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

MOBILE INFORMATICS IN RADIOLOGY: TRANSFORMING WORKFLOW

Latest Advances in 3D Imaging | Medical Imaging in Germany | MIR 2006 Congress Review | Guide to Staff Management

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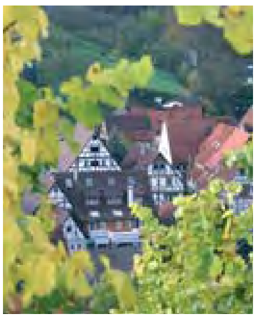

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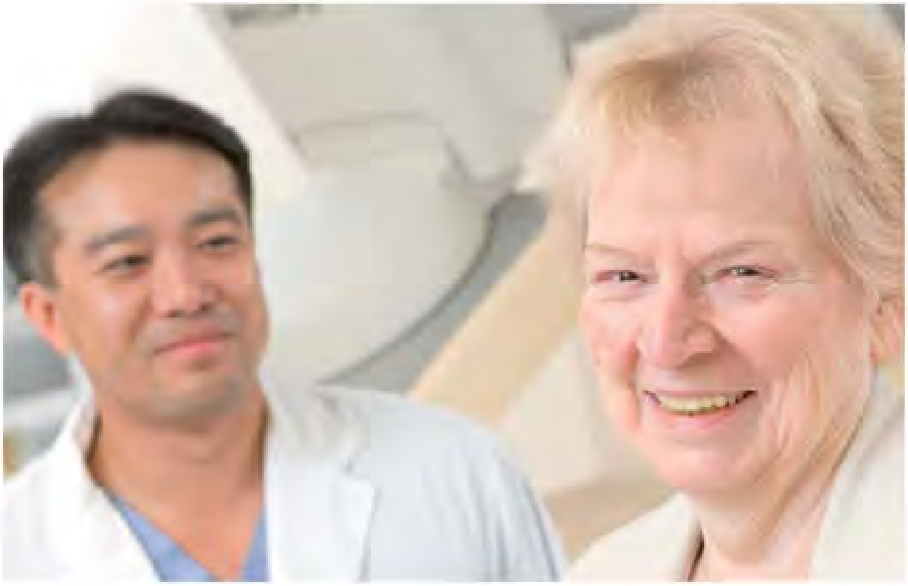

William Siu, M.D. and Vivian Shepherd

"I've been given a second chance."

Neuroradiologist uses the Philips Allura Xper FD20 interventional angio lab to visualize the finer details of life.

Retired health care worker, Vivian Shepherd, doesn't recall much of what happened on Saturday, December 4, 2004, other than she started the day making pancakes for her three granddaughters only to wake up hours later in the recovery room at Royal Columbian Hospital (RCH), New Westminster, B.C., Canada. Missing from the 76-year-old grandmother's memory is the moment she collapsed and fell to the kitchen floor, the frantic call for help made by her then 9-year-old granddaughter, and the ambulance ride to RCH. The hours that followed were a blur as she faded in and out of consciousness.

"When Mrs. Shepherd arrived at the ER, we determined that she had suffered a major stroke. She was paralyzed on the right side, unable to speak and obtunded," says William Siu, M.D., Interventional Radiologist, RCH. "I recall thinking how sad for this patient and her family to have this happen so close to Christmas. Fortunately, time and technology were on our side that day."

Following the hospital's acute stroke protocol, Mrs. Shepherd was rushed to Medical Imaging where a CT scan showed a clot in the left middle cerebral artery. That, along with her clinical picture, was enough for on-call Neurologist, Sheila Savedia-Cayabyab, M.D., Neurological Associates, to start intravenous thrombolysis therapy, and to consult with Dr. Siu for further evaluation for intra-arterial thrombolysis. "When you're dealing with a stroke patient, every second counts. The fact that Mrs. Shepherd got to the hospital as soon as she did was critical to her prognosis," says Dr. Savedia-Cayabyab.

With no time to waste, Dr. Siu and his team, using their new Philips Allura Xper FD20 interventional angio lab, performed an angiogram of Mrs. Shepherd's left carotid artery. "We saw a severe narrowing at the origin of the left internal carotid artery. After the narrowing there was an extensive blood clot in the carotid artery from the neck extending into the left middle cerebral artery. We performed angioplasty and stenting of the carotid artery to open up the narrowing and then advanced a microcatheter into the middle cerebral artery. We dissolved the clot by injecting t-PA, a powerful thrombolytic medication, through the microcatheter directly into the clot and restored blood flow to the left cerebral hemisphere. The procedure took less than 60 minutes, performing repeated angiographic runs without fail. A feat that would not have been possible with our previous angiography system."

According to Dr. Siu, visualization is key when performing neurological interventions. He credits the Philips Allura Xper FD20, installed just three weeks earlier, with Mrs. Shepherd's positive outcome, "There's no room for doubt when you're deep within the brain and feeding microcatheters a couple of millimeters in diameter through delicate and complicated vessels. "We chose the new Allura system because of its exceptional image quality. Its 2K by 2K imaging resolution and advanced 3D rotational angiography capabilities provide the detail and reliability we need to navigate complex vascular structures with precision, speed and confidence."

"When you're dealing with a stroke patient, every second counts."

Mrs. Shepherd says that while she's back to normal, her life has been forever changed. "Having a stroke smartened me up. It made me realize that I simply can't stress out. I wake up each morning and thank God I'm alive. I'm also thankful that I was the recipient of such great care and technology. I feel very privileged to have been given a second chance. I intend not to waste it."

For more information on this story and Philips Medical, go to www.philips.com/patientstories

PHILIPS
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Editorial

Mobile Imaging Informatics:
Transforming Workflow

PROF. IAIN MCCALL
EDITOR-IN-CHIEF
EIC@IMAGINGMANAGEMENT.ORG

Many healthcare facilities are committing a not inconsiderable amount of human, technical and financial resources, to the installation and implementation of mobile imaging informatics, providing remote access to exam reports, patient files and images that can be used to speed up reporting, queries and second opinions on diagnoses, as well as to improve access to research and teaching files.

Due to the radical changes brought about by these technologies, radiological images from modalities including CT, MR and digital radiography, can be sent to one central image acquisition and storage device. The same images can then be circulated between different workstations, patient suites, handheld PDAs and the internet, via mobile links.

With these transformations, radiology departments have the potential to gain considerable benefits. The implementation of mobile technology also has the possibility to free radiologists from their stationary computer terminals and workstations and allow them greater contact with patients, clinicians and other involved professionals. These developments must not, however, reduce the standard and quality of radiological care and must be implemented in a secure way for the benefit of the patient.

In this edition, our cover story focuses on the many areas of workflow that can be supported by integration of mobile informatics. We address not only the limitations of this kind of technology, but also the significant benefits. While the ultimate mobile tool for radiologists may not exist, there are many options that will aid radiologists to provide faster and more timely healthcare.

We welcome your thoughts and feedback.
Email your comments to:
editorial@imagingmanagement.org.

Prof. Iain McCall

HAVE YOUR SAY!

Letters to the editor at editorial@imagingmanagement.org

Prof. Iain McCall: Opening Address

Highlights of
MIR 2006 Congress

Management Issues Crucial to Radiology

More and more, radiologists are realising through gatherings like the recent 'Management in Radiology' congress (Budapest, Hungary, October 5 – 7 2006), that they risk the erosion of their profession as an entity if they fail to recognise the importance of good management practices to improve healthcare delivery. As well as many invaluable practical management insights from the wide range of presentations that took place, this was the main subject of discussion on the opening day: where will radiology be in ten years time? The conclusions drawn at the congress were disturbing and thought-provoking.

Prof. Iain McCall: Opening Address

"The annual Management in Radiology congress has proven very successful – international support has played a key role, and we welcome the many colleagues visiting from America and Australia. Initially set up by the late Prof. Ernest Mako, a superb radiologist who sadly died last year, we must offer sincere thanks to Prof. Palko and Prof. Mester from the Local Organising Committee for picking up the baton. Some of the main management challenges in radiology are rising globalisation with the advent of teleradiology, etc. as well as privatisation of healthcare services in the UK which brings growing challenges. MIR allows us to explore these to analyse patterns of healthcare delivery."

The End of Radiology as an Independent Specialty

One of the highlights of this year's congress was a provocative and very timely debate on the future of the radiologist. Opened by Dr Strickland, who argues against the future need for today's traditional general radiologist, with a move from modality-based focus to sub-specialist organ-based systems, she emphasised that this must be reflected in revised educational structures. Her vision for the future of the radiologist sees multidisciplinary meetings as loci where highly specialised radiologists make up part of a clinical team, which reflects a global knowledge of the whole clinical pathway.

Managing Imaging of the Future

This brought many further questions: How much general radiology education does a subspecialist need? Should there be fast-track specialist education for those who have made their choice early on? Is there any need for a general radiologist at all? Dr Strickland recommends the medical profession to implement important changes to education – ideally after the two general foundation years, post qualification as a doctor (already implemented in the UK), junior doctors choose an organ system which they specialise in for five years. One of the subspecialty disciplines within each organ system will match that of the imager. The advantages are streamlined patient service, reduced waiting lists, highly specialised equipment and expertise. Dr Strickland acknowledges that this shift may come with costs: a sub-specialist imager may miss a diagnosis related to a different organ system that a general radiologist would not – and it also brings the loss of radiology as a cohesive discipline. Nevertheless, she argues that the benefits for the majority of patients will far outweigh the occasional missed diagnosis. Dr Strickland predicts this

Prof. Paolo Pavone, Dr. Nicola Strickland

inevitable shift will happen in the next ten years, in which radiology as a profession will become fragmented into subspecialist imagers making up part of a clinical organ/body system specialised team.

Fighting Fragmentation of the Profession

Prof. Philip Gishen, in contrast, objects strongly to the 'giving away of the profession of radiology'. States Gishen, 'In the case of the UK, radiologists traditionally tend to be on a fixed salary, thus there is not such pressure on them to perform in comparison to radiologists operating on a payment by unit or payment by report system. This has the effect of removing the urgency with regards to protecting the role of the radiologist, who is paid the same whether some of the roles and responsibilities are moved to other specialists, e.g. passing reporting to the radiographers. Clearly the general radiologist still has a very valuable role to play, for example spotting mistakes and having a wider understanding of the patient's case history'.

Prof. Philip Gishen

A quick count of raised hands by Prof. McCall revealed that few in the audience believed the profession of radiology will still be integrated in the next ten years. The consensus was that the profession will evolve into a more specialised service. This raises the important questions: Will clinicians end up doing their own imaging? Should radiologists get more involved in primary care, dealing with the patient as a clinician or distanced as a service provider? As Prof. Andras Palko says, 'We live in interesting times'.

Future Congresses and Workshops

As of 2007, the administrative organisation of the annual MIR congress is being transferred to the central ESR office in Vienna under the guidance of Peter Baierl. Henrik Silber will organise the next meeting under new incoming MIR Chair, Dr. Nicola Strickland. Next year's MIR congress will take place in Oxford, UK, 10 – 13 October 2007, and will no doubt attract even more exciting debate and exchange of knowledge.

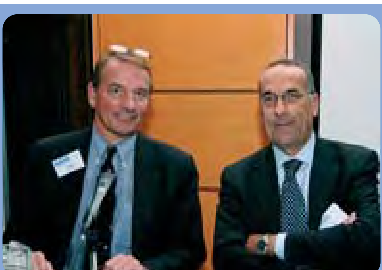
Prof. G. P. Krestin, Prof. Iain McCall

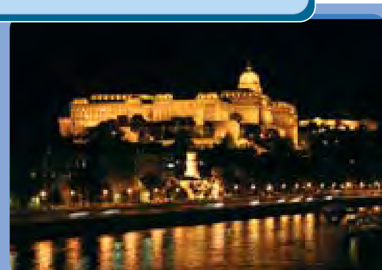
As part of its efforts to raise awareness of management issues, MIR is organising its annual workshop on 'The Art of Leadership' to take place in January 3 – 6 2007, in Gstaad, Switzerland. This course, which will be led by coaches Tony Poots (Director, Global Integration, UK) and Gerhard Pohl (GP Training and Coaching), will cover such issues as:

- Prioritisation
- Managing time
- Coping with stress
- Saying no
- Work/life balance

Find out more!

Photos from the congress can be viewed at www.imagingmanagement.org. Our next edition includes a cover story highlighting the top presentations from the congress.



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Association News

IHE Expansion Continues with New Domains Arising

There are four new integration profiles in trial implementation in the radiology domain in 2006:

1. Nuclear Medicine Image Integration Profile (NMI) with Cardiac Option is a change to the NM Image Profile, improving functionality for nuclear medicine cardiac image viewing.
2. Image Fusion (FUS) Integration Profile specifies communications between systems, creating and registering image sets and systems displaying fused images.
3. Import Reconciliation Workflow (IRWF) Integration Profile specifies how data importers obtain local demographics, coerce patient and procedure attribute values in the imported data and report progress/status of the importation process.
4. Mammography Image (MAMMO) Integration Profile specifies how DICOM Mammography images and evidence objects are created, exchanged and used. It describes how Acquisition Modalities transfer Full Field Digital Mammography (FFDM) images, how CAD systems act as Evidence Creators, and how Image Displays should retrieve and make use of images and CAD results.

From the IT infrastructure domain, there are two integration profiles which are particularly interesting to an imaging manager:

1. Cross-enterprise Document Media Interchange (XDM): provides document interchange using a common file and directory structure over several standard media. This allows the patient to use physical media to carry medical documents. This also enables healthcare providers to use person-to-person email to convey medical documents.
2. Cross-enterprise Document Reliable Interchange (XDR): focuses on providing a standards-based specification for managing the interchange of documents that healthcare enterprises have decided to explicitly exchange using a reliable point-to-point network communication. It is a natural complement to the IHE ITI XDS Integration Profile (for cross-enterprise document sharing) when a sharing infrastructure (repositories and registry) is not needed.

These new integration profiles will be tested during the European Connect-a-thon next Spring. During the last few months, IHE-Europe has defined a new governance model, which will reinforce its involvement in the development of new profiles, beyond its key role in laboratory and pathology. Based on a close cooperation with COCIR IT and INRIA, it will also consolidate the credibility of IHE, recently referred to in the European Commission report "Connected Health, Quality and Safety for European Citizens".

