGRAPHY

How has it Affected Radiological Workflow?

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High-quality digital mammography has been available now for several years and is increasingly used for both diagnostic and screening mammography programmes. There are many advantages offered by digital technology in the field of breast imaging. These include the possibility to compensate for mistakes in exposure and a wide dynamic range allowing high-quality mammographic exams, as well as reducing the number of repeat radiograms. The bigger exposure latitude and contrast allow easier emphasis on structures with different thickness and density and with low intrinsic contrast.

Moreover, the higher sensitivity of the system reduces the level of radiation doses necessary to obtain a good quality image. Digital systems permit the use of high resolution monitors, saving film-copy costs, and electronic image storage, as well as to transfer and retrieve them in real time for consultation. CAD is also available to help the radiologist to identify lesions. Although CAD mammography systems have received wide-spread adoption in the US, where there is additional reimbursement for its use, its clinical value is still being debated. Many radiologists think that the more probable use of CAD in the future is as a double reading.

Why is CR a Convincing Prospect?

Since 2004, we have implemented CR in our department. At first, the progress of digital technology, as highlighted in the literature, convinced us to begin its use. The progressive improvements in digital mammography, in my opinion, will in a few short years, drive total substitution of all the machines for digital ones. Digital mammography is certainly user-friendly and time-efficient, because in just a few seconds the images reach the monitors where the radiologist can view them, in many different ways.

In my experience, both digital and analogue are good systems; each must be adjusted in terms of quality using specific algorithms and tests, but in the near future the digital system will become even more streamlined and offer far more possibilities. In particular, patients benefit by the reduced dose and shorter time to perform the exam.

Disadvantages of Using CR for Mammography

The most significant disadvantage of using fully digital systems for mammography, is the high cost of the equipment. Moreover, the comparison has to be done with full-field digital mammography, whose costs are higher than CR. However, integrated digital systems usually allow higher throughput than cassette-based CR systems.

The value of CR mammography systems compared to integrated full-field systems has recently been under intense discussion. There is no doubt that CR systems have a slightly lower DQE (Detective Quantum Efficiency) than integrated full-field systems and that the necessary dose to obtain the same quality is slightly higher. Moreover, one major selling point of CR systems is the lower investment cost, especially if existing mammography equipment can be used for acquiring the mammography images.

Most of the advantages of digital mammography are related to getting rid of film. It allows for a higher patient throughput and lets the technologist concentrate more on the patients. Especially interventional procedures, such as preoperative wire localisations, are much faster without the need for films to be developed between each step of the process. Also, digital images can automatically be transferred, stored and retrieved without the need for human interaction. The higher investment costs for digital mammography are at least in part compensated for by these savings.

There is no doubt that images acquired digitally should best be read as soft-copy on a monitor.

Accuracy of Digital Mammography

The diagnostic accuracy of digital mammography has been shown to be at least equivalent to film-screen mammography in a general screening population. Digital mammography is superior to film-screen mammography in younger women with dense breasts due to its ability to selectively optimise contrast areas of dense breast parenchyma. This advantage is especially important in women with familial or genetic predispositions for breast cancer, and highlighted the need for early detection programmes to target patients in the 25 - 30 year age group.

Quality Control

At present, no consensus exists among radiologists on which processing is optimal for digital mammography. The DQE of a digital system is difficult to measure in a standard way; it may depend on a variety of factors such as x-ray beam quality and detector dose. Tests for digital mammography systems are usually achieved by accessing the contrast-detail resolution of systems with specific phantoms. Image processing may also vary significantly among different digital dealers with limited interoperability.

FOCUS ON COMPUTED RADIOGRAPHY

CR's Adaptability Ensures Future Growth

AUTHOR

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What have been the main milestones in the development of CR?

CR units are now less bulky and cumbersome than when they were first pioneered during the 80s and 90s, and the technology has become more reliable and better suited to routine use in busy imaging departments. Also, the size of the image plate readers has decreased. Today, units are available to meet the requirements of any imaging department, from the largest to the smallest. Previously, the only decision was in choosing between a single- or multi-plate reader while now, we have desk top units, high throughput single plate readers, upgradeable readers and units that are more like DR units, in that no cassette handling is required.

The less obvious change has been the continued development of photostimulable technology to improve image quality (DQE), bringing image quality close to that available with DR. However, the cost of improving the image quality also diminishes the cost difference between the technologies.

What are the advantages of choosing a CR system, other than the relatively straightforward integration? What, in contrast are the disadvantages for buyers?

The main advantages of CR is that for routine radiography, it is more than adequate for all exams, including orthopaedics, paediatrics, portable, and emergency exams. The only type of exam that CR cannot be used for, which is possible in some DR systems, is tomography. It can be used with any existing radiographic equipment, you can choose where to put the image plate readers, you can move them easily, and there is no change in the projections you use. Also, it is available in many shapes and sizes to fit different requirements.

However, buyers will need to spend time optimising the x-ray parameters and adjusting their automatic exposure controls and ensure integration with the RIS. Technologists will have to learn to interact with the control consoles. Compared to DR the main disadvantage of CR is the fact that users must handle cassettes, so the workflow will never match that of DR.

What are some typical examples in workflow (e.g. processing times, image preview times, overall throughput), when one compares computed to digital radiography?

In a DR exam, the patient list is displayed on an in-room control console. Then the patient will be prepared, aligned and the images acquired. Since a preview image is available within seconds on the in-room control console, the radiographer will probably check each image between projections. The radiographer never needs to leave the exam room. The patient can be dismissed within seconds of the final exposure.

In CR, the patient is prepared and aligned in exactly the same way as for a film exposure. Following each exposure the radiographer can either take each image plate to the image plate reader between projections, or stack them up. In some cases an in-room image plate reader will be used, alternatively an assistant may take the exposed cassettes to a shared image plate reader. Before inserting them in the reader, the image plate must be registered with the CR system. This is achieved with a barcode reader or radiofrequency ID tag. The user selects the patient from the displayed list and the projection, then scans the image plate with a barcode reader. The image plate can then be put into any networked image plate reader. The time to display the image will depend on the CR reader, anything from one to five minutes.

A common configuration is to use an in-room control console so the image plates can be registered with the system as soon as they are exposed. That way the radiographer does not need to leave the patient. However, CR will always take longer to display the images than DR. So the patient can either be sent to wait so the images can be checked, or the patient remains in the exam room. Bottom line: CR workflow is more complex and time consuming than DR.

According to research, the US is increasingly interested in DR. How does the US compare to Europe in this preference?

Looking at raw market data can be deceptive. In the US there are a few hospitals that have a preference for DR. Most hospitals have a mixture of CR and DR or just CR. The revenues for CR are ahead of DR, but DR is growing faster. However, since CR costs less than DR, then the number of actual CR units is much higher than DR. Also, the cost of DR usually includes the radiographic equipment, which is rarely the case with CR. In most cases a hospital will install a DR when the radiology department is undergoing major refurbishment.

The bottom line is the economics - reimbursement for radiography is not high, so there are few economic incentives to use DR. The most persuasive argument is often the fact that two or three conventional radiographic room scan be replaced by a single DR room. That is not the case for CR.

Despite ongoing predictions that it will be obsolete in due course, computed radiography (CR) continually emerges as the most popular modality. Not only this, but CR unit sales are tipped to outpace the analog and digital radiography (DR) markets over the next five years. So why are those in the field continually predicting its demise?

Ten years ago, the first flat panel digital detector became a commercial reality (DuPont's Direct Radiography system). The ability to see a high quality radiographic image almost immediately, seemed to be the writing on the wall for CR. At that time, users of CR knew that it was a stretch to equate CR image quality with that possible with film. We also knew CR was unreliable due to the mechanics of image plate readers. CR plates were susceptible to dust, scratches, being dropped, and cracks. DR seemed to be better that CR in all areas of comparison: it was fast, the image quality was better, and being solid state, more reliable. But CR remains to this day due to improvements in configuration and workflow. Those who predict CR's demise don't understand the true advantages of CR, it's not just the DQE and resolution specifications.

⋈ *continued from p.4*

systems may in fact have a negative impact on productivity, so be certain the CR you choose can do everything you need to do.

Ensuring their choice allows them to perform all necessary studies (e.g., Long Bones, Scoliosis, Pandental, Mammography, etc.) is the next step. Then ask:

- Will it interface and automate fully with RIS, HIS, PACS to eliminate manual errors and workflow steps?
- Is there an IHE protocol such as 'IHE Scheduled Workflow', which they are trying to fulfill?
- Is there ample service infrastructure to assure uptime?
- Does the system provide management feedback to allow operational improvements?
- Does the system provide feedback on its own performance to assure maximum quality?
- Is all this easy to do?

Smaller institutions will find they may not have the range of clinical applications or interface needs that larger locations have, but still they should understand their specific need and how well the system they are considering meets that need – from workflow to service to image quality.

What sorts of benefits offset the time-efficiency cons inherent in choosing CR over DR?

RIS integration should lead to automation, rather than additional workflow steps – if more steps are needed, the system is not optimised.

In fact, the only thing needed in addition to transporting the cassettes is selecting the technique at the generator. While we often find radiographers fine-tune each image, this is actually an indication that the automatic processing parameters may not be optimised to the user preference. A well set up CR reader should auto-process the image correctly over 95% of the time.