IHE Europe is also proud to announce the election of its new user co-chair Karima Bourquard. Karima Bourquard who is with the GMSIH and is also acting as IHE-F user co-chair, succeeds Prof. Berthold Wein of Aachen. Peter Kuenecke, Siemens is now fully in charge of the vendor co-chair position. The position was shared with Emmanuel Cordonnier of Etiam over the last year. IHE- Europe is grateful to Berthold Wein and Emmanuel Cordonnier for all the time and energy they spent in promoting the initiative in Europe and defending European interests in the technical committees.

WWW.IHE-EUROPE.ORG

Highlights from EuroPACS 2006

The EuroPACS conference is one of the largest gatherings of specialists in medical imaging and digital systems for eHealth. This year's edition, which took place in Trondheim, Norway, offered information on the latest and most significant developments in clinical practice, research and education within digital radiology. Physicians, radiologists, scientists and healthcare professionals from more than 30 countries around the world attended over a hundred scientific lectures. Abstracts and proceedings are now online on the EuroPACS website.

Highlights from the scientific programme included:

- PACS implementation & development in US
- Why do I need medical imaging?
- The future of radiology
- PACS in Europe –a platform and tool for integrated solutions
- Web-based PACS for all users
- Regional eHealth experience and concepts in Austria
- Sharing IT and human resources to create a multicentre radiology department
- Diagnostic imaging Electronic Health Record (EHR)
- Medical images and the future of medicine

WWW.EUROPACS.ORG

ECRI-AIMS Equipment Management System

ECRI-AIMS has announced a new system for managing all aspects of technology-based assets found in European and international healthcare institutions. It is a web-browser application, enabling data stored centrally by the hospital to be accessed via a web browser connected to the hospital intranet. There is no client software to install and ECRI-AIMS therefore can be used by personnel at all levels at any time.

The system provides a complete resource for managing equipment inventory information, work orders, service contracts, spare parts, purchasing and stock control in a secure, comprehensive package.

ECRI-AIMS has been specifically developed to meet the needs of European healthcare by ECRI, in partnership with Phoenix Data Systems Inc. In addition to the main system components, there are more than ten optional modules available. With the optional EasyNet PlusTM, equipment users can raise and progress requests for service and also view equipment lists and history information via a web browser.

Among the additional modules currently available are:

- Parts & Purchasing
- Service Contract Management
- Performance & Quality
- Advanced Preventive Maintenance
- PDA
- Resource Management

WWW.ECRI.ORG.UK

Joint Congress of CAR/ISCAS/CAD/CMI/EuroPACS

Computer Assisted Radiology and Surgery (CARS) have announced that the 21st International Congress and Exhibition will be held in Berlin, Germany, on the 27 – 30 June 2007. The deadline for the submission of abstracts is January 10, 2007. Topics will include the following:

- Medical Imaging
- Computer Assisted Cardiovascular Imaging
- Image Processing and Display
- Medical Workstations
- Image Guided Radiation Therapy
- Security, Legal and Ethical Aspects
- Clinical Applications and Evaluation
- Integrating the Healthcare Enterprise (IHE)
- Telemedicine
- Expert Systems and Computer Assisted Education
- Economic and Management Issues
- IMAC in Surgery, Pathology, Ophthalmology, Internal Medicine, etc.
- Inter- and Intra-hospital IMAC
- IMAC Healthcare Infrastructures for In-home Care

Further information is available on the CARS homepage.

WWW.CARS-INT.ORG

COMMITTEE OF THE REGIONS

Key Role of the COR

Ilze Raath
Editor European Affairs
europe@emceurope.com

The Committee of the Regions (COR) was created by the Maastricht Treaty in 1992 and provides a forum for local and regional authorities on issues affecting them. It is an advisory body that ensures public authorities are consulted on EU proposals of direct interest to them, especially as they are often responsible for implementing these policies. Its work is organised through six commissions that examine the details of proposals and then draw up a draft opinion, which highlights where there is agreement with the European Commission's proposals, and where changes are needed.

Members of the COR

The COR is made up of 317 members and 317 alternate members, representing local and regional government from the 25 Member States, as specified by the Maastricht Treaty. Consequently, members represent the whole sphere of sub-member state government throughout Europe, including regions, provinces, counties, municipalities and districts. The members and alternate members are appointed for four years by the Council, acting unanimously on proposals from the respective Member States.

Responsibilities of the COR

In 2001, the Treaty of Nice strengthened its democratic legitimacy by introducing the necessity for political responsibility of its members in their capacity as representatives of regional and local authorities. The COR was established to address two main issues. Firstly, seeing that three-quarters of EU legislation is implemented at local or regional level, it would make sense for local and regional representatives to have a say in the development of new EU laws. Secondly, there were concerns that the public was being left behind as the EU was busy expanding and increasing its power. By involving the elected level of government closest to the citizens, the gap was being closed.

The Treaties (Nice and Maastricht) oblige the Commission and Council to consult the COR whenever new proposals are made in areas that have repercussions at regional or local level. The Treaties set out the following areas:

- Economic and social cohesion
- Trans-European infrastructure networks
- Health
- Education
- Culture
- Employment policy
- Social policy
- Environment
- Vocational training
- Transport

The Commission, Council and European Parliament have the option to consult the COR on issues not covered by the above-mentioned if they see important regional or local implications to a proposal. The COR can also draw up an opinion on its own initiative, which enables it to put issues on the EU agenda.

Organisation and Structure

The constituent bodies of the Committee of the Regions are as follows:

Plenary Assembly

The Committee meets as a Plenary Assembly and its main tasks are: adopting opinions, reports and resolutions, draft estimates of expenditure and revenue of the Committee and the political programme of the Committee; electing all the members of the Bureau; setting up commissions; and adopting and revising the Rules of Procedure of the Committee.

Presidency

The President directs the work of the Committee. The Committee elects the President from among the members for a two-year term.

Bureau

The Plenary Assembly elects the Bureau for two years. It consists of

the President, the first Vice-President, one Vice-President per Member State, 25 other members and the chairmen of the political groups (56 members in total). The Bureau is responsible for implementing the COR's political programme.

Commissions

At the beginning of each four-year term, the Plenary Assembly sets up commissions to prepare its work. It decides on the composition and powers of these commissions.
The compositions must reflect the national composition of the Committee. The commissions specialise in particular policy areas:

- Commission for Territorial Cohesion Policy (COTER)
- Commission for Economic and Social Policy (ECOS)
- Commission for Sustainable Development (DEVE)
- Commission for Culture and Education (EDUC)
- Commission for Constitutional Affairs and European Governance (CONST)
- Commission for External Relations (RELEX)

The commissions draw up the draft versions of opinions and resolutions which are submitted to the Plenary Assembly for adoption.

Secretariat-General

A Secretariat-General headed by the Secretary-General assists the Committee. The Bureau ensures that the COR and its constituent bodies function efficiently, by helping the members of the Committee in carrying out their duties. It draws up the minutes of the meetings of the Committee's constituent bodies. The Secretary-General is responsible for giving effect to the decisions taken by the Bureau or the President. In preparation for Bureau decisions, the Secretary-General draws up discussion documents and recommendations for a decision on each item up for discussion.

National Delegations

The members and alternates from each Member State form a national delegation. Each national delegation is responsible for adopting its own internal rules and electing a chairman.

Political Groups

Four political groups are represented in the COR, which reflect the main European political families: the Party of European Socialists (PES), the European People's Party (EPP), the European Liberal Democrat and Reform Party (ALDE), and the European Alliance (EA). These groups provide a forum for Committee members to discuss key political issues and reach common positions.

Interregional Groups

Members and alternates may also form interregional groups.

Execution of Duty

The Committee of the Regions is convened by its President at the request of the Council or the Commission, but it may also meet on its own initiative.

Work of the Commissions

The Bureau assigns requests for opinions (provided for in the annual work programme) as well as requests for opinions on documents not contained in the work programme to the responsible commission. In urgent cases, the President may designate a commission to deal with the specific matter. If the subject of an opinion requires the input from more than one commission, the Bureau designates a lead commission and, where necessary, one or more supplementary commissions.

If the commission concerned cannot draw up a draft opinion by a certain deadline, the Bureau may propose that the Plenary Assembly appoints a rapporteur-general, who submits his draft opinion straight to the Plenary Assembly. Draft resolutions or applications for the drafting of a resolution may be submitted to the Committee by at least 32 members or a political group.

If the Bureau decides that the Committee is to discuss a draft resolution or an application for the drafting of a resolution, it may either put the draft resolution on the Plenary Session preliminary draft agenda or appoint a commission to draw up a draft resolution.

The commissions present their draft opinions before the deadline set by the Bureau. If the commission thinks that a document referred to it by the Bureau has no regional or local interest, or political importance, it may decide not to draw up an opinion.

Plenary Session

The draft opinion (or draft resolution) is debated and voted on during the Plenary Assembly. When a deadline cannot be met under the normal procedure and the commission has adopted its draft opinion unanimously, the President transmits this draft opinion to the Council, Commission and European Parliament for information. The draft opinion is submitted to the following Plenary Session for adoption without amendment.

The Committee's opinions, as well as any communication related to the use of a simplified procedure or a decision not to draw up an opinion, are sent to the Council, Commission and European Parliament. As in the case of resolutions, they are forwarded by the President.

Industry News

Philips

Philips Hybrid Scanner Improves Cancer Treatment

A new-generation, highly advanced combination PET/CT scanning device improves diagnosis and treatment of cancers, while being more comfortable for patients than older equipment, research has shown.

The device merges two non-invasive imaging technologies in one ‘open’ machine. While both PET and CT scans are routinely used in evaluating cancer, the fusion of the two types of scans offers advantages over the two technologies alone. This hybrid PET/CT scanner incorporates advances in both PET and CT technologies, and merges these enhancements into one fused, 3D image. The combined image shows up areas of metabolic change in their precise anatomical context, sharpening diagnostic and treatment capabilities.

AGFA

Agfa Debut New Solution in Europe

At the World Congress of Cardiology in Barcelona, Agfa HealthCare made the European debut of the Heartlab Congenital reporting and analysis tool for congenital echocardiography reporting.

Heart defects are among the most common birth defects and are the leading cause of birth-defect related deaths, according to the American Heart Association (AHA). Advances in diagnosis and surgical treatment have led to dramatic increases in survival for children with serious heart defects, the association has stated. As a result there is a growing population of adults with congenital heart disease. Agfa’s new solution aims to tackle this increasing problem.

Konica

Konica Work With Alliance Medical

Alliance Medical, a European provider of managed imaging services, has become the first company in the UK to install Konica Minolta’s Drypro 793 Laser Imager.

Launched recently, this system is integrated into Alliance Medical’s existing PACS system. The Drypro laser imager has a minimal pixel size of 25 um. It is also equipped with a web maintenance function that allows the user a PC on the same network, via a web browser. In addition, it features a large LCD touch panel with menus that are intuitive and easy to navigate.

Sectra

Sectra receive Microsoft .NET award

Sectra was announced the winner in the category “ISV/Packaged Software Solutions” at Microsoft’s fifth Microsoft .NET Awards. The competition acknowledges and rewards Microsoft partners that have developed the most innovative IT solutions based on the .NET platform. The jury’s motivation was: “Sectra has developed a high-performance system for workstations and servers using streaming technology that enables radiologists to gain access to radiology images for diagnosis”.

Matrox

Update to Matrox Imaging Library Announced

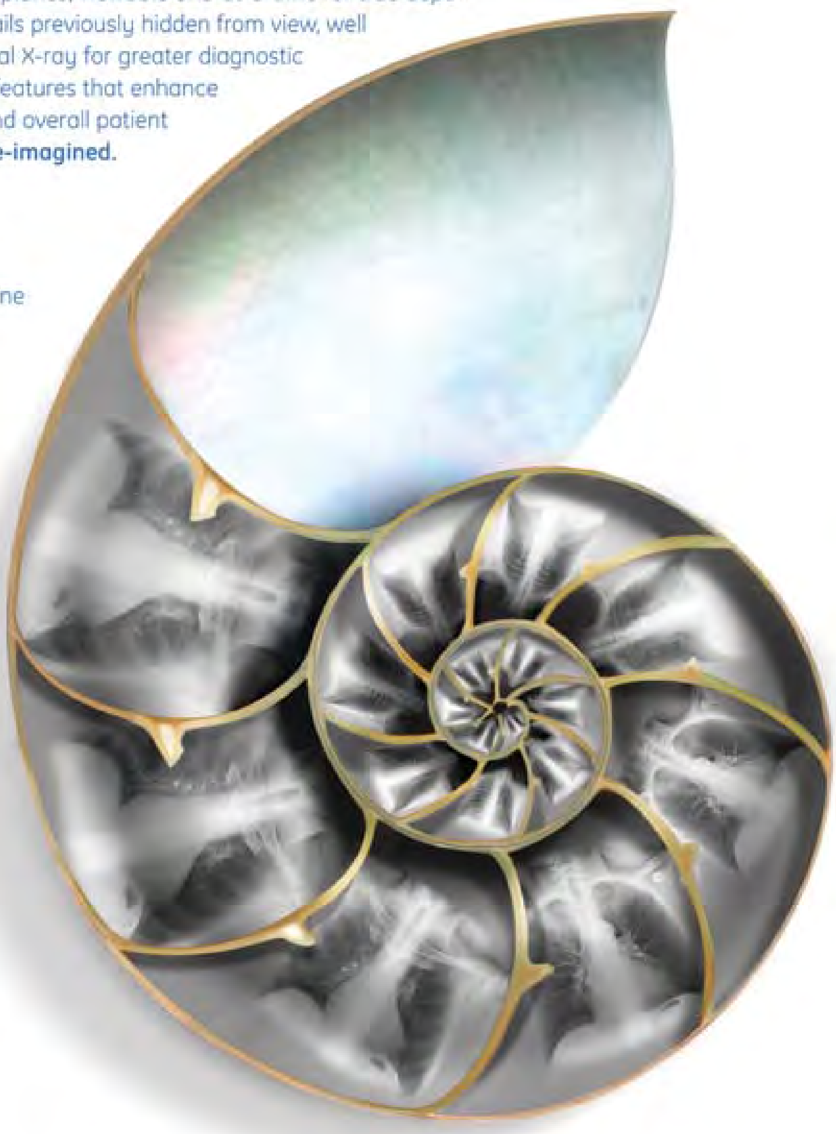
Matrox Imaging is announcing a new module for its Matrox Imaging Library (MIL). “Adding a metrology tool was the next logical step for MIL”, explains Pierantonio Boriero, Product Line Manager, Matrox Imaging.

As part of Processing Pack 3, the latest update to the current MIL 8.0 release, the Metrology module tool measures and constructs geometric features. Users may measure finite features such as arcs, circles, line segments, and points in specific image regions, and can also construct features within the image. In addition, users may define and validate tolerances from dimensions, positions and shape (angularity, concentricity, perpendicularity, roundness and straightness). The Metrology module supports calibration to obtain results in real-world coordinate systems.

GE Healthcare

GE Healthcare Complete Acquisition of Biacore

GE Healthcare announced that pursuant to its public offer it has received acceptances equivalent to approximately 98 percent of the total number of shares outstanding in Biacore. All of the conditions to the offer have been fulfilled and GE Healthcare is proceeding with the closing of the offer.



Hologic

Hologic Inaugurate New European Headquarters

Hologic have inaugurated their new European Headquarters, Service and Parts Depot, and Training Centre in Brussels. The new facility doubles the size of the Hologic European headquarters.

This is the second major investment for Hologic in Europe in the past six months. In May, Hologic announced the 21 million EUR acquisition of AEG Elektrofotografie, a privately-held company headquartered in Warstein, Germany. AEG develops, manufactures, and sells photoconductor materials for use in a variety of electro photographic applications, including copying and printing. The company is Hologic's sole supplier of amorphous selenium photoconductor coatings for Selenia™ digital mammography detectors.

Siemens

Siemens Helps Streamline Clinical Trial Process

Researchers at the Technical University of Munich and Siemens Medical Solutions have developed a method of electronically transferring clinical data gathered at the point of care for use in prospective clinical trials. Through this process, clinical trial research results can be documented more efficiently. This solution offers a scalable, automatic transfer of data between an electronic medical record (EMR) and an electronic data capture (EDC) system, overcoming interoperability challenges associated with systems that operate on different technical standards and work within distinct business environments. Enabling immediate data transfer, the solution is being tested in a pilot study that was initiated in June 2006. Preliminary results of this pilot were released at the ExL Pharma's 2nd Merging Electronic Health Record and Electronic Data Capture Conference in Washington, DC, and during an eClinical Forum presentation in Paris.

Letters to the Editor

EU Directive and MRI scanning: The Position in the UK

In follow-up to your news piece from Prof. David Norris (Volume 6, Issue 3), this is the position in the UK at present. In 2004, following an extensive review of the science and after carrying out a wide consultation, the NRPB (now the Radiation Protection Division of the Health Protection Agency, HPA) recommended adoption in the UK of the 1998 guidelines of the International Commission on Non-Ionizing Radiation Protection (ICNIRP) for EMF exposures. This recommendation was accepted by the UK Government.

The Directive (2004/40/EC) of the European Parliament and Council on the minimum health and safety requirements regarding the exposure of workers to the risks arising from physical agents (electromagnetic fields) incorporates some of the 1994 and 1998 ICNIRP guidelines. HPA is well aware of concerns amongst the medical profession that the Directive might restrict some practices that utilise MRI scanning. It is important that such concerns are addressed, preferably with evidence-based research on the magnitude of any problem. This will require a careful assessment of the exposures encountered by staff during MRI scans. Three research projects are already underway to establish the extent of the interaction between magnetic fields and MRI workers, and the European Commission will soon be publishing a tender for additional research proposals.

The UK MRI community has raised questions about the basis of ICNIRP guidelines for low frequency magnetic fields, particularly the limiting physiological response. A review of guidelines for static magnetic fields and time-varying fields of frequencies up to 100 kHz is currently being undertaken by ICNIRP. These fields and frequencies include those produced by MRI scanning equipment.

The implementation of the Directive in the UK is the responsibility of the Health and Safety Executive (HSE). Neither HPA, nor its predecessor NRPB, were involved in the legislative and negotiation process related to the development and agreement on the EU Directive. This was the responsibility of UK Government Departments and regulatory bodies.

More information can be found on the following websites:

1. A F McKinlay, S G Allen, R Cox, P J Dimbylow, S M Mann, C R Muirhead, R D Saunders, Z J Sienkiewicz, J W Stather and P R Wainwright (2004). Review of the Scientific Evidence for Limiting Exposure to Electromagnetic Fields (0–300 GHz), Documents of the NRPB: Volume 15, No. 3, 3-209. http://www.hpa.org.uk/radiation/publications/documents_of_nrpb/abstracts/absd15-3.htm

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Dr M J Clark
Centre for Radiation, Chemical and Environmental Hazards
Health Protection Agency
Oxon, UK

MOBILE IMAGE DELIVERY AND ACQUISITION

New Ways to Manage and Access Information

The development of wireless networks and terminals has made mobile connections to image archive and communication systems (PACS) a reality. This access is now possible outside the fixed hospital network and even outside the physical hospital boundaries. This article explores the benefits of new terminal devices as well as current limitations, and how mobile image acquisition can result in a real virtual hospital.

AUTHOR

Dr Jarmo Reponen

Chief Radiologist

Dept. of Radiology
Raahe Hospital
Raahe, Finland
jarmo.reponen@oulu.fi

The modern medical record can be conceived of as a portal, which can deliver information to the point of care. The information should consist of both textual and multimedia data requiring seamless integration of narratives and medical imaging. With suitable terminals, physicians in clinical wards can access images from the bedside.

Mobile Teleradiology

Mobile teleradiology interpreting units are based on different technical platforms ranging from laptop computers to mobile phones. Most promising terminal types for medical purposes are smartphones with computer functions, personal digital assistants (PDA) with phone capabilities or tablet PC devices with networking capabilities. Various wireless networks are available ranging from wireless computer networks (WLAN or WiFi) to mobile phone networks (GSM, GPRS, EDGE or UMTS). A common platform today is mobile IP technology, or the mobile internet.

Mobile teleradiology terminals have so far been mostly used for viewing images needing a secondary consultation. At the Oulu University hospital in Finland, since 2000, our neurosurgeons have made their decisions based on emergency CT image data before even entering the hospital. This is done using smartphone terminals specially developed for this purpose in EU-funded MOMEDA and PROMODAS projects. An important aspect has been to transmit radiology information system (RIS) and hospital information system (HIS) data together with images. For their purposes, image quality and speed of service have been satisfactory enough to facilitate a new type of consultation policy.

Benefits of Mobile Devices

The benefit of mobile devices is greatest if they can be connected to a comprehensive electronic patient record (EPR). In hospital wards, radiological images are one part of electronic patient information including narrative texts, referral letters, laboratory tests and biosignals. Most mobile EPR terminals are still laptop computers with ordinary displays and a WLAN.

Limitations

Mobile terminals still have technical limitations including small display size, limited battery life, slow processors and thus reduced computational power. Also the network speed, availability and costs can generate obstacles. The small display matrix and less-than-optimal colour spectrum usually limits the use of ordinary mobile camera phones for teleradiology. The more expensive smartphones can usually be equipped with software that enables better image manipulation capabilities. Unfortunately, these are usually not suited for standard DICOM images. The small matrix is the reason why mobile terminals have been mostly used for CT and MRI scans. They are not suited for primary reading, because diagnostic image manipulation and comparison with previous images is seldom possible. If the display matrix is increased, the result is an increased power consumption and thus heavier equipment and shorter operational time.

Mobile Telecom Networks

Even though mobile teleradiology is feasible for special purposes, current second generation mobile telecom networks (GSM and its evolutions GPRS and EDGE) still provide rather slow data transfer speeds. Emerging 3G networks (UMTS) may break this barrier, bringing broadband to mobile devices. The main limitations for UMTS are the price of connections and limited availability in many European countries. Also its top speed is not comparable with fixed networks.

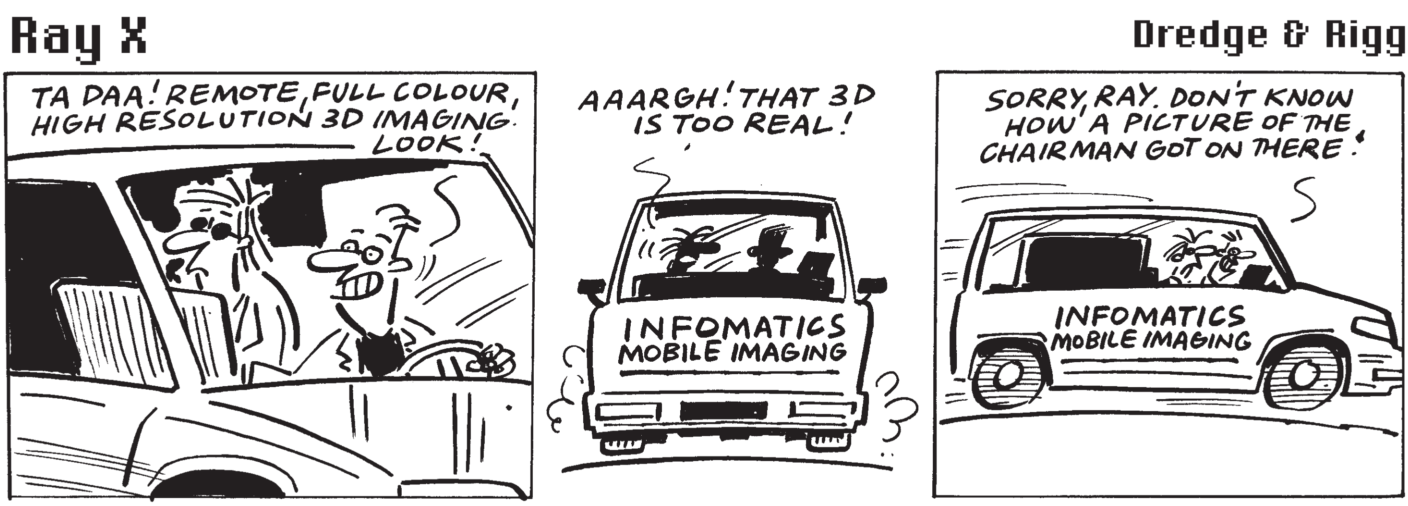
Another interesting wireless broadband technology is WLANè. In an earlier project, we saw how using a tablet PC system made data access fast and comparable with terminals connected to the hospital network. The main limitation of WLAN is that outside the hospital campus area it is available only in so-called service points, “hot spots”. Thus, WLAN is not suitable for health professionals that are on-duty and have to be able to connect to the hospital at any time.

Finally, transmission costs may influence choice of a network. Because image files are large, mobile phone networks are usually quite expensive, despite the possibilities offered by flat fee monthly agreements.

The capabilities of handheld devices are reaching levels needed for many medical imaging requirements. However, we are in a rapid development phase for mobile technology, and the life of mobile devices is rather limited. For these reasons, the development costs of consultation systems may be high compared to the expected usage of the applications. Therefore, a careful system design is needed.

Security issues are still more difficult to resolve in a mobile environment than in a fixed network. It is imperative that no patient identification data is released. Due to this, the buyer who purchases his mobile terminals as an add-on tool to his existing PACS and EPR system and not as a stand-alone system is wise.

From a radiological view point, mobile image acquisition is also possible. In Norway, at the Ullevaal University Hospital, they have an extensive experience of serving nursing homes with a mobile digital radiographic imaging equipment. New technology has made it possible to take the imaging equipment to the patients and transmit resulting images to interpreting radiologists whenever a network connection is established. The boundaries of a virtual department are nowadays quite extensive. Mobile teleradiology services can be utilised to their full potential only if they are integrated with electronic patient record systems. The patient is the final winner when medical professionals can deliver and access information in the most practical way.



THE DIGITAL NORTH DENMARK PROJECT

Our Experience Integrating Mobile Technology

AUTHOR

Dr Henrik Gregersen
Chairman
Musculoskeletal Radiology Section
Department of Radiology
Aalborg Hospital
Aalborg, Denmark
aas.igpo@nja.dk

The healthcare environment is constantly changing. From paper reports and films, which facilitated patient contact, professionals then embraced digital data processing systems, for the most part not as a true digital patient record, but as fragmented systems. Nowadays, doctors and nurses are spending increasing time with computers, and have less time with patients or colleagues. To prevent isolation, going mobile is a new and exciting development that will remove the limitations of a previously rigid digital healthcare environment, and support best workflow.

Going Mobile in Aalborg

Under the auspices of a national and EU project called the Digital North Denmark, the County of Northern Jutland sought digital technology systems that allowed free and unhindered access to images and other patient data. The aim was to give healthcare professionals tools to support their way of working, instead of forcing staff to adapt to IT systems.

Radiologists and clinicians were equipped with a wireless PDA, on which they could search the PACS for image data and get access to the written report. There is also a project going on to implement RIS functionality on the wireless system. Nearly all PCs in the hospital allow unhindered access to all image data and functionality.

The RIS-PACS system enabling this uses streaming technology to distribute the image data (EasyViz, Medical Insight, Hedehusene, Denmark). All computing facilities, reconstructions and PACS and RIS functions are performed on a central server and the only data transfer to the user is the screen signal. This means there is no image data transfer, or large datasets to send via the network.

The Perfect Teleradiology System

From very early in the process, the ultimate goal was to establish a system giving the user the perfect teleradiologic system with:

- Real-time access to radiology data and patient information;
- Unrestricted use of wireless and mobile devices;
- Availability of diagnostic tools and functions;
- Equal access, functionality and performance whether on-site or remote.

This goal has now been achieved, enabling me to work from any PC in the hospital, from any wireless access point on a PDA or laptop computer.

This gives me free choice of location and hardware for any given task. Most reporting is performed on my office PC, as most of my reading is MRI and CT. X-rays are more often read on diagnostic workstations. I can also work from home. On a 2MB internet connection, there is a slight delay in the manipulation of the images, but the functionality is the same on my home PC, PDA or on the office PC. This saves time, especially in situations where several examinations need my attention simultaneously. The PDA is mostly used for orientation, but diagnostic work can be performed, at least for MR and CT images.

Limitations can, however, arise. Since practically all users are moving around the facility, or accessing the system from outside the institution, it must be made easy for each user to move from one computer to another or the system must be wireless. Moving from one computer to the next is, in an office setting, difficult. If it proves difficult to move your application from one computer to another, no one wants to move.