In an effort to get the least costly digital image, people sometimes choose CR and limit themselves on options and applications training time. This can mean the prime objective of improved productivity is left unfulfilled. Those who take the time to get the processing as perfect as possible, have the RIS fully integrated with procedure mapping, apply optional image processing software such as EVP will find a slightly more expensive CR will give much improved productivity over the 'lowest cost to digital' approach.

FUJIFILM

The number one cause of death in women, breast cancer is currently diagnosed in one European woman in eight, and worldwide kills someone every 90 seconds. On the positive side, when detected at an early stage, the chances of survival are extremely high. Regular medical examinations are all that stand between your patients' health and longevity and those scary statistics.

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Compact design with 1-cassette stacker promising superb resolution for mammography, as well as pediatric and neonatal radiography. Delivering seamless and smooth workflow with superior operability.

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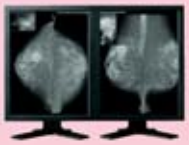
High-quality digital image reader uses Pattern Enhancement Processing for Mammography (PEM) to greatly facilitate the detection and identification of tumors and micro-calcifications.

DRYPIX 4000/7000

Offering 50-micron resolution with 3.6 maximum density, these advanced digital printers ensure the image quality ideally suited for mammography printing.



CAD (Computer-Aided Detection system)
Mammography Workstation

This viewing system automatically identifies, marks, and magnifies any area that may potentially be associated with breast cancer.

Film/screen mammography

AD Mammography System

Advanced film and screen technologies deliver optimal image quality for mammographic applications.

FEM240 Daylight system is recommended.

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IS ACADEMIC RADIOLOGY IN THE UK DEAD?

A Personal View

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The decline of candidates for academic training, the resultant lack of published studies and dearth of dedicated funding sources have led academic radiology in the UK to be described as "almost dead". Though many espouse the view that radiological research is thriving, albeit in a small number of academic centres, in this article I present my personal estimation that radiological research in the UK is in a parlous weakened state and will survive only if there is a coordinated effort to increase the national capacity for academic radiology.

In 2002, I became Chairman of the research subcommittee of the Royal College of Radiologists (RCR) and undertook a small-scale fact-finding exercise to understand the status of research activity within the UK radiological community. I examined the following metrics of research activity: principal investigator status on research grants, the level of personal ad hominem funding for career development for those in the specialty and the level of representation in the leading peer reviewed journals.

Study Shows Weakened State of Academic Research

The findings were lamentable, to say the least. Only three academic radiology departments have direct support from the Higher Education Funding Council (HEFC), a reduction from 12 in 1997. In 2004 there were only 37 radiologists in England with an academic component to their job plans, a decrease of 30% on 2003. Enquiries to the Medical Research Council (MRC), Engineering and Physical Sciences Research Council (EPSRC) and the Wellcome Trust revealed only one clinical research fellowship awarded to a radiologist and only four radiologists with principal investigator status on research grants from any of these three funding bodies in the previous three years.

The leading peer-reviewed journal (Radiology), reveals that during 2006 a mere 4% of publications had authors from a UK institute. A quick comparison with other European member states shows that we publish significantly more in this journal than Portugal, Denmark, Spain, Belgium or Italy, and are on a par with Switzerland and France, but lag significantly behind the Netherlands (168% of the UK output) and Germany (275% of the UK output). Finally, in the US, the NIH has formed the 'National Institute of Biomedical Imaging and Bioengineering' (NIBIB) who, with a budget of approx. 300million Dollar, aim: "To promote fundamental discoveries, design and development, and translation and assessment of technological capabilities in biomedical imaging and bioengineering".

The NIBIB was formed largely in response to the Academy of Radiology Research, an independent body representing a broad range of member societies with an interest in promoting imaging research. There can be little doubt that this model has been enormously successful and is sufficiently generic to bear repetition in the UK.

Although this small-scale survey is extraordinarily unscientific, it paints a relatively worrying picture of a poorly developed academic radiology community with negligible international standing and little track record of developing independent academic practitioners or obtaining direct grant funding.

Formation of UK Clinical Research Collaboration

In 2004, John Reid, then Secretary of State for Health, called for an expansion of UK clinical research including clinical trials and an extensive and sustained increase in the research workforce. This led to the formation of the UK clinical research collaboration (UKCRC), a partnership between government, the voluntary sector, patients and industry to oversee clinical research in the UK. The UKCRC has overseen the establishment of a new infrastructure for clinical research based on national and local research networks. Networks are already operational in cancer, mental health, stroke, diabetes, dementia and children's research. A more extensive range of networks were

established in Wales despite being focused primarily on specific disease states. In addition, we have seen the development of a dedicated career path for medically- and dentally-qualified academic staff.

Based on the recommendations of reports produced by the Academy of Medical Sciences and by Mark Walport as part of the Research for Patient Benefit Working Party, these networks provide a flexible career path for the prospective academic clinician. These posts aim to produce research-capable clinicians with higher degrees and extensive research experience from a training course integrated into clinical training. An outline of the training path is shown in Figure 1 (see below).

Numbers of Trainees on the Rise

The development of a dedicated academic career path is of considerable importance for the future of UK academic radiology. No matter what changes are made in the research infrastructure, expansion of academic training is without doubt the most important. The UKCRC has identified a national shortage of expertise in six specific specialties, including radiology. Despite this, only a small number of academic training posts have been funded in the first two rounds of applications for academic clinical fellowships. Nonetheless, this represents a quantum increase in the number of radiology trainees entering academic training.

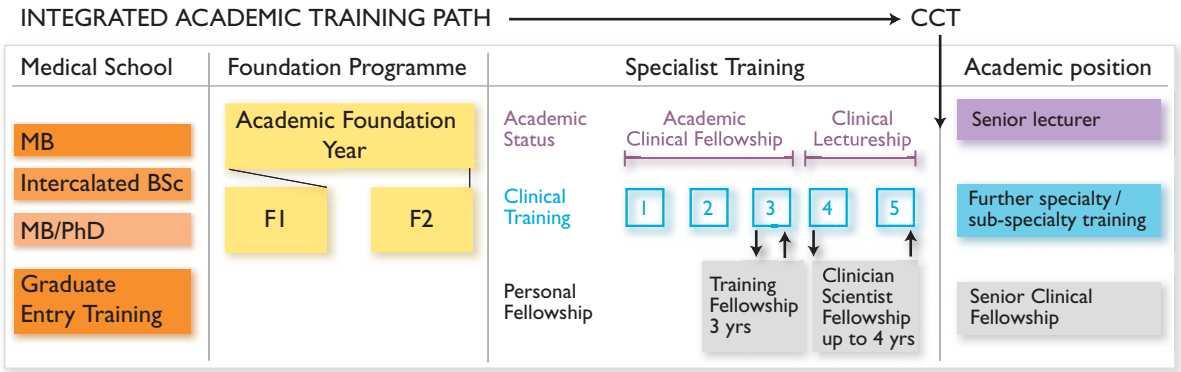
In parallel with these developments, the RCR has sought to support academic training by negotiating joint clinical research fellowships with the MRC and CRUK. These fellowships allow members and fellows of the RCR to apply for prestigious jointly-funded fellowships which are run in parallel, and to the same standards, as the primary clinical fellowships supported by these organisations. There have been significant leaps in attracting successful applicants to these posts with currently five joint clinical fellowships filled by diagnostic radiologists. Although this is a small number, it represents not just a massive increase on previous performance, but evidence of a significant sea-change in the attitude of junior radiologists to the academic career path.

Further Pressure Needed to Improve Outcome

Despite these improvements, there remain challenges with the academic career path in radiology. Although the training scheme is flexible, the majority of trainees undertaking the first three years of an academic clinical fellowship are likely to require additional time to obtain a higher research degree. In most cases, they will need to compete for a clinical fellowship against trainees from other specialties for funding to take three or four years away from clinical medicine. At the present time, there is an easily identified shortage of such fellowships and it is possible that the aspirations of many of these would-be academics will fall at this hurdle. For those who succeed, there are now a small number of clinical lecturerships from which the trainee can apply for consultant grade academic posts.

Conclusion

Some improvements have undoubtedly been seen. However, there must be another major change in the research landscape if academic radiology in the UK is to be rejuvenated. The number of radiologists who are successful in acquiring principal investigator status on research projects or programmes from the major funding bodies is undesirably small. As the number of adequately trained academic clinical radiologists increases, this should resolve. In the 1980s, UK radiology as a specialty lost its leading role in cardiac radiology. There is a significant danger that we are in the same situation with radiological research. There can be no doubt that without continued effort and coordination, the field of academic radiology in the UK may be eroded into non-existence, which would have a severe impact on the overall future of the profession itself.



The timings of personal fellowships are indicative - there should be flexibility according to individual career progression

Fig 1. Integrated Training Path

PET/CT MOVING INTO THE MAINSTREAM

Slow Adoption and Political Decisions Curb Growth

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With any technology that has sat on the shelf for a long time, a rise in sales is often viewed with some skepticism. Is this a false dawn, a blip only to be followed by a downturn? PET has taken a very long time to go from a promising research tool to everyday routine use. CT and MR were both well established ten years after the first commercial systems were launched. PET has taken over fifteen years to reach the same point on the curve. But now the future growth in system placement and patient examinations looks bright.