Conclusion

Adoption by clinicians has been mixed. Several clinicians are not availing of the wireless application, as either they are unaware of the functionality or prefer to use a stationary computer. Reactions to the use of PDAs are mainly scepticism about screen size or resolution, as well as battery life and the fact that input on a PDA is troublesome. Today, the vast majority of images are viewed on a PC. Few diagnostic workstations exist in clinical settings. This means a considerable saving for the hospital, and considerably easier viewing possibilities for the clinicians, as close to the patient as possible.

ENABLING ACCESS TO PATIENT DATA

Ensuring True Mobility in Imaging

Mobile imaging is not new; for over ten years, it has been used in several areas, including the transmission of trauma CT scans for on-call reporting by radiologists at home or for emergency referral to a tertiary centre. It has also been used to enable smaller hospitals in remote areas, often without radiological cover, to transmit x-ray images to a major hospital for a second opinion, to enable optimum patient management.

AUTHOR

Liz Beckmann

Managing Director

Lanmark Medical
Beaconsfield, UK
lizbeckmann@
lanmarkmedical.co.uk

Constraints on the transmission of images have changed significantly. Ten years ago, a standard telephone line was capable of transmitting only at speeds of around 2.4kbps and is nowadays still restricted to around 56kbps. The introduction of ISDN improved transmission speeds to 128kbps; but with multi-slice spiral CT, the size of the data sets increased to the order of 500-700 slices, with the result that transmission time significantly increased and became an even greater issue.

Broadband ADSL, operating at up to 8Mbps, has had a huge impact in alleviating this problem; however, the benefit is in one direction only. The download to a remote computer has improved; but any upload from a computer to the internet is slower.

Security Risks

The impact of moving data around by mobile technology means that security and patient confidentiality are of paramount importance. Issues are similar whether images and patient data are being transmitted around the UK or overseas. Whilst VPNs offer a degree of security, they are expensive and exclude the ability to send data for a specialist second opinion.

Companies are working on the application of resilient encryption technology which enables data files to be sent across intranets and the internet with a high degree of security and in such a way that only the authorised recipient can decrypt the data, even if it is stored in encrypted form on a remote computer.

Viewing Needs

One of the greatest challenges of going mobile is the quality of the receiving viewing unit. In comparison to a basic computer which can achieve resolution of 1280 x 1024, many mobile devices such as PDAs, have a resolution below 480 x 640. Although it is possible to view images in quadrants with roam and zoom, this is neither ideal nor clinically acceptable. Mobile access can be provided to image data for a user without the need for dedicated mobile equipment; for instance using a PC connected to an intranet or the internet. Also, laptop computer systems while not as portable as PDAs offer screens with better resolution and higher processing power.

Data access over an intranet, the internet or VPN can work in different ways. Firstly, where the remote user downloads images onto their own system. Here the issue of the security of the data on the remote machine becomes important, and issues such as who has access or how long data is retained must be controlled.

Alternatively, remote users can access and view image data which is held on a central server. In such cases, the speed of the connection is important in defining response time for any manipulation carried out by the user on the data. On large data sets these time delays can pose a problem.

Technology Trends

To achieve a viable, lightweight device for mobile applications, there is a need to develop lightweight and high power displays and increase processing power, memory size, and battery power. One of the greatest problems is current battery technology. To get an operating time of several hours, batteries are bulky, and even then, need frequent access to mains power for recharging. This is an issue which seriously needs addressing if we are to achieve true mobility in imaging.

As imaging develops, challenges increase. Both data sets and the complexity of data manipulation required has increased. The ability to fuse or compare image studies and rotate images in real time requires significant computing power, which is a problem with compact mobile devices. Whilst these facilities are not required in all cases or applications, they often add significant benefit for patient management.

MOBILE LIFE IN THE RADIOLOGY DEPARTMENT

Our Experiences With Mobile Technology

AUTHOR

Prof. Nevra Elmas

Professor of Radiology

Department of Radiology
Ege University Medical Faculty
Izmir, Turkey
nevraelmas@gmail.com

Workflow dynamics within modern radiology departments have transformed with the growing influence of information technology, of which the most significant additions have clearly been DICOM image data systems, PACS, Radiology Information Systems (RIS), Hospital Information Systems (HIS) and teleradiology.

Defining Mobile Radiology

Nowadays, all one requires is a local area network (LAN) system connected with a pocket PC or personal digital assistant (PDA) to be included in the gamut of mobile radiology. This system is termed the Mobile Radiology Information and Telemedicine System (MORITS). System configuration comprises of a mobile DICOM server and PDAs. Connection from PDAs with the DICOM server can be obtained via the LAN. The Linux-based Mobile Dicom Server (MDS) can be accessed with PCs and PDAs by means of a wireless or wired LAN access point, and an Ethernet bridge can be attached to the MDS.

Displaying Images

DICOM images can be displayed by using any PDA or PC by means of a web browser. Simultaneous access to the MDS is possible for multiple authenticated users. Mobile PC and PDA clients are connected to the MDS over a wireless LAN (802.11), with a maximum of 250 clients connected simultaneously. With most PDAs, image compression is necessary for complete display of DICOM images. This wireless system allows efficient management of heavy loads of lossless DICOM image data and is useful for collaborative work by radiologists in education, conferences and research.

In our system, three types of PDA clients are used: a Linux PDA, the Pocket PC (Microsoft, Redmond, WA), and the Palm OS (PalmSource, Sunnyvale, CA). Our PACS archives contain DICOM images in various resolutions from 256 x 256 pixels to 2,140 x 1,760 pixels. The standard display resolutions of common PDAs are 320 x 240 pixels for the Pocket PC and 480 x 320 pixels for Palm OS version, and as non-compressed DICOM images exceed these common PDA display sizes, it is necessary to use compressed images to display the whole image on these PDAs. In using the pocket-sized MDS, the system uses two basic network modes: a closed personal network environment and a network connected to an existing LAN. Our MDS is used as a short-term DICOM archive for teaching files for use in education and research. To store DICOM images in the MDS, users connect through an existing wired LAN. After archiving target DICOM images each user carries their own personal access device, allowing co-authors to share image data directly using the MDS without copying or burning CDs.

Security Considerations

This system is not without certain security considerations. For example, when the MDS is started, a digit code is requested. A basic web server security code is installed in the MDS and a HTTP basic authentication requires the client to send a user name and password in clear text as part of the HTTP request. Another security system is radiofrequency (RF) power control of the signal strength: the RF power of the wireless LAN can be set from several to approximately 50 metres. To secure the wireless LAN, a low RF power must be selected. Currently, wireless LAN security is a work in progress. There are three basic methods in 802.11 networks for securing access points: extended service set identifier (ESS-ID), media access control (MAC) address filtering and the wired equivalent privacy (WEP) encryption mechanism.

Advantages and Disadvantages

The advantages of PDAs in radiologic work are many. They are small and portable. Radiologists can communicate using handheld devices compatible with wireless communication networks from outside areas. Images and diagnoses can be transferred as different files, such as Microsoft Excel or Word files for teaching and education. Radiologists can use PDA or PC clients to access the MDS. Storage of images can be read both for personal and group work for research. With these advantages, MDS is more beneficial than conventional PACS.

WIRELESS ACCESS TO PATIENT RECORDS IN A CLINICAL ENVIRONMENT

Overview of Emerging Trends

While mobile access to medical data and patient is becoming more widely available, accessing images still represents a technical and logistical challenge. Demand for remote image access is increasing dramatically. Solutions using wireless technology and improved performance of portable computers allow more realistic implementation of mobile alternatives than conventional imaging workstation, particularly for clinical wards and bed-side patient care. This paper reviews some emerging trends for more convenient mobile access to image data.

AUTHORS

Dr David Bandon
Digital Imaging Unit Head

Prof. Osman Ratib
Head of Nuclear Medicine

Dr Antoine Rosset
Radiologist

Department of Radiology and Medical Informatics
University Hospitals of Geneva (HUG)
Geneva, Switzerland
david.bandon@sim.hcuge.ch

Moving Images Around

In clinical settings, physicians rely more and more on images and image data for patient management and clinical decisions, therefore they expect to have rapid access to digital images at the point of care. Many technical solutions are emerging as alternatives for remote access to image data.

Image Access on Portable Computers

The development of higher performance laptop and tablet computers allows more efficient management of large volumes of data with sufficient processing power for image manipulation and processing. Besides, the development of solutions based on thin-client technology allows remote laptops access to image processing and visualisation tools remotely from central servers through web-based or thin-client applications. These recent evolutions have led to more widely accepted solutions of remote image access via portable devices such as tablet PCs (see fig. 1).

Fig. 1: Example of tablet PC with image visualisation capabilities (Centricity Radiology Web software from GE Medical Systems)

The convenience and performance of these tools opens a new era of clinical applications that can benefit from the mobility of these devices through wireless technology while maintaining enough performance to be suitable for clinical requirements and management of large image data sets. Several prototypes of such implementations have been reported using web-based image viewing applications. More recently, advanced image processing and rendering tools have become accessible on portable computers due to the rapid improvement in performance of these devices.

Handheld Devices and PDAs

Numerous systems were developed to allow extracts of electronic patient records (EPRs) to be downloaded and stored in handheld devices to be readily accessible when needed. Wireless communication provides the added convenience of direct access to central data repositories and sources of on-line information. Our experience with handheld devices for displaying medical images shows that today's handheld devices suffer from three major limitations: low display resolution, low storage capacity and relatively limited communication speed.

In an effort to explore an alternative solution that combines the convenience of a handheld device with the quality and performance of high-resolution image display systems, a project developed at UCLA explored an innovative concept for image retrieval and display in clinical wards. The system is designed to replace existing lightboxes in clinical wards with high-resolution, wall-mounted flat panel display devices driven by handheld PDA devices that can initiate the query and retrieval of specific medical images and documents from remote storage archives (see fig. 2, page 24).

With the increasing size of image studies such as multi-detector CT, functional MRI, and multi-

continued on p.24

OUTSOURCED DIAGNOSTIC IMAGING SOLUTIONS

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

AUTHOR

Dr Arpan K. Banerjee
MBBS FRCP FRCR

Consultant Radiologist

Birmingham Heartlands
And Solihull Hospitals
NHS Trust
United Kingdom

Dr Arpan K. Banerjee, MBBS FRCP FRCR, Consultant Radiologist in the UK at the Birmingham Heartlands and Solihull Hospitals NHS Trust, explains the benefits that outsourcing radiological requirements can bring to public and private health-care providers.

The UK's "Outsourced Imaging" Model

According to a recent study by a European management consultancy team, Britain is the global leader when it comes to getting the best from "outsourcing", i.e. using the private sector to deliver public services. In the UK, the Government's commitment to providing greater access and choice for patients, combined with a willingness to develop plurality of providers, irrespective of their public or private status, has led to the widespread recognition of the benefits outsourcing can bring to both patient and health-care institutions alike.

Mobile Imaging

Today, many hospitals not only in the UK but also across Europe are turning to mobile imaging solutions. In turn, mobile imaging is becoming ever more flexible and comprehensive. The use of a mobile interim service ensures that hospitals can respond quickly to developing situations in an economical manner, with units being used only for the required amount of time.

Such services are especially important when hospitals are upgrading existing systems or installing new ones. Furthermore, as hospitals can use their own staff in the units, they can be sure of maximum continuity of systems, with minimum impact on budgets.

Where imaging demand does not justify a new system installation, or where imaging demand is permanently high, fully managed mobile services with highly trained radiographers, either as a one-off solution or a long-term aid, offers 'a value for money' solution.

Conclusions

Whether fixed-site or mobile, fully managed or operated by existing hospital staff, outsourced imaging provides hospitals with a solution tailored to their needs. With the expansion of the EU, hospitals in new EU-member states will soon be able to open their doors to the technologies and services that are becoming central to health-care in Western Europe.

For further information, please contact:
Alliance Medical Group
Home Farm Drive
Upton, Nr. Banbury
Oxon OX15 6HU, UK

tel: + (44) 1295 671 253
fax: + (44) 1295 671 233
e-mail:europe@alliancemedical.eu.com
www.alliancemedical.eu.com

Fig. 2: Pocket PC (1) communicates with the flat panel display device (2) via an infrared channel (3). The additional touch pad device (4) is mounted next to the flat panel device for manual image and display functions.

modality PET/CT, the size of data tends to exceed the capacity of traditional media, and therefore, alternative solutions for convenient transportation of large image data are urgently needed.

We selected general consumer products recently released by Apple Computer for their wide availability, low cost, convenience and ease of use. We specifically adapted them for medical imaging applications. The iPod was integrated to serve as a high-capacity portable DICOM storage with high-speed transfer rate. It integrates a fast and high-capacity hard disk to store up to 40GB of data. It can be connected to any computers with a FireWire 400 (IEEE 1394) or a USB-2 interface.

Transmission speeds of these interfaces are up to 400 and 480 Mbits/s, respectively. OsiriX software was adapted to automatically detect when an iPod is connected to the computer and automatically updates its local DICOM database to display the studies available on the iPod disk. Users can also copy image data from and to the iPod. With the recent generation of iPod photo devices, it is also now possible to display colour images on the screen.

Clinical Applications of Mobile Technologies

In emergency rooms, there are several situations where images can be acquired directly at the bedside. Portable ultrasound as well as endoscopic devices can generate digital images to be transferred to remote consultation locations. In most cases, image transfer requires a physical connection to a network which limits smooth workflow. Also, image acquisition often needs to query the patient's worklist before going to the patient location with the imaging device, which can mean further limitations.

Once images are acquired, the acquisition device must be physically reconnected to a network plug to transfer images to the PACS. At our hospital (HUG), we encountered recurrent problems like broken network cables disrupting communication or the need to manually reconcile images with the patient's file when the physician failed to retrieve patient demographics before the exam. Thus, we adopted mobile technologies (MT) for image acquisition, in Spring 2006, launching a pilot with one mobile endoscopic device for urgent gastroenterology exams. Results are satisfactory with no manual reconciliation needed and, in general, less problems.

Wireless networks and mobile carts permit bedside patient data entry and provide image previews in emergency rooms and clinical wards via wireless networks. The department of paediatrics at the HUG is our pilot site for extending filmless operations outside of radiology. A user satisfaction survey showed that the vast majority of physicians would not revert to film except in specific cases for 35% who pointed out that image access in OR and clinical wards was less than optimal due to ergonomic problems. Wireless access was the non-prompted solution most often quoted. The fact that physicians spontaneously suggested wireless to improve their work environment is an important element in favour of MT. While wireless distribution to wards has been initially implemented for computerised physician order entry (CPOE), we will now include image access from laptops.