The development of PET over the past five years in a routine clinical setting has mirrored that of the earlier modalities, CT and MR: rapid establishment in Germany, Belgium, and Italy followed by the Netherlands, Switzerland and Spain, with Scandinavia and the UK very late in establishing a lower routine provision. However, the demands on the healthcare system in Germany have stalled development of PET and this has impacted growth in neighbouring German speaking countries.

In 2006 the number of patients receiving PET scans in Europe broke the 500,000 barrier, up 39% on 2005. In five years time, the number of studies are likely to approach two million.

PET/CT Still Costly Though Prices Falling

PET in its new guise of PET/CT is viewed as expensive, but is this fair? While a 64-slice system costs 2.3 million Euro, a more modest 6 or 8 slice unit costs 1.6 million Euro, marginally more expensive than a 1.5T MRI.

The cost of a radiology examination is heavily influenced by the cost of the equipment on which it is performed, and the throughput. Early PET cameras were relatively slow but PET/CT is much faster. Taking Europe as a whole, the average throughput is ~1,700 patients per year, but in systems placed in the past three years, average throughput is much higher. We have identified a number of PET/CT system carrying out in excess of 2,500 examinations per year. At these throughputs, the price of a PET/CT scan is in the order of 250 Euro, plus the cost of radioisotope and reading fees.

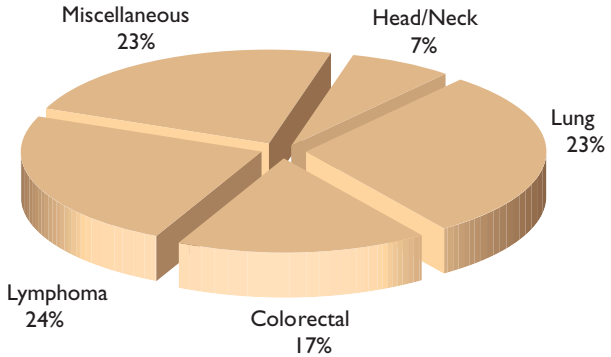
New Offering on the Horizon

In the next five years it seems probable that throughput will rise as new technologies are introduced. The Gemini TF launched by Philips in 2006, is the first clinical machine that encompasses hybrid PET/CT combined with Time of Flight (TOF) technology. It is strongly rumoured that other suppliers will also announce TOF systems in the next twelve months.

TOF refers to the transit of photons from their source in the body to the PET scanner's scintillator ring. Measuring the slight difference in the arrival times of two photons from the same positron with sufficiently good timing resolution determines the distance the positron was from each detector. Measuring TOF and incorporating that information into PET imaging can halve the amount of noise in an image. An improvement in signal to noise allows trade-offs – one is reducing the time to acquire the image. According to Philips, for a whole-body PET scan, image acquisition is accomplished in less than ten minutes.

The price of PET/CT, which is currently heavily influenced by the CT component, will fall as lower specification multislice scanners become more affordable. By 2010 an annual throughput of 4,000 patients and PET/CT pricing of below 1.5million Euro is feasible.

Cancer profile by clinical area – Europe



Source: Medical Options - PET 2006 survey

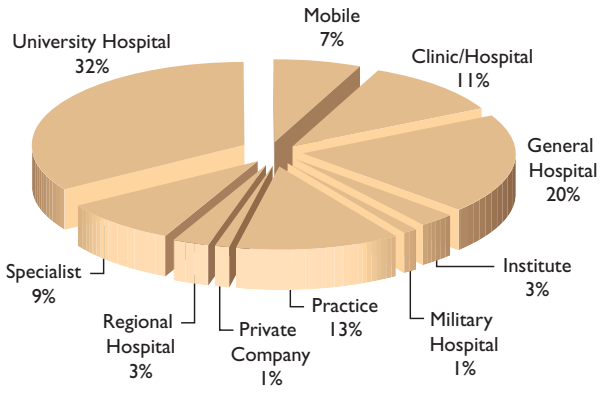
Radioisotope Production a Pricey Component

Producing the radioisotope, which is almost exclusively 18FDG, is potentially an expensive process but benefits massively from economies of scale. Today in Europe, most sites estimate that 18FDG costs them between 300 - 400 Euro per patient. FDG is usually supplied 'in bulk' and then 'aliquoted' for each patient. In the United States, in localities where there are high volumes of PET scans and a large number of suppliers of 18FDG, pricing may be as low as 150 Dollar per patient. It is reasonable to assume that European pricing will weaken as more PET/CT units are installed.

Initially the model in Europe was to have a PET camera alongside a cyclotron. This was not surprising given the limited opportunities to source 18FDG. Over the last three years there has been a shift towards commercial supply. In 2006 we estimated that around 61% of 18FDG was supplied by commercial suppliers. Legislation, and in particular directives governing quality control and good manufacturing practice, has made it increasingly difficult for centres to supply their neighbours unless they have the necessary paperwork. Moreover, PET has moved out of larger institutions and into settings such as general hospitals and private practice which are more inclined to buy-in diagnostics. By 2006, universities comprised less than one-third of centres offering PET or PET/CT examinations.

Sites which already have a radiopharmacy are far more likely to investigate production in-house than those which are supplied from elsewhere. Supplies of 18FDG in Spain are almost entirely commercial whereas in Italy a high proportion of sites have a cyclotron on-site.

PET Centres - Europe, 2006



Source: Medical Options - PET 2006 survey

It is not clear whether in the future the drift to commercial supply will continue. As throughput rises on-site production becomes more attractive. Moreover suppliers have made it far simpler to synthesise tracers.

With the cost of a PET-CT scan and the cost of tracer adding up to less than 500 Euro it is quite easy to see that with reading and interpretation of the images a total procedure fee of 600 Euro is not unreasonable. In 2007, PET reimbursement (CMS) in the US was reduced by ~25% to below 950 Dollar, excluding professional charges.

Oncology to Continue as 'Bread and Butter' of PET/CT

It is easy to overlook the fact that PET was originally a neurological application. The majority of early studies followed brain activity in response to stimuli. In Europe neurology now accounts for only ~1% of patients. Ninety-seven percent of studies are oncology with the remainder cardiology and studies of inflammatory conditions.

In the next few years the growth of PET in Europe will be primarily driven by further expansion of oncology applications. A question that remains unanswered is whether PET will become one more modality in the work-up of oncology patients, or will something be replaced. Until recently the perceived cost of PET and PET/CT has deflected any argument that it may replace existing studies. Now with the cost of PET/CT falling there is more attention being paid to this subject.

Conclusion

PET was a nuclear medicine technique and PET/CT is nearly always located in the nuclear medicine department. But PET/CT is of considerable interest to radiologists. The prominence given to PET/CT at recent RSNA meetings only reinforces the point. PET/CT is a new modality and offers practices the opportunity to expand. The dynamic between CT and nuclear may also in the case of PET work in favour of CT. PET as the follow-up study. Both radiologists and nuclear medicine practitioners have incentives to shift examinations from conventional nuclear medicine to PET.

The next phase of PET development may well see existing scintigraphy applications replaced by PET. Around five million patients are currently examined using conventional nuclear medicine. Applications outside oncology may also stimulate the demand for PET but in the next five years the establishment of the technique will be underpinned by the rising demand from cancer patients.

UTERINE FIBROID EMBOLISATION

Ensuring Post-Procedural Best Practice

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Interventional radiologists play as important a role in post-procedural processes as they do during pre-procedure evaluation and the intervention itself. Patients consider the IR as their treating physician and expect to receive post-procedure care and assurance during their convalescence as much as they do from our clinical colleagues. Moreover, the course of recovery and typical sequelae as well as complications are not well understood beyond the IR community. It is in the interest of the IR and the patient to ensure that side effects and complications are adequately treated and inappropriate actions (e.g. hysterectomy) are avoided.

An early phone interview allows the inevitable gradual decrease in pain and physical weakness patients experience after UAE to be verified. Patients are reassured, minor problems such as minimally increased temperature, onset of minor vaginal bleeding, etc. discussed, and adequate pain medication checked. Some centres with an outpatient IR clinic may also see the patient at four weeks for a regular clinical visit. This may also be performed by the patient's own gynaecologists providing that he/she is familiar with the typical clinical course after UAE.

Clinical and Imaging Outcome

Uterine or individual leiomyoma size reduction is not a good indicator for clinical success in UAE. Symptom improvement remains the single important measure for clinical success. Improvement in clinical symptoms is generally seen three months after the procedure. At this time, only neglectible size reduction of fibroids may be observed. Interventional radiologists should be aware of this discrepancy since patients might be irritated by imaging reports and may need reassurance regarding the course of symptomatic improvement and size reduction of fibroids treated. While menorrhagia may improve as early as within the first cycle after UAE, bulk-related symptoms may take longer to improve. Transient amenorrhea for up to three cycles is common. However permanent amenorrhea is seen in a minority of patients, associated with patients age and rarely seen in patients under the age of 45 years.

Follow-up imaging can be done by transvaginal ultrasound in those women who improve. If patients do not report improvement of symptoms four months after UAE, the treating interventional radiologist should investigate the causes of failure. A detailed history of signs and symptoms in the preceding months should be collected. Thereby, true persistence of symptoms can be differentiated from symptoms that may be related to ongoing fibroid sloughing, intracavitary remnants of fibroid material or infectious complications. Evaluation for infection and hysteroscopy to assess the uterine cavity should be performed.

Persistent Symptoms

In case of persistent symptoms, no decrease or even increase of uterine fibroids contrast-enhanced imaging should be performed to rule out incomplete fibroid infarction after UFE and the possibility of a leiomyosarcoma. MR imaging is particularly helpful in those cases that do not improve beyond four months follow-up after UFE. Typical imaging features are observed after fibroid embolisation.

The leiomyoma show a homogeneous low-signal intensity on T2-weighted images after UFE, variably high signal intensity on T1-weighted images due to haemorrhagic infarction as well as a lack of enhancement after administration of gadolinium-based contrast agents. MR imaging also depicts morphologic changes such as sloughing of fibroids in contact with the uterine cavity. The latter may be associated with vaginal discharge in patients having undergone UFE but do not require additional treatment.

In case of ongoing fibroid expulsion a dilated cervical os and leiomyoma tissue pointing towards the cervix may be observed. Endometritis is seen in 0.5% of cases after UAE and usually responds well to antibiotics but may result in septicaemia if left untreated. With MR imaging, tissue within the uterine cavity may be observed together with high-signal-intensity fluid on T2-weighted images indicating retained fluid. Punctuate foci of low signal intensity represent signal voids due to the presence of air on T1- and T2-weighted images. Contrast-enhanced MR images increase the conspicuity of intracavitary fluid collections and also depict hyperperfusion of inflamed adjacent endometrium. Contrast-enhanced MRI can determine persistent perfusion of fibroids after UAE which maybe the cause of clinical failure. It has been demonstrated that persistent perfusion may lead to regrowth of leiomyoma tissue and recurrence of symptoms.

Digital Imaging Project Reaches Conclusion

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The radiology department at the East-Tallinn Central Hospital (ETCH), Tallinn, Estonia, has completely re-engineered the radiology workflow management during the last four years using the latest radiology and hospital information systems (RIS/HIS) and PACS technology. ETCH is the third largest hospital in Estonia with 560 beds, 28,000 inpatients and 440,000 outpatient visits (2006). It is located in five remote buildings in Tallinn, the capital of Estonia. The implementation of HIS dates back to 1992 and the first PACS was installed in 2003. Today patient data is processed almost completely electronically in local Electronic Patient Records (EPRs), not including ambulatory and nursing records.

In June 2003, the hospital launched the first PACS in Tallinn. Before the advent of PACS, films were developed using manual film processors. By summer 2007, with the conclusion of this project, we are now 'filmless', with an annual volume of 155,000 radiology exams. Radiologists in our department are also providing reporting services for external facilities both in the UK and Denmark.

Workflow Re-engineering

While much attention has been paid, with regards to the digitisation of radiology, to new technical solutions, less has been discussed about workflow re-engineering and integration of different digital solutions. Maximising the potential of digital imaging can only be achieved when workflow and patient data management are organised in a new way. Below are outlined issues for consideration in planning this new kind of management. A special focus is given to holistic patient data management and cross-border reporting.

Even though resources were limited, re-engineering department workflow was a key priority. Achieving clinician acceptance for this transition was done by organising multi-disciplinary meetings in the radiology department as often as possible, depending on their schedule constraints. The surgeons, orthopaedic surgeons and urologists for instance, held daily meetings.

PACS Implementation

The implementation of PACS started by creating a high-bandwidth (100 mbps) IT network connecting all remote departments with a central hub. Remote x-ray rooms with less than 10,000 exams per annum were closed as digitising that size of department is not economically efficient. Two out of five departments were closed and the remaining were equipped with phosphor plate readers. All images were sent directly to the central PACS from where they were retrieved to workstations for radiologist reporting or viewed via the web by referring clinicians.

From the outset of PACS planning, it was essential that HIS/RIS and PACS should be integrated so all devices would use the same patient database to minimise potential mistakes whereby patient data might be entered multiple times. The hospital started using PACS with limited diagnostic workstations and web user licenses. Altogether five workstations and five concurrent web user licenses were available in 2003. From 2003 there has been a significant increase in equipment connected to the PACS. There are now approximately thirty different modalities sending digital images to the archive.

From Linear to Matrix Workflow

Classic hospital or department workflow is linear, meaning that almost all patient data resides with the individual patient or physician and can't be accessed from different locations (see fig. 1). Thus creating simultaneous diagnostic or treatment processes is difficult.

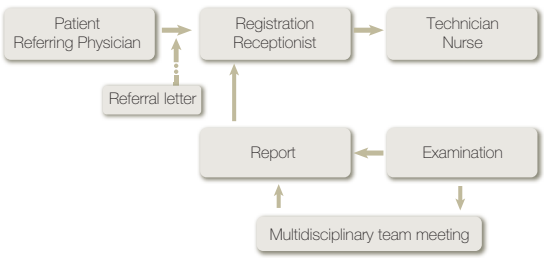

Fig. 1. Linear workflow. Patient data moves with patient. The information flow is only to one direction.

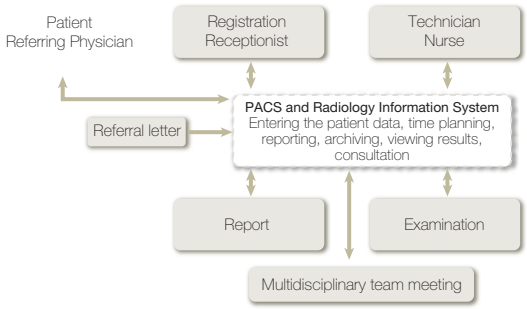

Fig. 2. Matrix workflow. Patient data is accessed any time and from any place. The change of information is mutual.

Digital processing of patient data opens new dimensions for patient care management. Now patient data can be used any time and any place if needed (Fig. 2). The patient can make appointments electronically and the physician can retrieve patient data from different EPRs, view simultaneous images of exams and consult with colleagues from remote locations, etc.

From this point of view, the implementation of PACS is allowing radiologists to achieve workflow optimisation. The radiologist can report not only the images made in the department or radiologist location, but also the images that have been taken in other locations. Consequently it gives the opportunity to organise the work of the department in different ways. Reporting can be done on the basis of the anatomic region, modality, urgency, department, etc. In ETCH, the work shift of the radiologist is divided into general radiology and specialisation by modality or anatomic region.

New Recruitment Opportunities in the Digital Department

A cooperation between the hospital and a private radiology group during the last five years has been greatly enabled by the advent of the digital department. This allows us to engage enough radiologists in case of an unpredicted rise in the number of exams. This has provided ETCH with knowledge about legal and organisational issues that have to be considered in cross-institutional workflow management. Connecting radiologists from different institutions allows creation of a virtual networked department. Our radiologists have found this way of working more interesting and beneficial but also more challenging. Reports and interventions are made by twenty-five radiologists and radiology residents employed either by the hospital or the private radiologist group.

Concerns of Digital Patient Data Management

The main concerns in management of patient digital data and remote healthcare services are quality and security. Quality issues include:

- Poor patient-radiologist contact leading to underestimation of imaging indication;
- Poor radiologist and referring physician contact leading to misunderstanding of reports;
- Lack of availability of patient data and previous images because of inadequate HIS-PACS integration, and
- Language concerns where reports are done in a different country to the patient.

Security risks include patient data access from outside the department firewall, which can be avoided by proper soft- and hardware installation. Risks are similar whether the radiology service is provided inside the country or cross-border within the European Union. In our experience, both barriers should be taken very seriously but can be overcome by using proper methods.

Our Answers to Quality and Security Concerns

Our latest technological improvements concern a new PACS installation in 2007 that allows archiving of all kind of images including non-DICOM and non-radiology images. This new PACS is web-based, with streaming technology allowing whole sets of processing functionalities to clinicians. The PACS is integrated with the local web-based HIS (ESTER, GennetLab AS, Estonia) so the radiologist or referring physician can open images using the HIS and simultaneously view other patient data. The same possibility is available for general practitioners outside ETCH. This kind of holistic patient approach achieved by HIS-PACS integration minimises the risk of having inadequate patient history or referral letters before imaging or during reporting.

Other quality issues are managed as follows. Image viewing and reporting is done using proper diagnostic monitors, providing the reporting radiologist with the relevant prior images. Our radiologists have access to Estonian Nationwide PACS where more than 80% of radiology images made in Estonia are stored. Radiology reports are generated on templates and stored in the RIS. Cross-border reporting and the translation of the report is done by a multilingual secretary if needed. A structured multilingual reporting tool is being tested and has shown promising results. In some cases, like MRI or CT, double reading is practised.

Special Features in Cross-institutional Reporting

The security of patient data is guaranteed using VPN or SSL connections between the different healthcare institutions or users. From a legal point of view, the patient data security, confidentiality, liability and obligations are regulated by the contract between two healthcare institutions. The same is valid for financial issues. In this way, we have managed to overcome the types of problems commonly experienced by institutions such as ours operating out of several remote locations that choose to implement PACS. In conclusion, it is clear that a holistic PACS system that takes into account all quality and security issues, is the only logical choice.