Conclusion

The main challenge to implement mobile technologies (MT) in wards is performance. Both the network and the wireless system must scale for bandwidth for the heavy traffic load. At the HUG, the first system utilised the 802.11 technology (Wifi with a bandwidth enabling 11 Mbit/s) delivering only 1 to 2 Mbit/s. A chest x-ray was available after 45 seconds, which is too slow to be used in clinical routine at the bed-side. A current upgrade to new 802.11 technology (54 Mbit/sec.), combined with the use of image quality on demand, improves performance. Encouraged by our positive experiences with MT, we will be adopting them widely to ensure adequate implementation in response to the needs of each department. We anticipate that cost efficiency studies will be required to justify the initial investment of MT. It is our conviction that MT is a natural extension to the filmless and paperless hospital and will better support physicians in their routine activities.

References for this article are available at: editorial@imagingmanagement.org

BEYOND THE HEART:
INNOVATIONS IN RADIOLOGY

AUTHOR

Dr Jim R. Brown

Senior Director of Clinical and Technical Marketing

Philips Medical Systems, Ultrasound

The Evolving Ultrasound Market

Beyond the heart, researchers are exploring applications for 3D or "volumetric" ultrasound technology to help improve the physician's diagnostic and treatment decisions. The following are just a few areas in which ultrasound shows real promise for a variety of conditions.

Ultrasound in Oncology

Ultrasound is providing clinicians the ability to more accurately quantify the size and nature of tumours as well as help assess whether they are benign or malignant. The result is earlier and more confident diagnosis by the physician as well as a potential reduction in the number of costly biopsies required.

Ultrasound and the Breast

In the western world, more than 1 in 10 women currently develop breast cancer. Approximately 70% of these cancers are a particular type of tumour known as an invasive ductal carcinoma. Currently, the only way to confirm whether these growths are really malignant is to perform a biopsy, an expensive and time-intensive procedure.

A universal characteristic of malignant tumours is that they stimulate a process in the body known as angiogenesis. Microvascular imaging (MVI) using ultrasound is a quick and cost-effective way for clinicians to image these blood vessels surrounding a tumour to determine whether it is malignant or benign. A contrast agent (SonoVue, Bracco Diagnostics Inc.) with a suspension of micro-bubbles is injected into the bloodstream. The MVI then captures a sequence of images that are assembled into a 'movie'. The resulting image visualises the presence of angiogenesis or not.

3D Breast Imaging

Another way ultrasound is facilitating cost-effective lesion analysis is using 'volumetric' imaging, obtaining a full volume of tissue data and examining it in multiple dimensions. Using 3D, the physician can better assess a breast lesion's borders and characteristics as well as study the surrounding breast tissue that could help in disease management. Visualisation techniques like progressive precision slicing of a volume to generate 2D images can also help the clinician quickly evaluate breast tissue. Future visualisation technology will allow segmentation of the lesion from surrounding tissue and automatically assess characteristics of the lesion to determine mass size, shape, internal properties and orientation to breast architecture.

These lesion quantification technologies may also play a valuable role in therapy and post-operative care. Following a lumpectomy or ablation, they can help differentiate between scar tissue around the surgical site and new tumour growth.

Liver Tumour Ablation

Liver tumour ablation is an evolving application being used by interventional radiologists and oncologists. Using ultrasound guidance, physicians can locate tumours and destroy them without resecting large portions of the liver. Used as a 3D guide, ultrasound can pinpoint the size and location of a liver tumor and guide the placement of an ablation needle that uses a radiofrequency (RF) current to destroy the cancerous tissue. Following the RF ablation procedure, ultrasound imaging helps evaluate and assess the procedure to determine whether it was a success.

Fertility

In patients with infertility or who are experiencing repeated spontaneous abortions, volumetric imaging can help the physician identify the cause(s) and condition(s) that led to infertility. 3D ultrasound is superior to conventional scanning techniques as the entire uterine volume can be acquired and interrogated to produce unique views of the uterus and surrounding anatomy that can help assess malformations that may lead to infertility. Volumetric ultrasound is also useful in performing sonohysterography to examine thickened endometrium, to identify the location and number of polyps, abnormal bleeding or adhesions.

Volumetric multiplanar imaging provides more detailed assessment since it offers a coronal plane view, giving better visualisation of the uterine anatomy to precisely pinpoint the abnormality. The coronal view captured by 3D ultrasound also provides a better image of cornual and cervical ectopic pregnancies.

Erratum!

In the last issue of IMAGING Management, our feature on 'Power Injectors in Computed Tomography' mentioned Tyco Healthcare's '***Optivision DH***' product. It should have mentioned '***OptiVantage DH***'.

Live volume imaging allows the acquisition and immediate display of a volume of ultrasound in true real time. Using this new technique clinicians can rotate, look above or under structures without moving the transducer – something not possible using conventional 2D ultrasound. This is especially helpful when evaluating complex anatomical structures and spatial relationships.

Ultrasound and the Musculoskeletal System

Sports medicine, and the viewing of the musculoskeletal system (MSK) has benefited from ultrasound, which provides a safe and powerful modality for viewing superficial soft tissues such as tendon injuries. Ultrasound's high resolution provides an unbeatable view in diagnosing ruptures, adhesions or tendonitis of the Achilles tendon, biceps, thumb, quadriceps, patellar tendon, or rotator cuff. Ultrasound also is ideal in evaluating the mystery surrounding sports hernias and providing detailed interpretations. The ability to look closely at moving tendons in the hand is of significant clinical benefit to orthopaedic and hand surgeons preparing surgical plans to repair a specific injury.

The most useful role for MSK ultrasound in the clinic is as an extension of a physical examination. Additionally, it can be used to evaluate joint dynamic and static stabilizers to assess joint synovitis or fluid, and to identify the exact site for therapeutic modalities and direct needle placement for aspiration or to deliver local anaesthesia.

Ultrasound is ideal when integrated with MRI and CT. General or vague pain can be imaged using MRI. Once a specific injury is located, ultrasound or CT can be used to make a definitive diagnosis.

Conclusion

In summary, the advent of new technologies such as live volumetric imaging, advanced visualisation and quantification are moving ultrasound from a purely diagnostic imaging tool to one that is aiding the physician in making treatment decisions, guiding procedures and providing cost-effective patient management. Ultrasound is rapidly changing the way healthcare is delivered, improving patient care while reducing costs for healthcare providers. The more we as clinicians, interventionalists and surgeons can learn as a result of this technology the greater the impact on disease management and patient outcomes.

HOW 3D IMAGING IS ADVANCING RADIOLOGY

Practical Guidelines for a Successful 3D Imaging Service

PACS soft-copy reading, as with film reading, has traditionally been limited to viewing the transmission of cross-sectional images in fixed orientations as provided by the original scan. Improvements in the speed, usability and affordability of 3D workstation hardware and software, and improvements in integration of 3D software within PACS, means it's now possible to apply computer image processing techniques for 3D imaging and CAD within routine clinical workflow to provide 3D imaging within a PACS environment.

AUTHORS

Gordon J. Harris

Director, 3D Imaging Service

Massachusetts General Hospital

Associate Professor of Radiology

Harvard Medical School

Boston, MA

USA

gjharris@partners.org

Matthew A. Barish

Director, 3D and Image Processing Center

Brigham and Women's Hospital

Assistant Professor of Radiology

Harvard Medical School

Boston, MA

USA

MDCT has opened new possibilities and increased demand for 3D imaging. Rapid acquisition using thin slices and improved rendering algorithms facilitates exquisite 3D images and reformats. However, review of the ensuing large numbers of images from modern MDCT and MR scanners, often hundreds or even thousands of slices per study, pose significant challenges to radiologists' efficiency. Having 3D capability available for diagnosis and surgical planning allows radiologists and referring physicians to get a summary view of the entire anatomy in a few concise, anatomically clear 3D views, and then refer back to the original 2D data for comparison and confirmation. Thus, 3D reconstruction is more frequently becoming a valuable technique to summarise in a concise and clear way the overwhelming number of slices produced by modern CT and MR scanners.

3D medical imaging has revolutionised both radiological diagnosis and surgical planning. 3D reconstructions provide life-like views that can quickly summarise the relationship among anatomic structures for planning surgical procedures before and within the OR. Benefits include decreased exploratory time in the OR, less damage to healthy tissues, and a lower risk of complications for the patient, all of which contribute to reduced surgical morbidity.

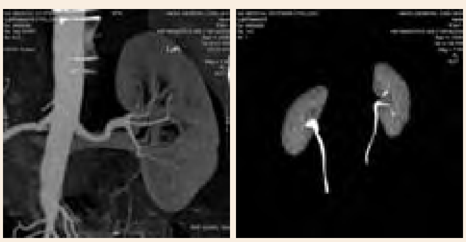
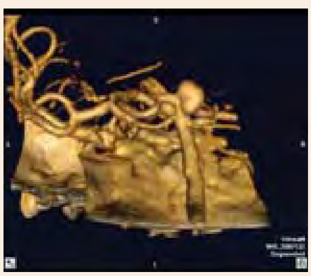


Fig. 1: Left: CTA of the renal arteries. Right: CTU of the ureters and collecting system. Both images were created from the same CT contrast scan session, with one contrast bolus at different time delays and depict high-resolution details required in assessing renal donors for transplants.



CTA showing a double aneurysm at the top of the basilar artery on cerebral CTA, which can replace catheter angiography for assessing cerebral aneurysms.

How Can 3D Reduce Costs?

Increased diagnostic sensitivity across all specialties and the likelihood of shorter OR time per procedure contribute to reduced costs. Thus quality of care is greatly enhanced, often with a decrease in cost compared to alternative procedures. For example, prior to the establishment of 3D imaging services at our institutions, standard protocol for assessing laproscopic living renal donor candidates involved a catheter angiogram to assess the renal vasculature (number, location, and relation among renal arteries and veins) plus an intravenous pyelogram (IVP) to assess the configuration of the ureters and renal collecting system.

These procedures involved exposing the patient to significant health risk involving anaesthesia, catheterisation, as well as high radiation dose, and several thousand dollars in costs for both procedures. Through 3D imaging post-processing of high-resolution CT scans, the current protocol involves a CT angiography scan (CTA) to assess the renal vasculature in place of the catheter angiogram, plus a delayed phase CT urogram (CTU) which replaced the IVP, and both the CTA and CTU are acquired in a single outpatient CT contrast study (see Fig. 1).

Thus, a single, contrast-enhanced CTA/CTU outpatient procedure, costing a few hundred dollars with minimal risk and exposure to the patient, has replaced two expensive and invasive procedures costing several thousand dollars and exposing an otherwise healthy patient to significant risk. Ultimately, 3D imaging provides patients with improved care, significantly lower risk and cost and improved diagnostic clarity.

Potential Uses for 3D Imaging

3D imaging services have become an integral part of the clinical workflow for radiologists and referring clinicians in many hospitals as they can process exams for a variety of sub-specialties including vascular, orthopaedic, chest, breast MR, GI/GU, emergency and paediatric exams. In addition, a variety of neurology, neurosurgery and oral-maxillofacial exams are reconstructed with 3D imaging, including brain surface renderings for neurosurgical planning, CTA for stroke and aneurysm imaging, brain tumour volumetric measurements, imaging of craniosynostoses and complex facial fractures/trauma.

3D reconstructions are also essential to vascular imaging. For example, aortic aneurysm, liver resection and living liver and renal donor assessments are greatly aided by pre-surgical 3D imaging of CT or MRA vascular evaluation and treatment planning on computer rather than exploration in the OR. 3D imaging is also effective in assessing pancreatic cancer and associated vascular involvement and for virtual endoscopy, such as colonography or bronchography.

Many complex 3D exams, CTA for example, require 45 to 60 minutes or more to process all the associated views, while other less complicated 3D exams may take only 15 to 30 minutes each to process. If the clinical volume at a facility is sufficient, it is cost-effective to have one or more dedicated 3D technologists process these exams or alternatively outsource the 3D image processing.

What to Look for in a 3D Technologist

A dedicated 3D technologist should be hired as an experienced, certified CT or MR technologist who can work closely with the radiologists and referring physicians to create 3D protocols that generate the most useful views for each type of exam. The 3D technologist must understand cross-sectional anatomy and pathology in-depth, as well as scan artifacts, and must learn to operate complex computer software. The training period for a dedicated 3D technologist thus ranges from 3 to 6 months at our institutions.

One consideration in determining the cost-effectiveness of the service would be the cost of not having a dedicated 3D imaging service. For example, if a radiologist spending a few hours per day performing 3D processing would be diverted from reading additional clinical cases, which would have generated added revenue, and the facility might need to hire additional radiologists to read exams. Likewise, if CT or MR technicians were to perform 3D imaging between scans, it would slow down scanner throughput, decreasing revenue.
A dedicated staff for 3D imaging services can provide an efficient and consistently processed set of 3D views. By having a dedicated 3D technologist processing exams, it is also possible to create greater uniformity and consistency across exams, as opposed to having 3D images produced by a variety of radiologists or technologists who are not trained to produce a clinically determined set of 3D imaging protocols.

Requirements for a Successful 3D Imaging Service

Successful implementation of a 3D imaging service requires that clinical workflow, protocols, billing and staffing issues are established in a way that enables routine clinical 3D imaging with rapid turnaround and consistent, high-quality, clinically-relevant post-processed images. The 3D imaging services at our institutions work closely on an ongoing basis with hospital billing and compliance, coding and PACS to establish workflow, and with the radiologists, referring clini-

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FULL FIELD BREAST TOMOSYNTHESIS

Significant Benefits of 3-D Imaging

Andrew P. Smith, Ph.D.

What is Breast Tomosynthesis?

Breast tomosynthesis is a 3-dimensional imaging technology that involves acquiring images of a stationary compressed breast at multiple angles during a short scan. Individual images are then reconstructed into a series of thin high resolution slices that can be displayed individually or in a dynamic ciné mode.

WHY 3-D BRINGS MORE BENEFITS

In conventional 2-D mammography, pathologies of interest are sometimes difficult to visualise due to the clutter of signals from objects above and below. This is because the signal detected at a location on the film cassette or digital detector is dependent upon the total attenuation of all the tissues above the location.

Fig. 1: Cross-sectional tomosynthesis slice from the centre of a breast shows a spiculated lesion

Tomosynthesis is a 3-D method of imaging that can reduce or eliminate the tissue overlap effect. While holding the breast stationary, images are acquired at a number of different x-ray source angles. Objects at different heights in the breast project differently in the different projections. The final step in the tomosynthesis procedure is reconstructing the data to generate images that enhance objects from a given height by appropriate shifting of the projections relative to one another.

PERFORMING THE ACQUISITION

The geometry of tomosynthesis is shown in Figure 2. The breast is compressed in a standard way. While holding the breast stationary, the x-ray tube is rotated over a limited angular range. A series of low dose exposures are made every few degrees, creating a series of digital images. Typically, the tube is rotated about ±15°, and 11 exposures are made every 3° during a total scan of 10 seconds. The individual images are projections through the breast at different angles and these are what are reconstructed into slices.

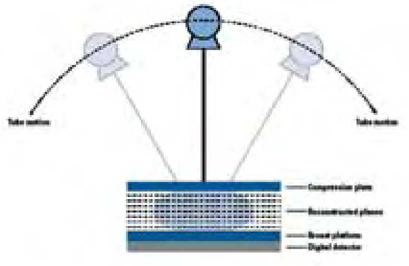

Fig. 2: Tomosynthesis acquisition geometry showing the direction of motion of the x-ray source, and the orientation of the reconstructed planes

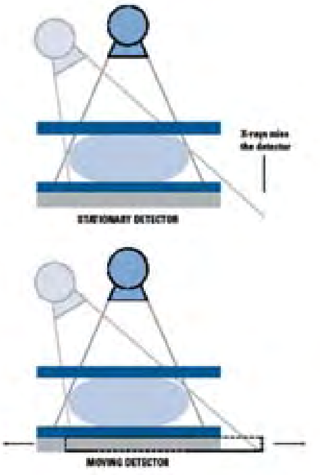

Fig. 3: Tomosynthesis imaging can involve two acquisition geometries: stationary and moving detectors.

Normally the breast would be placed in the MLO or the CC view, although the tomosynthesis system should support the ability to acquire images in any desired orientation. There are two basic tomosynthesis system designs, which differ in the motion of the detector during acquisition. One method moves the detector in concert with the x-ray tube, so as to maintain the shadow of the breast on the detector. An alternate method is to keep the detector stationary relative to the breast platform. Systems that utilise stationary detectors will have a smaller field of view than systems that move the detector, because only a moving detector manages to keep the entire breast tissue imaged at all angles.

OPTIMISING IMAGE ACQUISITION IN TOMOSYNTHESIS

Another consideration in the design of tomosynthesis systems is the motion of the x-ray source during acquisition. The x-ray tube can move in a continuous or step-and-shoot motion. If the tube rotates continuously, short x-ray pulses are used to avoid blurring the image. If step-and-shoot motion is employed, the gantry must come to a complete stop at each angular location before turning on the x-rays, otherwise vibration will blur the image. With continuous motion, scan speed must be slow enough, or each x-ray exposure short enough, to avoid image blurring due to focal spot motion.

The angular range and number of exposures acquired during the scan are additional variables that need to be optimised. In general, more exposures will allow reconstructions with fewer artifacts. This must be balanced against the fact that for a given total examination dose, more exposures will mean smaller signals for each of the individual shots. For sufficiently small exposures, imager receptor noise will dominate the image and degrade reconstructed image quality. With regards to angular range, a larger angular range gives superior reconstructed slice separation, where smaller angular ranges keep more structures in focus in a given slice. Increased separation might be desired for resolving two closely lying structures, but could impair the appreciation of a cluster of microcalcifications by having individual calcifications appear in different slices.

POTENTIAL CLINICAL BENEFITS

Tomosynthesis should resolve many of the tissue overlap reading problems that are a major source of the need for recalls and additional imaging in 2-D mammography exams. The biopsy rate should also decrease through improved visualisation of suspect objects. Some pathologies that are mammographically occult will be discernable through the elimination of structure noise. Additionally, tomosynthesis may allow improved detection of cancers in women with heterogeneously dense breasts.

Reduced Dose

Tomosynthesis may eliminate the need for multiple exposures of the same breast, because the images do not have tissue overlap. Because of this, a single tomosynthesis acquisition, such as in the MLO orientation, may be all that is required. In addition, less additional imaging is required because of the reduced recall rate. Thus it is entirely reasonable to assume that patient dose will end up less with tomosynthesis than with conventional mammography. Finally, the improved contrast of the tomosynthesis images may allow lower dose while still maintaining clinical performance.

Tissue Localisation

Because the location of a lesion in a tomosynthesis slice completely determines its true 3-D coordinate within the breast, biopsy tissue sampling methods can easily be done using the tomosynthesis generated coordinates.

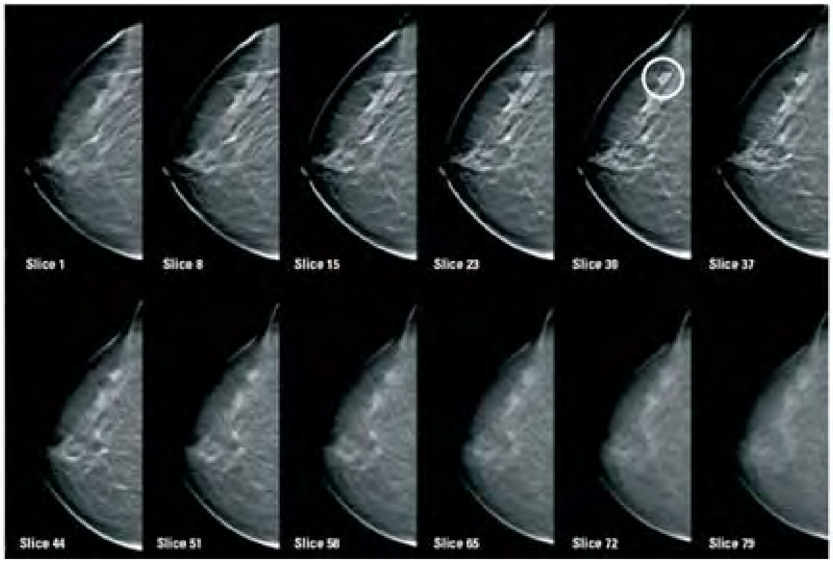

Fig. 3: Tomosynthesis imaging can involve two acquisition geometries: stationary and moving detectors.

Faster Review Time

Because the images are presented with reduced tissue overlap and structure noise, objects are expected to be visualised with improved clarity. This will likely lead to faster case review and more confident readings.

Reduced Compression Pressure

In conventional mammography, breasts are highly compressed so as to reduce tissue overlap. High compression pressure is not needed for tomosynthesis imaging. Just enough breast compression to pull tissues out of the chest wall and keep motion at a minimum is adequate. Therefore, there is the possibility of less painful compression using tomosynthesis. If reduced breast compression is used, the x-ray energies may need to be raised so as to more efficiently penetrate the thicker breasts. In this case, it is important that the image receptor maintains its high quantum efficiency at the higher energies. Cesium iodide, with poor absorption at higher kV, may not be the optimal detector material. A selenium-based detector does not have this limitation as its k-edge is below the mammographic energy range.

Contrast Enhanced Imaging

Researchers have studied mammography using IV administered iodinated contrast agents. Using either dual energy or pre- and post-contrast imaging, they have observed enhancement of otherwise occult cancers and differentiation of benign from malignant tumors. While this research is still in its infancy, contrast enhanced tomosynthesis images might offer even greater malignant tumor to background uptake than observed with the 2-D contrast imaging, and could conceivably supplant MRI gadolinium breast imaging.

CONCLUSIONS

Tomosynthesis offers the possibility of revolutionising mammography. In particular, tomosynthesis may offer the following potential benefits:

- Elimination of overlapping tissues
- Better cancer detection
- Fewer recalls
- Fewer biopsies
- Less dose
- Less painful compressions
- Faster review

Acknowledgements
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Andrew Smith, PhD, is manager of imaging science at Hologic, Inc. in Bedford, Mass, where he is involved in research and development in digital imaging systems. He attended the Massachusetts Institute of Technology, where he received a bachelor and doctoral degrees in physics.

To receive the complete version of this article, please contact Managing Editor Dervla Sains at: editorial@imagingmanagement.org

BUILDING TRUST IN REMOTE REPORTING

Ensuring a Viable Service

Today, the possibilities offered by the digital workplace, such as remote reporting and off-hour coverage mean that virtual radiologists can offer imaging services in new and exciting ways. The challenge, however, is to provide trust over distance - across departmental or even national boundaries. In this article, we discuss three major issues in building trust in remote reporting: organisational change issues, continuous feedback and legal implications.

AUTHORS

Dr Hanna Pohjonen

Rosalieco Oy
Espoo, Finland
hanna.pohjonen@
rosalieco.fi

Prof. Hans Blickman

Chairman

Dept. of Radiology
UMC St. Radboud
Nijmegen, The Netherlands
j.blickman@rad.umcn.nl

Thus far, remote reporting has been technically restricted by point-to-point connections and manual sending of patient information between participating organisations. However, regional solutions for RIS and PACS covering the whole community have addressed this lack, providing healthcare record summaries or index databases that are the glue enabling the viewing of images from other organisations, as well as electronic marketplaces, where consultation services can be delivered in a flexible way.

Financial and Technical Aspects

Financial and technical considerations typically dominate the planning of a remote reporting service. Common questions that are discussed carefully on the side of the service provider include:

- How many units of clinical service will need to be sold to cover costs?
- How many units of clinical service will need to be sold to make a profit?
- What are the resource requirements (funding, personnel costs, facilities, technical solutions, etc.)?
- How does the cost of production balance against projected revenues?

The challenge, however, is to provide trust and learning over distance across departmental or even national boundaries. It is also crucial to understand how the community will be affected by the proposed service to ensure viability after the pilot phase and integration as a seamless part of the radiological operation of a hospital.

In the following section, three different aspects important in building trust in remote reporting are discussed: organisational change issues, continuous feedback and legal implications.

Organisational Change Issues

When the organisation is prepared for integrating remote reporting as part of the radiological operation of a hospital, trust in the service itself can be built. In order to do so, the following factors in the current organisational environment should be considered:

- What groups will support the development of a remote reporting service? Why?
- What groups will block the development of the service? Why?
- How will you gain support or buy-in for the development of the service in your organisation?
- What problems can you anticipate that will affect the success of the remote reporting service?

The remote reporting service provider should be closely involved in the organisational change management of the customer. The customer should get familiar with the 'face' of the service provider. The backgrounds of the project leader and the core project team and their ability to execute the business case strategy should be clearly described. At the very least, the following questions should be answered:

- What are the roles and responsibilities of the project leader and the project team?
- Who are the key leaders, what is their experience with similar projects?
- Does the project team have training or learning needs to support the success of the proposed project?
- Describe the function of outside supporting professional services, if any.
- What are the reporting relationships between key project team members?

Continuous Feedback

When buying a remote reporting service the customer wants proof of quality, known and accepted processes and protocols, transparency, possibilities for peer review and double-blind readings from time to time. On the other hand, the service provider expects access to the relevant data, feedback on discrepancies and learning from other specialists.

A prerequisite for a self-sustainable remote radiology business case includes feedback from both radiologists and clinicians in building and maintaining trust in a remote reporting situation where the service provider is not in the same location and ensuring transparency in performance and quality indicators. Users of the remote reporting service should be able to give digital feedback easily and in a user-friendly way.

At the same time learning is enabled by systematic automation of feedback on different levels between participants in the healthcare process. Constructive feedback creates a safe environment for individual self-improvement. Feedback software should be easy to use and preferably desktop-integrated with the local RIS/PACS (see fig. 1).

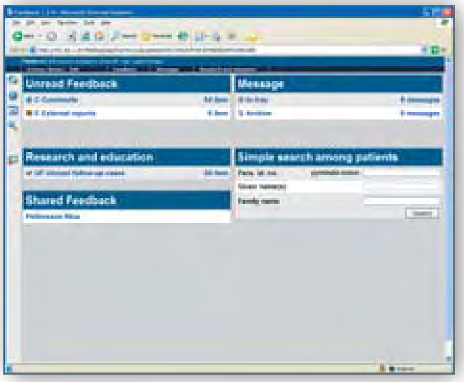

Fig. 1: An example of feedback software from eCare, which can be desktop-integrated with any RIS/PACS.

Legal Implications

In building a remote reporting business case, you should consider the main issues that may arise from the need to manage personal information in a manner that takes into consideration both individual sensitivities and the need to provide healthcare practitioners (and, potentially, patients, administrators and others) with access to health records. In particular, you need to demonstrate that you have understood the trust and security implications arising from the legal and clinical environment in which the remote reporting service is to operate.

The following issues should be discussed and agreed on between the service provider and the customer:

- How will patient information be stored, transmitted and used so that it is kept confidential and only shared with those individuals who have a legitimate need to see it? Will encryption and electronic signatures be needed? How will patient consent be recorded and, if necessary, used to govern access to information?
- How will all actions performed be associated with the individual who performed them? What manual and automated facilities will be required to maintain and subsequently process any audit trail/security log etc.?
- What processes will be used to address disaster recovery and business continuity?
- Who will provide the service and who, ultimately, will be responsible for the care of the patient – will clinical responsibility be shared, in fact, between several clinicians?
- How much will the patient be told about how their information is used and how will their informed, voluntary consent be obtained? Who, under what circumstances, may act on behalf of the patient to grant or withhold consent?
- What legislation governs the capture, storage, dissemination and destruction of information? Are there different legal considerations in different relevant countries? What are the legal implications if the information management process fails to achieve the required or expected Quality of Service as might be described in terms of confidentiality, integrity (e.g. completeness and correctness), and availability (e.g. timeliness) of information?
- Will the service be offered locally, nationally or internationally? If so will the radiologists involved need to be qualified and insured to practice in another country? Will it be necessary for them to revalidate their qualifications or take new ones?
- If the service is to be provided online, how will contracts be created and entered into and how will payments be collected?

Conclusion

Building trust in remote reporting is a complex and challenging task that should be carefully considered from several points of view in order to assure a self-sustainable remote reporting service.

continued from p.29

cians, CT and MR scan departments to establish clinical 3D and scan protocols optimised for clinically useful 3D imaging.