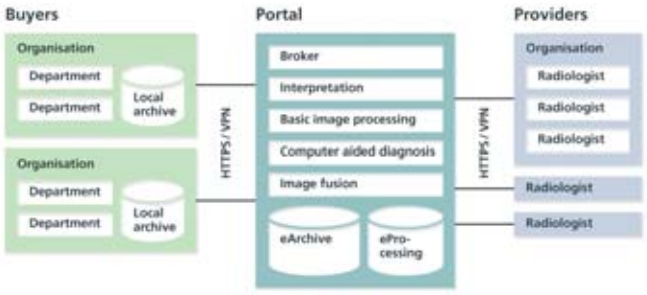

Fig. 3. eHealth marketplace

OVERVIEW OF THE HEALTHCARE SYSTEM IN ESTONIA

A Personal View

One of three Baltic states, Estonia covers an area of 45,227km², making it slightly bigger than Holland but with a population density ten times less. Estonia's population (1.34 million in 2006), has fallen by 13% since the collapse of the Soviet Union and its subsequent independence, due to emigration and a falling birth rate. Despite this, several success stories, e.g., continuous economic success and several e-initiatives (e-government, country-wide PACS etc.), provide hope for future growth.

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About fifteen years after reobtaining independence, Estonia underwent radical economic reforms and widespread privatisation. A balanced budget, flat-rate income tax, a free trade regime, a fully convertible currency and a competitive commercial banking sector induced a massive influx of western investment during the 1990s and changed the economic orientation quickly. Successful monetary reform and the union with NATO and the EU led to further economic viability. However, some left-wing opinion leaders say that rapid economic success has pushed social security and welfare to the backburner.

Economic Growth and a Penny-pinching Healthcare System

The 2001 Health Services Organisation Act specified that healthcare providers in Estonia would operate as private entities under private law. The aim of this policy was to decentralise hospital management but still preserve public influence through hospital supervisory boards. Therefore the majority of hospitals could be considered as public institutions. Primary care is mostly provided by family doctors (self-employed entrepreneurs).

13% of healthcare is funded through payroll tax, collected by the National Health Insurance Fund. During economic growth periods this guarantees a permanent increase of healthcare funding and reduces danger from political fluctuations. A simultaneous "separate and independent flow of health money" permits the Ministry of Finance to keep a distance from healthcare financing troubles. Therefore the share of healthcare costs arising from GDP in Estonia has remained around 5 - 5.4% for years, a lot less than the EU average (see fig. 1). The Ministry of Finance has set the goal to reach the 6.5% target by the year 2050.

Healthcare Pays the Price of Cost Containment Measures

In spite of the efforts of the medical community to increase funding for medical care, the ruling governing coalition prefers "Milton Friedman's liberality and the doctrine of the thin state". The Chairman of the National Health Insurance Fund has stated that "The Estonian healthcare system is the most cost-effective in Europe". However, this cost-effectiveness is mostly achieved by forced low-price service contracts and strict budget constraints. Managers of surviving hospitals have to improvise ingeniously, cut costs, avoid unnecessary treatment, overdevelop profitable services and postpone investments into infrastructure and hospital buildings. For example, due to low-priced outpatient services in public hospitals (each twenty min. specialist consultation costs approximately 10 Euro), there is no incentive to reduce waiting lists and patients are often forced to appeal to private institutions.

Another example of health cost containment for the state is the DRG policy. Hospitals are paid on the basis of fee for service, in general. This principal has been corrected by the "DRG-type" formula since 2004.

DRGs would in theory provide appropriate incentives to control costs and improve healthcare provision. Actually the DRG-formula in Estonia was introduced in quite a peculiar way, not offering incentives for care providers. Clinical fields are non-uniform and endure wide cost variance. For major hospitals the introduction of DRGs has resulted in a 3% loss of remuneration. Usually these losses are compensated by "counteractions" like service overproduction and cost inflation. This Machiavellian strategy means that while the ultimate objectives of DRGs are not attained, at least these fuzzy payment methods enable the Health Insurance Fund to control expenditures.

Radiology in Estonia

Compared with other medical services, radiology and other diagnostic procedures are relatively fairly priced.

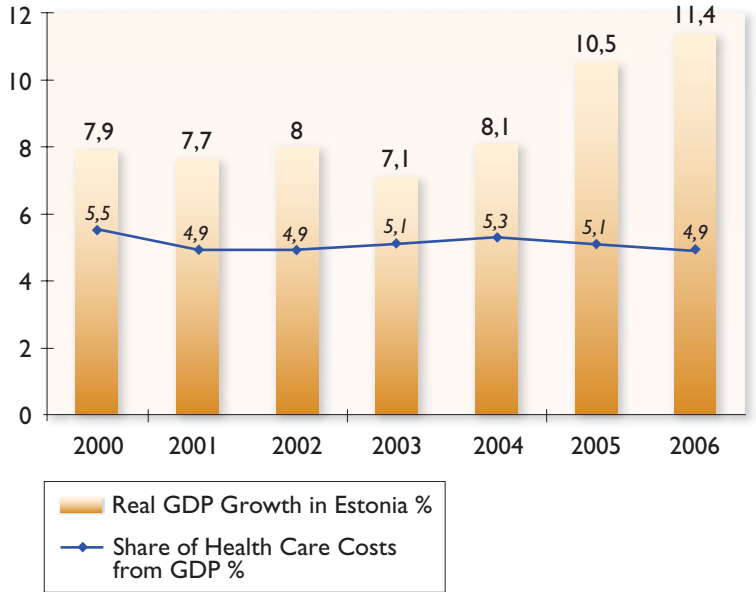

Fig. 1: Real GDP Growth and Share of Health Care Costs from GDP (%) in Estonia 2000-2006

The Estonian Society of Radiology has lobbied hard on this issue for years, enabling coverage of basic radiological needs in Estonia. The most common diagnostic procedure is still x-ray. In 2004, 750 x-ray exams and 351 ultrasonographies were made per 1000 population.

Modern computerised and more informative studies are also on the rise. The number of CT studies doubled during 2000 - 2004 (from 23 to 59 per 1000 population). A continuous increase in computerised studies is also expected in the future. In 2006, a boom in CT was noticed: five county hospitals of fourteen purchased their first new CT. Now there are 13 CTs per million in Estonia, above the European average (12). There are 2,3 MRI units per million, six times less than in neighbouring Finland.

60% of radiology departments are using digital radiography systems (mostly CR). Digital systems are preferred due to teleradiology opportunities and universal access to nationwide PACS. An archiving price of one Euro per study is generally considered affordable by image producers. Family doctors have free access to all studies of their patient list.

Brain Drain in Estonia

The relatively low wages of medical personnel in Estonia and free movement of labour in the EU has led many doctors to neighbouring countries. Among other specialists, radiologists are in high demand. By some estimations 25% of medical students emigrate after graduation for residentship. To protest against underfinancing of healthcare and low wages, in January 2007 the Estonian Medical Association, which represents about half of all Estonian doctors, and the Estonian Nurses' Union took strike action to combat the government's reluctance to enter into negotiations. Fortunately the strike was avoided by negotiations and a 25% increase of the minimum wage was achieved. Due to high inflation rates and favourable market trends for medical professionals, similar actions may arise next year.

New developments in PACS and an open teleradiology market offer alternative options for radiologists despite questions of trust and medical malpractice liability still remaining unanswered. Several radiology departments in Tallinn offer diagnostic services to Denmark and the UK. Work is hard, but worth it - why not export services and stay at home with one's family?

Conclusion

Estonia has bravely entered the European community. Due to its small size and bold political decisions, the country enjoys stable and dynamic economic development. In spite of economic success, healthcare professionals feel neglected and are expecting more proportional attention and further investments.

DEVELOPING RESEARCH IN ESTONIAN RADIOLOGY

New Strategies Ensure Consistent Growth

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The University of Tartu, founded in 1632 is a national university in Estonia uniting different branches of science. The Faculty of Medicine in the University of Tartu is the only faculty for medical education in Estonia including radiology. Research and teaching are the major activities of the Faculty of Medicine and the Foundation University of Tartu Clinics. Its mission is to advocate for a highly-educated Estonia through internationally acclaimed research and the provision of research-based higher education. Due to the small size of our country, in order to develop radiology, we have had to implement several strategies to develop the academic, clinical and biomedical environment for research with close cooperation between domestic and foreign partners. This is to ensure that we are keeping pace with development across the globe. This article covers the steps we have taken to carry this out.

The department of radiology aims to guarantee academic sustainability which must be achieved by employing the best Estonian and foreign researchers in the radiology at the university of Tartu. Its main goals are to:

1. Make academic careers more attractive for junior radiologists, researchers and residents, and motivate them to consider this path;
2. Connect doctoral studies closely with university teaching to create a new generation of academic staff - career possibilities must be made clear to young specialists;
3. Raise the income level of academic staff. The low income level of academic staff and doctoral students compared to radiologists in clinical practice is one of the reasons why young specialists do not choose an academic career;
4. Provide individuals in academic posts with experience at a foreign institution when elected to academic posts; and,
5. Increase the proportion of members of the academic staff from abroad and support their involvement in the teaching and research of radiology in Estonia.

Status of Radiological Research

Research and teaching are, by necessity, closely connected. Due to Estonia's small size, there are only a few persons involved in research and teaching in radiology, with only two positions in the department of radiology. The department of radiology is led by the Professor, or 'Docent', who is responsible for the development of radiology in Estonia, for teaching radiology and resident training in the University of Tartu and who must be the leader of research in radiology. A senior assistant is also responsible for resident training. Other positions are filled by the senior radiologists from the Foundation University of Tartu Clinics, who are also involved in teaching students and radiology residents. Altogether there are only three radiologists in Estonia who have PhD degrees able to apply for grants and lead research projects. Only one of them now works at the University of Tartu. To bolster these low numbers, a guest professor is also nominated from abroad. Since September 2006, Professor H. Aronen from the University of Turku, Finland is working here in this capacity.

Young Researchers Give Hope for the Future

Due to the lack in Estonia of our own supervisors for doctoral studies, several Estonian doctoral students are sent abroad to outstanding research centres in radiology in different countries, for example to the Karolinska Hospital, Sweden, the National Hospital, Oslo, etc. There, young researchers in radiology get supervision and funding to fulfil their research plans and increase their experience.

It is to be hoped that these young researchers will inject new life, after returning to Estonia, using new

experiences in clinical practice and developing their own research projects in Estonia. Only with a strong competitive edge and an international focus in research and tuition is the development of the University of Tartu as an outstanding research centre, possible.

Developing Research Projects in Estonia

Several projects in radiological imaging in Estonia are based on cooperation with other clinical specialties. A long-standing cooperation connects research in radiology and neurology, oncology, paediatrics, neuropaediatrics, intensive care, rheumatology and orthopaedics. All these studies were funded nationally through different governmental grants.

The basic system for initiating clinical research studies in Estonia is to get approval from the Ethical Committee of Human Research in the University of Tartu. The committee includes physicians, lawyers, social workers, philosophers and priests. They evaluate the ethical and juridicial aspects of the scientific value of the study and suitability of the planned research in humans. The evaluation is separated from the working place and the researchers. The Ethical Committee is based on the convention of human rights and biomedicine of the European Union (1997), other international documents of bioethics and Estonian legislation. The aim of the committee is to guarantee the human rights and the health of the research subjects.

Types of Research Funding

The Estonian Ministry of Education and Research is responsible for the planning, coordination, execution and surveillance of research and education policies. The Estonian Research Council is an advisory body to the Minister of Education and Research, members of which are nominated for three years by the government. The council is supported in its activities by nine expert groups. The channels of the Estonian research and development financing funding system are:

1. Targeted financing;
2. Baseline funding;
3. Research grant funding (the Estonian Science Foundation);
4. National research and development programmes; and,
5. Funding of research and development infrastructures.

Targeted financing is decided by the Minister of Education and Research following the recommendation of the Estonian Research Council. The aim is to ensure a competitive basic structure for scientific research. Open to all fields and all research groups , both basic and applied research is funded. The Estonian Research Council organises the peer-reviewing of submitted applications and advises the Minister on opening funding for new research themes and the continuation of funding for previously approved ones. The funding period for approved research topics is up to six years, subject to periodical assessment of progress. The Estonian Research Council also makes proposals concerning the covering of infrastructure expenses of research and development institutions. 34 new research topics with a total budget of 58.54 million kroons were approved for targeted financing in 2007.

Baseline funding is a new instrument, introduced in 2005. The purpose is financing research institutions on the basis of research quality in order to support the development and initiative research of institutions. Also, it is aimed for co-financing of cooperation projects, international and local, between academia and industry.

Estonian Science Foundation & Research

The Estonian Science Foundation (EstSF), established in July 1990 by Estonian Government, is an expert research-funding organisation. Its main goal is to support the most promising research initiatives in all fields of basic and applied research. The EstSF uses state budget appropriations to award peer-reviewed research grants to individuals and research groups on a competitive basis. The purpose is primarily to support high-level initiative research, new ideas and studies. Project applications are evaluated by expert commissions and approved by the EstSF Council. In the year 2007 EstSF is financing 630 research projects - 144 new and 486 continuing. The overall sum of granting in 2007 is 101.6 million kroons.

Guidelines for a Knowledge-based Estonia

At present the main guideline and document for Estonian Research and Development policy is

"Knowledge-based Estonia", the Estonian Research, Development and Innovation Strategy 2007-2013, which was approved by the Estonian parliament in February 2007. The strategy outlines the aspiration of Estonia to become a knowledge-based society where research and development are valued highly as one of the preconditions for the functioning and development of the entire society. Key principles of the policy is to promote high-quality and internationally competitive research with focus on human potential and infrastructure which can create high economic surplus value.

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RADIOLOGICAL TRAINING IN ESTONIA

European Training Charter Brings Changes

The majority of physicians working in Estonia are graduates from the Faculty of Medicine at the University of Tartu. Until the mid-1970s, it was necessary to complete a full six years of studies in order to be an authorised medical practitioner. Following this training, a few postgraduates were then eligible to receive short intensive specialised training in Tartu University Hospital or in leading medical centres of the former Soviet Union, to become radiologists.

Since 1970, postgraduate training has been given more emphasis. At first, one year of general medical postgraduate training (internship) was introduced, which could be followed by up to one year of specialised medical training, for example in radiology. It was still possible to gain practical experience by working under the supervision of a skilled senior radiologist after a six-month specialised course, rather than through systematic training.

How has Training Evolved?

This system was felt to be highly unsatisfactory and in the mid-1990s, postgraduate radiology training was extended to two years. Since 1995, in order to become a medical specialist, obligatory postgraduate medical training (residency) was introduced by law in Estonia. Since 2003, because of the reformed curriculum for undergraduate studies, it is possible to enter residency training directly after six years of studies in the University of Tartu. However, these days the duration of radiology residency in Estonia is still for four years. The adjustment of our radiology training programme with the European Training Charter for Clinical Radiology is in progress and we are building up to full compliance with the ideal five-year radiology residency by 2008.

The integrated radiology residency training programme is carried out in the best facilities in Estonia under the supervision of the top specialists in the profession. The residency is based at major teaching hospitals in Tartu and Tallinn such as Tartu University Hospital, the North Estonia Medical Centre, the East Tallinn Central Hospital, the West Tallinn Central Hospital, Tallinn Diagnostic Centre and Tallinn Children's Hospital. Tartu University Hospital and the North Estonia Medical Centre are tertiary referral and trauma centres.

In addition to developing practical professional skills and experience while performing procedures and investigations, the residents have to participate in theoretical courses, conferences, and clinical rounds and educate themselves with the help of scientific literature. There are no tuition fees for residents during the residency. Residents are paid monthly salaries of about 13,000 Estonian kroons (approx 800 Euro) according to contracts signed with hospitals for their training period.

The compulsory training duration is 32 hours per week (including lectures, seminars, other training events and being on duty and/or on call), but devot-

ed trainees do not count work hours minute by minute. If residents of the 2nd training year and/or older perform radiological work, additionally to their 32 hours per week, as assistant radiologists they may get paid fairly generous additional financial compensation for these duties.

National Organisations

In Estonia, the Ministry of Education and Research provides financial means for education for the number of specialists ordered by the Ministry of Social Affairs. The total number of state-funded residency places and their allocation per specialty is established in the national residency places commissioning agreement. The Council of the University of Tartu approves the maximum number of residency applicants per year to be accepted for radiology training, as well as other specialties. The number of residents is determined by considering propositions of the Faculty of Medicine in common with recommendations by the Estonian Society of Radiology according to prospective national healthcare strategies and social demand. In recent years, an average number of seven radiology residents are accepted every year.

Performance Assessment in Residents

A regular dialogue between trainer and trainee is significant in order to monitor progress and to mend any weak points that may manifest. For that purpose an assessment process is instituted during the clinical radiological training programme. Written assessments of the residents are completed by trainers at the end of each rotation cycle. Evaluation is based upon the resident's performance in achieving stated objectives in the general competencies like medical knowledge, patient care, professionalism, interpersonal and communication skills, and systems-based practice.

Residents are responsible for maintaining an electronic procedure logbook for all clinical radiological activities such as the number of clinical examinations performed by the resident and are a permanent part of the resident's record. A written computer-based exam is required of first year residents, and for third and four year residents, an oral examination.

Management and Administration Training

Responsible administration and management, balanced workflow and appropriate technical support are very important requisites for a smoothly functioning department.

Regrettably, the current radiology residents' training programme in Estonia is too short to disseminate sufficient knowledge of the principles of administration and management applied to a clinical department with multi-disciplinary staff and high-cost equipment.

During four years of residency, the emphasis is on obtaining core knowledge of diagnostic radiology. In the near future, five-year training is going to be introduced. With that, there will also be more time for management training.

Resident Workloads

The radiology residency in Estonia offers strong academic training in general diagnostic radiology. In the four-year curriculum, in the first year the resident's time is distributed in those areas in which she or he must become acquainted to become competent in basic radiology skills. These four to eight week rotations include introduction to chest, gastrointestinal, urogenital, emergency and musculoskeletal radiology, nuclear medicine, ultrasound, computed tomography (CT), vascular and interventional radiology, and MRI.