Conclusion

3D imaging in radiology has had a major clinical impact in the past decade in routine clinical practice. However, there is a cost and a learning curve involved in producing optimal clinical 3D imaging. The benefits of implementing 3D imaging services can include improved confidence in diagnosis and treatment/surgical planning, reduced cost and invasiveness of procedures, pre-surgical planning rather than exploratory surgery and ultimately less risk to the patient and improved patient care.


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• high patient throughput
• touchpanel operation
• X-ray tube focus can be lowered down to 35 cm.
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Cardiology system
Opescope
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MobileArt
Mobile X-ray system, motor-driven
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PICTURE ARCHIVING AND COMMUNICATIONS SYSTEMS (PACS)
PRODUCT COMPARISON CHART

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

CONTACT

ECRI Europe

Weltech Centre Ridgeway,
Welwyn Garden City,
Herts AL7 2AA, United Kingdom

info@ecri.org.uk

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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 Also text/arrow annotations, multi-series synchronization, crosshair 3-D navigation, ratio, area, perimeter includ ing freehandmeasurements, and CR and CT image processing.

3 Also cardiology & mammography.

4 Also decesead, discharge date, location, maiden name, name, medical service, medical record #, registration date, gender, VIP, encounter/person personnel relation, encounter/person type, encounterstatus, and financial class.

5 Also remote storage services; supports EMC Centera and enterprise, IBM enterprise storage, and others with integration assessment.

6 Also virtual colonoscopy.

7 Active-active cluster recommended.

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

	ECRI[1]
MODEL	**PACS**
WHERE MARKETED	
SYSTEM CONFIGURATION	
Architecture	Single server cluster
Hardware	Hardware independent
OPERATING SYSTEMS	
Image server	Windows or UNIX
Web server	Windows or UNIX
Security	128-bit SSL
Database server	Windows or UNIX
Management	Experinced database company
LONG-TERM STORAGE	
Media	Hardware independent
Max. Capacity, TB	Unlimited
ON-DEMAND STORAGE	
Hardware	RAID (SAN)
Max. Capacity, TB	Unlimited
Multiple remote servers capable	Yes
DIAGNOSTIC WORKSTATION	
Independent log-in	Yes
Admin-controlled worklist	Yes
Ad hoc patient search capability	Yes
Auto notification of prior exams	Yes
Prior reports (without images)	Yes
User-definable hanging protocols	Yes
Session interruption function	Yes
Color and greyscale display	Yes
Key image select	Yes
3-D image processing	Yes
Specialist physician tools	Orthopedics, cardiology
Integrated report dictation	Yes
Voice recognition	Yes
WEB IMAGES ACCESS	
Radiologist-specific web app	Yes
Max # monitors supported	2
TOOLS	
Patient search	Name or MRN
Image compression	Automatic based connection bandwith
Image manipulation	Identical to diagnostic workstation, except 3-D
Image selection	Thumbnails
Auto remote software updates	Yes
IMAGE SHARING	
Printing support	Yes
CD-ROM production	Yes
SYSTEM ADMIN GUI TOOLS	
Patient manage	Yes
Hardware manage	Yes
Auto fail-over of critical comps.	Yes
BACK-UP	
Power	UPS standard
Dbase frequency	Every hour
AUTO DUPLICATION OF LONG-TERM	
Archive	Yes
Remote system monitoring	Yes
Auto alert of system failure	Yes
Test server	Yes
INTERFACES	
IHE conformance	Year 4
RIS	Brokerless, bidirectional
Electronic patient record	Yes
Report dictation	Yes
Other	
DICOM 3.0	
Query/ retrieve SCP	Yes
Query/ retrieve SCU	Yes
Worklist management	Yes
Performed procedure step	Yes
DICOM JPEG2000	Yes

FUJIFILM	Mercury Computer Systems	CERNER	SIEMENS
Synapse	**Visage PACS 4.0/4.2**	**Provision PACS**	**syngo Dynamics**
Worldwide	Worldwide	Worldwide	Worldwide
Scalable from single server to multi site clusters	Centralized server	Unified PACS/RIS	Client/server
Windows compatible	HP/Compaq/Dell	IBM, Dell, HP, Sun, optional high availability cluster	Micron NetFrame 620/640 (entry level); HP/Compaq ML370 (large)
Windows 2003	Windows 2003 server	Linux or Solaris	Windows Server 2003
Windows 2003, IIS	Windows 2003 server	Linux or Solaris	MS IIS (Win Server 2003)
128-bit SSL	128-bit SSL	128-bit SSL	SSL
Windows 2003	Windows 2003 server	Linux AS, Solaris 8	Windows Server 2003
Oracle	Microsoft SQL server	Oracle	Microsoft SQL
Selectable to customer requirements	HD-RAID/DVD Central Storage (RAID/TAPE...)	SAN/NAS, DVD, HDD, tape library	DVD, DLT, HSM, PACS
Unlimited	Unlimited	Unlimited	Unlimited
Any spinning disk technology	RAID (DAS/SAN/NAS)	RAID (SAN/NAS)	SAN
Unlimited	Unlimited	Unlimited	Unlimited
Yes	Fail-over-server-capable	Optional	No
Yes	Yes	Yes	Yes and user
Yes	Yes	User controlled	Yes
Yes	Yes	Yes	Yes
Yes	Yes	Yes	Yes
Yes	Yes	Yes	Yes
Yes	Yes	Yes	Yes
Yes	Yes	Yes	Yes
Yes	Yes	Yes	Yes
Yes	Yes	Yes	No
With 3rd party	Yes	Yes	No
All tools available to all users	Orthopedics, cardiology	Orthopedic, surgical templates, stitching[3]	Yes
With 3rd party	No (RIS functionality)	Optional	No
3rd party integrated	No (RIS functionality)	Optional	No
Same for all users	Yes	Yes	Yes
5	2	4 + 1 for RIS	Unlimited
Name, MRN, census, Query by example (QBE)	Elaborate filtering grid	Multiple aliases, any institution specific alias, client, age range, DOB, race[4]	Name, MRN, user defined
Lossless, user selectacble lossy	2 independent levels adjustable	JPEG 2000	Proprietary
Window /level, zoom, pan, magnify, cine, density value, ROI, angle/ruler measure[2]	All, limited 3D functionality	Zoom, pan, invert, orientation, line measurements, window with/level, others	Gamma correction
Thumbnails, crosshair for across series in diff planes	Thumbnails, series overview	Thumbnails and worklist	Multiple image formats
Workstations Yes	Yes	Yes	Yes
Yes	Yes	Yes	Paper, DICOM
With 3rd party	Yes	DICOM CD burner	Optional
Yes	Yes but limied to PACS-typical requirements	Yes	Yes
Yes	Yes	Yes	Yes
Yes	Yes	Optional	Yes
UPS	UPS	Yes	Yes, UPS standard
Daily, configurable, permanent transaction logging	Administrator definable	Site configurable	Daily
Optional	Optional	Yes	Yes
Yes	Yes	Yes	Yes
Optional	Yes	Yes	Yes
Yes	Optional	Optional	Optional
Year 4, selected profiles	Brokerbased	Yes	Yes. Evidence Creator profile for Echo and Vascular studies
Brokerless, bidirectional, HL7, Web interface	Brokerless, URL based, bidirectional	Unified/brokerless	Bidirectional
Yes	Via URL	Yes	Broker or interface
Yes	No (RIS Funtionality)	Optional	No
	Report storage and correcture	Not specified	Not specified
Yes	Yes	Yes	Yes
Yes	Yes	Yes	Yes
Yes	Yes	Yes	Yes
Yes	Yes	Yes	Yes
No	No	Yes	No

	ECRI[1]	Kodak	VEPRO
MODEL	PACS	Carestream 10 PACS	Medimage
WHERE MARKETED		Worldwide	Worldwide
SYSTEM CONFIGURATION			
Architecture	Single server cluster	Centralised, distributed	Centralized server with backup server
Hardware	Hardware independent	Sun, Wintel	VEPRO class 2b certified
OPERATING SYSTEMS			
Image server	Windows or UNIX	Sun Solaris, Windows	Windows 2003
Web server	Windows or UNIX	Sun Solaris, Windows	Windows 2003
Security	128-bit SSL	128-bit SSL	128-bit SSL
Database server	Windows or UNIX	Sun Solaris, Windows	Windows 2003
Management	Experinced database company	Oracle	VEPRO
LONG-TERM STORAGE			
Media	Hardware independent	Spinning disk, DVD jukes, tape jukes[5]	CD/DVD robot
Max. Capacity, TB	Unlimited	Unlimited	Unlimited
ON-DEMAND STORAGE			
Hardware	RAID (SAN)	RAID (SAN/NAS)	RAID-SAN
Max. Capacity, TB	Unlimited	Unlimited	3-256
Multiple remote servers capable	Yes	Optional	Yes
DIAGNOSTIC WORKSTATION			
Independent log-in	Yes	Yes	Yes
Admin-controlled worklist	Yes	Administrator/user	Yes
Ad hoc patient search capability	Yes	Yes	Yes
Auto notification of prior exams	Yes	Yes	Yes
Prior reports (without images)	Yes	With/without images	Yes
User-definable hanging protocols	Yes	Yes	Yes
Session interruption function	Yes	Yes	Yes
Color and greyscale display	Yes	Yes	Yes
Key image select	Yes	Yes	Yes
3-D image processing	Yes	Yes	Yes
Specialist physician tools	Orthopedics, cardiology	Orthopedic templating, mammography[6]	Optional
Integrated report dictation	Yes	Optional	Yes
Voice recognition	Yes	Optional	Yes
WEB IMAGES ACCESS			
Radiologist-specific web app	Yes	Yes	Yes
Max # monitors supported	2	2	2
TOOLS			
Patient search	Name or MRN	Any defined worklist field; worklist can select DICOM fields	Patient demographics, DICOM worklist
Image compression	Automatic based connection bandwith	User selectable	User-selectable lossless, lossy
Image manipulation	Identical to diagnostic workstation, except 3-D	All, except 3-D	All
Image selection	Thumbnails	Thumbnail, key images, series, study/image level searches	Thumbnails, text
Auto remote software updates	Yes	Yes	Yes
IMAGE SHARING			
Printing support	Yes	Yes	Yes
CD-ROM production	Yes	Optional	Yes
SYSTEM ADMIN GUI TOOLS			
Patient manage	Yes	Yes	Yes
Hardware manage	Yes	Yes	Yes
Auto fail-over of critical comps.	Yes	Optional[7]	Yes
BACK-UP			
Power	UPS standard	UPS	UPS
Dbase frequency	Every hour	User defined	Online
AUTO DUPLICATION OF LONG-TERM			
Archive	Yes	Yes	Yes
Remote system monitoring	Yes	Optional	Yes
Auto alert of system failure	Yes	WIP	Yes
Test server	Yes	Optional	Optional
INTERFACES			
IHE conformance	Year 4	Year 4	Yes
RIS	Brokerless, bidirectional	Brokerless	All major RIS via own PACS broker
Electronic patient record	Yes	Via URL activation	Full implementation
Report dictation	Yes	Optional	Yes
Other		Stds based for LDAP, DICOM, HL7, URL	Any doc can be stored in archive
DICOM 3.0			
Query/ retrieve SCP	Yes	Yes	Yes
Query/ retrieve SCU	Yes	Yes	Yes
Worklist management	Yes	Optional	Yes
Performed procedure step	Yes	Yes	Yes
DICOM JPEG2000	Yes	Yes	Yes

ANALOG MAMMOGRAPHY PRODUCT COMPARISON CHART

	ECRI [E1]	Planmed	Planmed
MODEL	Analog Mammography	Nuance Classic [P1]	Sophie [P1]
WHERE MARKETED		Worldwide	Worldwide
FDA CLEARANCE		Yes	Yes
CE MARK (MDD)		Yes	Yes
GENERATOR TYPE	High-frequency, single-phase	Constant potential, high-frequency, 80 kHz, single phase	Constant potential, high-frequency, 80 kHz, single
kV RANGE	22-35	20-35, increments of 1kV	20-35, increments of 1kV
mAs RANGE	4-600	1-720	1-720
mA range	Up to 100	42 small focus, 120 large focus; available with a tube that gives 35 mA with small focus and 110 mA with large focus	42 small focus, 120 large focus; available with a tube that gives 35 mA with small focus and 110 mA with large focus
Time range, sec	0.02-8	0.1-5 broad focus, 0.1-9.9 fine focus	0.1-6 broad focus, 0.1-9.9 fine focus
AEC DETECTOR	Yes	Flex-AEC with 48 detectors	Solid state with 3 independent sensors
Parameters controlled	kV,mAs, anode/ filter	mAs, kV [P2]	mAs, kV [P3]
X-RAY TUBE			
Anode type	Rotating	Rotating, oil and fan cooled	Rotating, oil and fan cooled
Heat capacity, HU	300,000	300,000	300,000
Heat dissipation rate, HU/ min	60,000	56,000	56,000
Target/ filter combinations	Mo/ Mo, Mo/ Rh	Mo/ Mo, Mo/ Rh	Mo/ Mo, Mo/ Rh
Focal spot size, mm	0.1 and 0.3	0.1 and 0.3	0.1 and 0.3
POSITIONING ASSEMBLY			
Collimation	Yes	Automatic	Automatic
18 x 24 cm	Yes	Yes	Yes
24 x 30 cm	Yes	Yes	Yes
Movement locks	Electromagnetic	Motorized	Motorized
Assembly movement			
Rotation,	-135 to +180	+180, -135, motorized, isocentric, adjustable speed	+180, -135, motorized, isocentric, adjustable speed
Vertical, cm (in)	100 (39.4)	60 (23.5) motorized, adjustable speed	60 (23.5) motorized, adjustable speed
SID, cm	66	65	65
Scale guide	Distance and pressure	Digital display of force, thickness, and angle	Digital display of force, thickness, and angle
HANDSWITCH		Yes	Yes
RADIATION OUTPUT			
mR/ sec @ 28 kVp	>800	1,300	1,300
RADIATION SHIELD		Optional	Optional
L x W, cm (in)		185 x 75 (73 x 30)	185 x 75 (73 x 30)
Thickness		0.5 mm Pb equivalent or 0.3 mm	0.5 mm Pb equivalent or 0.3 mm
COMPRESSION SYSTEM	Manual, automatic, fine adjustment	Motorized, user-adjustable degressive speeds and force; manual compression, automatic or manual release of compression; digital display for breast thickness and applied force; optional MaxView breast positioning system	Motorized, user-adjustable degressive speeds and force; conventional and Twincomp compression systems, automatic or manual release; digital display for breast thickness and applied force; optional MaxView breast positioning system
Force, newtons	200	Selectable to 200	Selectable to 200
SCREEN-FILM SYSTEMS	All (unless digital)	9 user selectable; 1 user configurable for AEC	9 user-selectable; 1 user-configurable for AEC
GRID RATIO	5:1	5:1, 34 lines/cm	5:1, 34 lines/ cm
BUCKY	For both film sizes	18 x 24 cm; 24 x 30 cm reciprocating	18 x 24 cm; 24 x 30 cm reciprocating
MAGNIFICATION DEVICE	Yes	1.6x, 1.8x, 2.0x	1.3x to 1.8x, motorized and continuosly adjustable
STEREOTATIC DEVICE	Optional	Microprocessor-controlled Nuance Classic Cytoguide/Nuance Classic DigiGuide	Microprocessor-controlled Cytoguide/ DigiGuide
FILM ID SYSTEM	Yes	Network ID camera	Network ID camera
LABEL PRINTER	Optional	optional	Optional
POWER REQUIREMENTS		208-240 10% VAC; 50/60 Hz; 15A	208-240 10% VAC; 50/60 Hz; 15A
H x W x D, cm (in)		103 x 76 x 100 (40.4 x 29.9 x 39.2)	98.5 x 76 x 90 (38.8 x 29.9 x 35)
WEIGHT, kg (lb)		180 (396)	160 (352)
OPTIONAL ACESSOIRES		MaxView breast positioning system, side access positioning system, Nuance Classic Cytoguide/DigiGuide, network ID camera, perforated or rectangular localization paddle with scale and crosshair, high-lip paddle, accessory storage unit, shield, turnable base, CR interface	Cytoguide, DigiGuide, network ID camera, rectangular localization paddle with scale and crosshair, high-lip compression paddle, MaxView breast positioning system, radiation protection screen, accessory storage unit, CR interface, flex-AEC
OTHER SPECIFICATIONS		Dual control panels; automatic Rh filter selection; fully automatic technique selection based on tissue thickness and composition; compact and transportable; automatic release; antiblooming (bias) circuit; automatic view angle; help-code display; built-in calibration and maintenance system. [P4]	Dual control panels; automatic Rh filter selection; fully automatic technique selection based on tissue thickness and composition; compact and transportable; automatic release; antiblooming (bias) circuit; automatic view angle; help-code display; built-in calibration and maintenance system; autoload Bucky. [P4]