In the first year of training residents also acquire the necessary knowledge of the basic sciences such as the physical basis of image formation in all imaging modalities, picture archiving computer systems (PACS), radiology and hospital information systems (RIS, HIS), quality control, radiation protection, radiation physics, radiation biology, anatomy, physiology, the pharmacology and application of contrast media. Didactic lectures, seminars and case conferences help the new resident assimilate the large volume of new material. From the first year of training, residents participate twice a month in calls with an experienced radiologist.

In the second and third years of training, the resident will spend one or two additional months in each area each year including mammography, paediatric radiology, neuroradiology and all the other organ-based rotations. During the second and third years the resident will progressively move closer to the goal of being able to work unaided, an ability expected of all the fourth year residents.

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- The use of information technology: PACS, the electronic patient record, electronic requesting and feedback of results, speech recognition, etc.
- Teleradiology & outsourcing of imaging and reporting
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- Management improvement strategies
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- Topics related to all aspects of management in imaging today

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HOW TO...
ENSURE PATIENT SAFETY IN DIAGNOSTIC IMAGING

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While the adage "if it ain't broke, don't fix it" may apply nicely to auto repair, this philosophy is highly inappropriate in medicine for reasons we will explore in this article. While many in medical practice, at least in the United States, are still waking up to the reality of medical error, this has not yet filtered down to radiology. The questions are: What about radiology has led to a lack of emphasis on patient safety? What strategies can be employed to bring radiology practices in line with more global efforts in patient safety?

Patient safety in diagnostic imaging has been under-emphasised for a number of reasons. Firstly, the highly technological emphasis of the specialty has a result of rapid advances in medical imaging, have directed attention more towards applications than potential safety issues. Moreover, with the advent of advanced digital imaging techniques and archiving (PACS), the widespread availability of image data has reduced the person-person contact or verbal exchange of information that often gives additional insights into nuances of patient care.

Also, there are fundamental differences in the patient-doctor interaction in radiology versus other healthcare professions. Radiology has traditionally engendered a close specialist-to-specialist relationship with limited patient contact. The radiologist's most recognised responsibilities, imaging performance, interpretation, and communication, do not intrinsically have a direct connection with the patient. Also, it tends to fall to clinical healthcare providers to interact with patients concerning diagnostic study findings. The resulting distancing of radiologists from patient contact has meant that patient welfare may not be as paramount as in other areas in the hospital.

In addition, typical safety efforts in radiology have been mainly focused on reducing complications or errors in interventional radiology, minimising radiation exposure or IV contrast media complications, and optimising sedation-related care, especially in paediatric radiology. In reality, the scope of patient safety goes well beyond these provincial focuses.

Is "Culture of Blame" a Cause?

In the midst of technological advances, we must also remember that the delivery of healthcare entails people taking care of people. Healthcare professionals, though intelligent, highly trained and dedicated, are human beings, and therefore fallible. The traditional culture of medicine is one that does not accept mistakes, often referred to as a "culture of blame". When a mistake occurs, especially one that results in harm or death to a patient, the answer is often to assign total responsibility to the healthcare professional, even before completing a thorough investigation of the event.

We are beginning to better understand the concept of "systems issues" in healthcare. Thorough investigations conducted after an adverse event often reveal systems problems that, if not addressed, lead to the possibility of a repeat adverse event. For example, if "look alike" medications are stored side by side on the medication cart, a nurse might inadvertently pick up the wrong medicine at the time of an emergency, with potentially lethal results.

> ***"The responsibility of the radiology team extends beyond a properly performed, interpreted, and archived exam"***

Firing one nurse will not prevent a second nurse from making the same mistake. The answer is to change the system: to seperate look-alike medications from the top of medication carts where they can be easily confused.

If a simple human error occurs the healthcare provider should be consoled and the system fixed. If a provider chooses to bypass a basic safety policy (e.g., double identifier), the provider should be educated, coached and mentored, leading to an understanding that the behaviour cannot be repeated. Thus, providers are held accountable for their actions, while organisation leaders are accountable for system fixes.

Elements of a Comprehensive Safety Programme

The first step is recognising that patient welfare, and not merely diagnostic accuracy, is the duty of the radiologist. Also, a more global, interdisciplinary programme of patient safety should be developed (see fig. 1). A number of institutions, including our own, have developed safety programmes comprised of committees or teams at a local level, including radiology. These teams consist of individuals involved in patient care, including technologists, transporters, and coordinators.

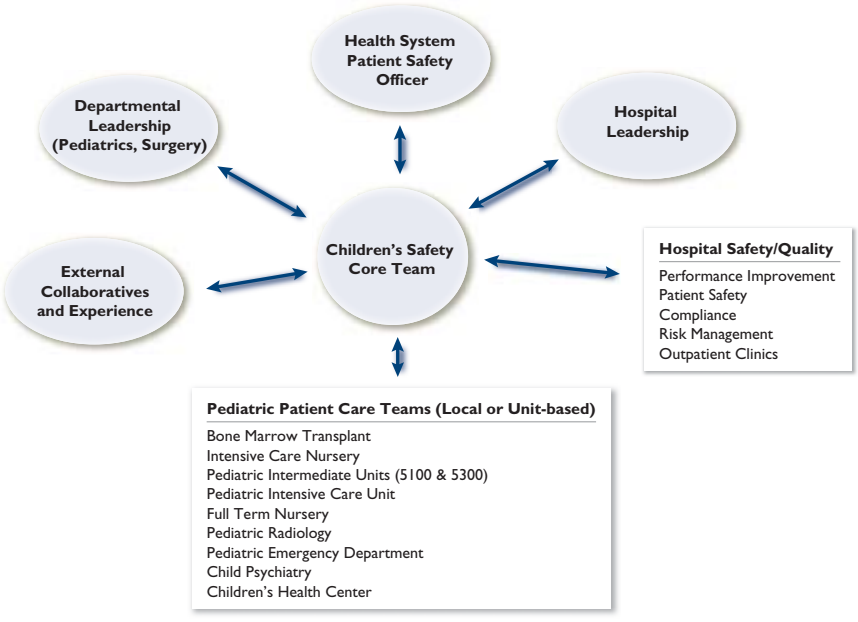


Fig. 1: Formal Team Structure; Duke Health System

Regular team meetings, with incorporation of "walk rounds" (a proactive risk assessment of facilities and personnel functions within these facilities) help to identify potential sources of errors or unsafe practice as well as facilitating communication and a shared investment in the programme. Again, the responsibility of the radiology team extends beyond a properly performed, interpreted, and archived examination. Thinking must not be restricted to the traditional concepts of contrast reactions, radiation protection, etc., but must also take into account issues such as prevention of falls, imaging the pregnant patient, potential hazards of equipment or materials in the rooms.

In addition, these types of programmes have facilitated improved systems of communication between the various personnel in the department. That is, not a "top down" system of review and appraisal where an administrator deems that there should be some measure of increase in safety development, but rather the same administrators actively take part in the programme with all individuals in the department. Every voice is given weight and each individual can contribute important safety information. In this way, many potential problems have been identified, by those individuals "in the trenches".

An extended version of this article, with all references included, is available upon request to Managing Editor, Dervla Gleeson (editorial@imagingmanagement.org)

THE BELGIAN MUSEUM OF RADIOLOGY

Interview with Curator, Dr Rene Van Tiggelen

INTERVIEWEE

Dr Rene Van Tiggelen
Curator
Belgian Museum of Radiology
Brussels, Belgium
info@radiology-museum.be

Why did you decide to launch a museum of radiology, and what were the challenges in doing so?

I am also a great admirer of Professor Röntgen's, who did not take out any patent for his discovery and in 1901, after being awarded the first Nobel Prize of Physics, reassigned its whole amount to his Alma Mater at Würzburg, Germany.

The originality of the museum lies in the fact that it was born inside a department of radiology. I wished my patients to be intelligently occupied while in my waiting room. I also wished to somewhat alleviate their anxieties by telling them the history of their forthcoming exams. Also, as a military radiologist, I had collected some downgraded radiological equipment in order to train military radiographers. This is how the idea of the Belgian Museum of Radiology took shape.

In 1995, I took the opportunity of the celebration of the centenary of Röntgen's discovery to expand the collection. My superior at the time, the General L. Viaene (Medical Corps) supported the project. Since its creation in 1990, the collection was enhanced by the acquisition of civilian radiological material. Progressively, some colleagues donated obsolete installations. Others gave the equipment belonging to a parent or a predecessor which was cluttering up their suites.

When I started, I benefited from the Army's premises and from its logistical support, but financial resources were non-existent. This is why in 1996 I decided to create the Friends of the Belgian Radiological Museum Association. The subscriptions of its faithful members ensures the organisation of two meetings per annum devoted to a specific topic, one in spring and one in autumn. Otherwise the museum relies heavily on the volunteers' shoulders.

Are there many special radiology museums across the world?

There are in fact only a few museums of this kind in the world. In Germany is the Remscheid-Lennep Museum (*www.roentgen-museum.de*), one at Würzburg (*www.fh-wuerzburg.de/roentgen)*, and one in Palermo, Italy (*www.unipa.it/~radpa/museo/museo.html*).

Do you have many visitors to the museum?

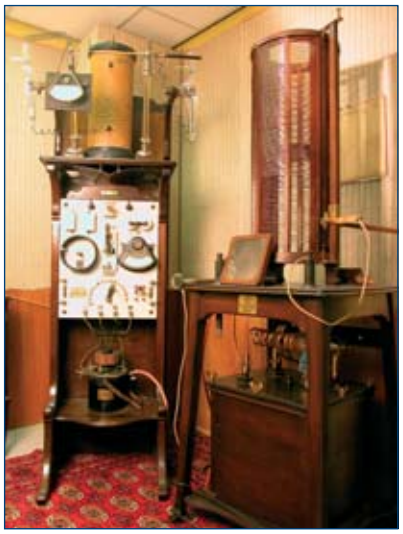
Demand for the museum is fairly large. There is a significant amount of visitors. No entrance fee is asked for the individual. Guided tours are charged a small fee. These guided tours are mainly organised for groups of nurses, radiographers in training or radiology registrars, as well as for historians, senior citizens and even small children who often ask surprisingly pertinent questions. Some radiologists include a visit to explore a peer's assessment of their staff.

What kind of special activities or initiatives does the museum organise?

Some exhibitions have been very successful, i.e., "Radiology and Women" and "Radiology and the Nobel Laureates. In 1995 we mounted an exhibition, organised a couple of meetings, edited a stamp and published a book recounting the history of a hundred years of radiology. Among our publications, one of my favourites concerns the "rediscovery" of x-rays and comes with a DVD. Röntgen demanded all his notes about his researches be burned after his death, but we tried to reconstruct the discovery of the x-ray the way it probably happened. The museum's website (www.radiology-museum.be) receives a large amount of visits and allows us to establish many fulfilling relationships with foreign visitors.

What are some of the more "curious" or interesting pieces on display?

In our museum we display the first (seventh in the world) scanner installed in 1974 in Charleroi, Belgium in Prof. M. Collard's department (see picture). A computer is used to store the subsequent tomographic images, improve or colour the images electronically and reproduce the images in sequence afterwards. It results in in-depth images of the various body tissues allowing the diagnosis of lesions and the follow-up of applied medication and treatments.



First Scanner Installed in Belgium

Linking computers and tomography was achieved during the research work carried out in the 1970's in England by Prof G. Hounsfield and Prof. A. Cormack. Their work was sponsored by the firm EMI, producer of the very successful group The Beatles. The computer was developed during World War II for deciphering the coded messages of the German and Japanese armies.

Where do you source your artefacts from? Have there been any notable donations?
Almost all the artefacts have been offered to the museum. Only a couple of items have been purchased. The Royal Belgian Society of Radiology and the Professional Association of Radiologists gave us the financial means necessary to acquire a radiological installation dating from 1904 (mobile equipment probably used by the "Force Publique" in the former Belgian Congo.)

The "new" portable radiological equipment, is described as follows in the "Archives d'Electricité Médicale": "*The equipment is made up of three boxes: The first one, a weight of 29,5 kg, contains a 23 cm spark coil with atomic contact breaker, a spintermeter, an ammeter and a-periodic voltmeter, a current inverter, a switch, and fuses. The second box, a weight of 20kg, contains: a 24 x 30 cm fluorescent screen in foldable darkroom, a tube stand, a 30 x 40 radiography frame, a series of double envelopes, a gas blowtorch with rubber pipe, a spirit lamp, a chromoradiometer of Benoist, a Chabaud type tube with osmotic regulation and a classical tube, two well isolated wires. The third box of weight 19kg, contains six batteries of 20 Amp-hours, capable of making the coil working for 4 consecutive hours. Thanks to the low weight, the high power and the relative compactness, this equipment deserve to be quoted among the improvements of this type of apparatus*". (Description of E. Dupont : Médecin de Bataillon .Arch. Méd Belg 1905, 1:317-319.).

Another installation dating from 1907 was offered by the Friends of the Museum. This widely-distributed "Art-Nouveau" model, elaborated by A. J. D'Arsonval, (France, 1851-1940) and manufactured by G. Gaiffe (France 1857-1943).

continued from p.18

The QUDI Liaison Radiologist position was created to:
- Establish and manage a national out reach strategy to inform radiologists on the activities of the QUDI programme.
- Lead the QUDI Advisory Committee, manage the QUDI Technical Reference Group and assist in revision of project briefs and the design of new projects.

Project Development

Input into project development is actively sought from members of RANZCR and other interested parties through a number of mechanisms. The concepts are subject to a thorough workup through to release of a project brief. Proposals are received from interested investigators (who may be commercial consultancies, academic organisations or research groups or individuals). After thorough standardised evaluation, the projects are commissioned and funded. There is ongoing monitoring of the projects through quarterly reports.

Dissemination Strategies

The results of projects are reviewed by college fellows led by the TRG and then:
- Published on the RANZCR website (*www.ranzcr.edu.au*).
- Summarised in the QUDI e-newsletter.
- Presented at the annual QUDI research seminar.
- Presented at national and international meetings.
- Published in the literature.

The strength of the programme is its ability to provide a structured and fully-funded means of systematically addressing quality issues in radiology. It impacts the practice of radiology by:
- Informing standards of practice;
- Providing evidence for RANZCR policy development;
- Informing and influencing government policy;
- Informing practicing radiologists and referring medical practitioners; and,
- Informing consumers and patients about the role, practice and outcomes of quality radiology practice.

Further details of the programme can be found by contacting Programme Director Ms Jane Grimm **qudi@ranzcr.edu.au** or visiting the RANZCR website *http://www.ranzcr.edu.au/qualityprogrammes/index.cfm.*

Key Seminars & Conferences

SEPTEMBER 2007

8 – 12 CARDIOVASCULAR AND INTERVENTIONAL RADIOLOGICAL SOCIETY OF EUROPE (CIRSE) ANNUAL CONGRESS
Athens, Greece
www.cirse.org

10 – 12 27TH ANNUAL BREAST IMAGING CONFERENCE
Athens, Greece
www.cirse.org

12 – 14 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

17 – 18 BIOLOGICAL EVALUATION OF MEDICAL DEVICES
London, UK
www.management-forum.co.uk

21 - 24 MRI IN PRACTICE
Antwerp, Belgium
www.aaedpro.com

22 THE EVOLUTION TO ALL-DIGITAL RADIOGRAPHY
Wisconsin, USA
www.mtmi.net/seminars/evolution.php

OCTOBER 2007

4 – 6 ESMRMB SCHOOL OF MRI – ADVANCED COURSE ON BREAST & PELVIS MR IMAGING
Madrid, Spain
www.esmrmb.org

4 – 6 16TH EUROPEAN SOCIETY OF PAEDIATRIC RADIOLOGY CONGRESS
Mainz, Germany
www.espr.org

7 – 11 17TH WORLD CONGRESS ON ULTRASOUND IN OBSTETRICS & GYNAECOLOGY
Florence, Italy
www.isuog2007.com

10 – 13 MANAGEMENT IN RADIOLOGY (MIR) ANNUAL CONGRESS
Oxford, UK
www.mir-online.org

13 – 17 2007 ANNUAL CONGRESS OF THE EUROPEAN ASSOCIATION OF NUCLEAR MEDICINE (EANM)
Copenhagen, Denmark
www.eanm.org

15 – 17 8TH INTERNATIONAL SYMPOSIUM ON VIRTUAL COLONOSCOPY
Boston, United States
http://www.bu.edu/cme/seminars/VC07/program.html

18 – 20 EUROPEAN SOCIETY OF CARDIAC RADIOLOGY (ESCR) 2007 ANNUAL SCIENTIFIC MEETING
Rome, Italy
www.escr.org

23 – 24 INTRODUCTION TO THE MEDICAL DEVICES DIRECTIVES
London, UK
www.management-forum.co.uk

24 – 27 EUROSON 2007 19TH CONGRESS
Leipzig, Germany
www.euroson2007.de

NOVEMBER 2007

14 – 17 MEDICA ANNUAL TRADE FAIR
Dusseldorf, Germany
www.medica.de

25 –30 RSNA ANNUAL CONGRESS
Chicago, USA
www.rsna.org

DECEMBER 2007

13 – 16 30TH ANNUAL SAN ANTONIO BREAST CANCER SYMPOSIUM
San Antonio, TX, USA
www.sabcs.org

FEBRUARY 2008

1 – 4 MRI IN PRACTICE
Sydney, Australia
www.aaedpro.org

MARCH 2008

7 – 11 EUROPEAN SOCIETY OF RADIOLOGY (ESR) ANNUAL CONGRESS
Vienna, Austria
www.myesr.org

15 – 20 2008 SOCIETY OF INTER - VENTIONAL RADIOLOGY (SIR) ANNUAL SCIENTIFIC MEETING
Washington, DC, USA
www.sirmeeting.org

APRIL 2008

23 – 26 INTERNATIONAL SOCIETY FOR RADIOGRAPHERS AND RADIOLOGICAL TECHNOLOGISTS (ISRRT) 15TH WORLD CONGRESS
Durban, South Africa
www.isrrt.org

JUNE 2008

5 – 8 25TH INTERNATIONAL CONGRESS OF RADIOLOGY (ICR)
Marrakesh, Morocco
www.icr2008.org

10 – 13 EUROPEAN SOCIETY OF GASTRO-INTESTINAL AND ABDOMINAL RADIOLOGY (ESGAR) 2008 ANNUAL MEETING AND POSTGRADUATE COURSE
Istanbul, Turkey
www.esgar.org

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