ERRATUM

Due to a technical fault beyond our control, some of the data in the last edition's Product Comparison Chart was incorrectly transmitted. Please find herewith the corrected version.

	Planmed Sophie Classic [P1]	GE Healthcare Diamond	HOLOGIC Lorad Affinity Series	HOLOGIC Lorad M-IV Series
	Worldwide	Worldwide	Worldwide	Worldwide
	Yes	Yes	Yes	Yes
	Yes	Yes	Yes	Yes
	Constant potential, high-frequency, 80 kHz, single	Single-phase, high-frequency, 3.6 kVA (2.5 kW)	Constant potential, high-frequency, inverter	Constant potential, high-frequency, inverter
	20-35, increments of 1kV	15-39, increments of 1 kV	20-39, increments of 1kV	20-39, increments of 1kV
	1-720	2-500	3-500	3-500
	42 small focus, 120 large focus; available with a tube that gives 35 mA with small focus and 110 mA with large focus	30-100	10- 100	10- 100
	0.1-6 broad focus, 0.1-9.9 fine focus	0.02-10	Up to 5	Up to 5
	Solid state with 3 independent sensors	AutoPoint, 8 discrete detector arrays	Solid-state	Solid-state
	mAs, kV [P3]	Time, kV, mA, filter, detector	Automatic time/ kV/ filter	Automatic time/ kV/ filter
	Rotating, oil and fan cooled	Rotating, dual-angle	Mo, rotating	Mo, rotating
	300,000	300,000	300,000	300,000
	56,000	60,000	60,000	60,000
	Mo/ Mo, Mo/ Al; optional Mo/ Rh	Mo/ Mo, Mo/ Rh, Mo/ Al	Mo/ Mo, Mo/ Rh	Mo/ Mo, Mo/ Rh
	0.1 and 0.3	0.1 and 0.3	0.1 (small), 0.3 (large)	0.1 (small), 0.3 (large)
	Automatic	Automatic	Automatic	Automatic
	Yes	NA	Automatic	Automatic
	Yes	NA	Automatic	Automatic
	Motorized	Motorized	Electromagnetic, fail-safe	Electromagnetic, fail-safe
	+180, -135, motorized, isocentric, adjustable speed	185	+195, -155, digital readout	+195, -150, digital readout
	60 (23.5) motorized, adjustable speed	77 (30)	71-140 (28-55) motorized	63.5-140 (25-55) motorized
	65	66	65	65
	Digital display of force, thickness, and angle	Digital	Digital readout	Digital readout
	Yes	Yes	No	No
	1,300	≥840	≥800	→1,500, 60 cm
	Optional	Yes	Yes	Yes
	185 x 75 (73 x 30)	194 x 81 (76 x 32)	185 x 60 (73 x 24)	190 x 80 (75 x 31)
	0.5 mm Pb equivalent or 0.3 mm	0.5 mm Pb equivalent	0.5 mm Pb equivalent	0.5 mm Pb equivalent
	Motorized, user-adjustable degressive speeds and force; automatic or manual release of compression; digital display for breast thickness and applied force; optional Twincomp or MaxView breast positioning system	Motorized, bidirectional ECS, SoftTouch manual	Manual, motorized in both directions; precompression, full compression; dual footswitch	Manual, motorized in both directions; precompression, full compression, dual compression modes; dual ,footswitch
	Selectable to 200	0-250	110-178 full compression, 300 manual	89-178 full compression, 300 manual
	9 user-selectable; 1 user-configurable for AEC	NA	Up to 3, programmable	Up to 3, programmable
	5:1, 34 lines/ cm	5:1, ROC equivalent 6:1	HTC or 5:1 linear, focused standard	HTC or 5:1 linear, focused standard
	18 x 24 cm; 24 x 30 cm reciprocating	18 x 24 cm; 24 x 30 cm	18 x 24 cm, 24 x 30 cm	18 x 24 cm, 24 x 30 cm
	1.6x, 1.8x	MultiChoice single device 1.6x, 1.8x, 2x	1.8x	1.8x
	Microprocessor-controlled Cytoguide/ DigiGuide	Delta 32	Stereotactic compatible	Optional StereoLoc II
	Daylight ID system or network ID camera	Dataflash Plus	Rapid ID Flasher	Integrated AutoFilm ID
	Optional	NA	Optional	Optional
	208-240 10% VAC; 50/60 Hz; 15A	198-264 VAC; 50/60 Hz; 16A	200-240 VAC 10%; 50/60 Hz; 25 A	200-240 VAC 10%; 50/60 Hz; 35 A
	98.5 x 76 x 90 (38.8 x 29.9 x 35)	194 x 68 x 121 (76.5 x 27 x 48)	178 x 76 x 109 (70 x 30 x 43)	190 x 64 x 128 (75 x 25 x 50) gantry, 189 x 81 x 43
	160 (352)	350 (771)	268 (588)	384 (800) gantry, 91 (200) console
	Cytoguide, DigiGuide, network ID camera, perforated or rectangular localization paddle with scale and crosshair, high-lip paddle, MaxView breast positioning system, Twincomp compression, radiation protection screen, accessory storage unit, CR interface, flex-AEC	3-D imaging with TACT (tuned aperture comp.tomography), specialty paddles	HTC grid and FAST paddles (standard on platinum models), various compression paddles, magnification table, localization kit; 10 cm coned down, aperture, view, or integrated markers	HTC grid and FAST paddles (standard on platinum models), various compression paddles, StereoLoc II, DSM, localization kit, barcode reader, accessory cabinet, integrated markers, MIS interface
	Dual control panels; automatic Rh filter selection; fully automatic technique selection based on tissue thickness and composition; compact and transportable; automatic release; antiblooming (bias) circuit; automatic view angle; help-code display; built-in calibration and maintenance system; [P4, P5]	ParkBack tube head; AutoPoint automatic detector selection; PaddleLogic; motorized cassette loading. Meets requirements of IEC 60601-1, ISO 9001, MQSA, and UL.	18 x 24 cm SRL 2000 ;Bucky; 24 x 30 cm SRL 2000 Bucky; HTC grids; FAST paddles, various paddles; magnification platform; full-field magnification; aperture; face shield; radiation shield; Rapid ID Flasher; dual-function footswitch; auto aperture; integrated markers available [H1]	18 x 24 cm SRL 2000 Bucky; 24 x 30 cm SRL 2000 Bucky; HTC grids; FAST paddles, various paddles; magnification table; face shield; radiation shield; AutoFilm ID; dual-function footswitch *Please note: The M-IV is CR compatible and meets European mammography requirements.*

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

FOOTNOTES TO THE PRODUCT COMPARISON CHART

ECRI
E1 These recommendations are the opinions of ECRI's technology experts. ECRI assumes no liability for decisions made based on this data.

Planmed
P1 Marketed in Japan by Shimadzu Corporation.
P2 User-selectable normal AEC (mAs) or advanced AEC (mAs, kV); kV and thickness compensated; flex-AEC automatically selects sensors.
P3 User-selectable normal AEC (mAs) or advanced AEC (mAs, kV); kV and thickness compensated
P4 Complies with IEC 60601-1, IEC 60601-2-45, IEC 60601-1-2 (EMC) and IEC 60601-2-28 (x-ray tube assemblies). Meets requirements of CSA, DHHS, and UL.
P5 autoload Bucky with MaxView/MaxView-ready units.

Hologic
H1 Please note: The Affinity is CR compatible and meets European mammography requirements.

THE MEDICAL IMAGING INDUSTRY IN GERMANY

Largest Single Imaging Market in Europe

Germany is probably unique in that it maintains two separate systems for providing medical imaging services. Although radiologists and other medical specialists using medical imaging technologies operate both in hospitals as well as in outpatient facilities, both offices are subject to two different reimbursement systems. In addition, some medical imaging technologies may be used by non-radiologic specialists in Germany, for example, the use of diagnostic ultrasound by a wide range of medical specialist professions. From the point of view of providers of medical imaging equipment, this means that they have to adjust to different groups of customers as well as different economic conditions.

AUTHOR

Dr Hans-Peter Bursig

Managing Director

ZVEI Division Medical Engineering

Frankfurt am Main, Germany

bursig@zvei.org

Imaging Hit by Cost Control

In the past five years, the German market for medical imaging equipment has been basically stagnant, due to a number of cost containment measures in the Statutory Health Insurance system, known by its German abbreviation "GKV". Through a number of measures, reimbursement for all medical procedures, including medical imaging, has been controlled. At the same time, Germany introduced a DRG-based reimbursement system in its hospitals. These influences and changes have in the past years greatly reduced the ability to invest in medical imaging technologies.

Market Values 2000-2005 Sum: Medical Imaging only

2000	2001	2002	2003	2004	2005
734m €	715m €	732m €	710m €	718m €	732m €

Lower Demand for Mid-range Equipment

The German market for medical imaging equipment (excluding IT systems like RIS and PACS) has an average yearly value of around 725m Euro. At the top end of the market, modern equipment has replaced previous generations, thus improving the quality and efficiency of imaging services provided. At the lower end of the market, modern production methods introduced by the industry have helped to make economic versions of imaging equipment widely available. Such systems tend to provide only a limited set of features compared to the most advanced systems. Depending on reimbursement details in Germany, there is a slight pull for high end quality as well as for low end prices at the same time. Customers have increasingly revised their procurement practices to reflect this new economic environment. Increasingly, funds available for investment are distributed between high- and low-range pieces of equipment, reducing the market potential for mid-range equipment. The following paragraphs look at several segments of the market.

Market Segments

MRI and CT, the current procedures of choice for most clinical situations, enjoy relatively favourable market conditions, although they are subject to the general trends described above. Multi-slice CT as well as high-field MRI systems have encouraged replacement decisions in order to keep track of technological as well as medical developments.

Trend of Digitisation in Imaging

In Germany, x-ray as well as angiography modalities are open to use from non-radiologist medical specialists. However, this is under the condition that the individuals in question have acquired the necessary qualifications and the use of these imaging technologies falls within the scope of their specialty. Examples are cardiologists as well as orthopaedic specialists, who both make use of medical imaging in questions specific to their specialty. While the demand for angiography has benefited from advances in interventional radiology, the demand for x-ray equipment has been declining. This is mainly due to the economic situation of non-radiologic users of such equipment.

Nevertheless, the introduction of digital x-ray technologies (both CR and DR) has led to the replacement of conventional systems. This is especially the case in settings where most of the equipment used is already digital and feeding information into a departmental information system and a PACS. A specific situation also exists in the area of mammography. Germany is in the process of establishing a national mammography screening programme. The requirements for this programme may lead to the replacement of a certain number of existing pieces of equipment.

Some Technologies Still Lack Attention
The market for nuclear medicine is subject to particular conditions, since conventional nuclear medicine has been restricted to specific procedures and cases due to advances in other imaging technologies. On the other hand, PET is providing a powerful imaging technology, whose full potential is not yet fully understood. The development of hybrid systems (e.g. PET/CT) is further enlarging the scope for PET. The market is, nevertheless, held back by the fact that PET has not yet received approval for reimbursement from “GKV”, if performed outside hospitals. In total, the market for conventional nuclear medicine systems has been stable, while limited growth has been achieved in the market for PET systems.

High Quality of Equipment and Education
The market for diagnostic ultrasound shows the most diverse picture. Used by most medical specialists, ultrasound is the most widely-used technology in Germany. This has led to the development of a large number of specific applications and technologies being available. Despite that degree of specialisation, the market has to a very high degree been subject to the general trends described above. The number of pieces of equipment sold has increased, while the total value of the market has remained stable. At the same time, the German Society for Ultrasound in Medicine (DEGUM) is concerned about the education of users of ultrasound in Germany and is proposing stronger criteria for training. Another concern of DEGUM is that a considerable number of pieces of equipment may be too old and are not in a proper state of maintenance.

Improvements in Workflow
Of specific note is the market for IT systems in radiology, particularly Radiology Information Systems (RIS) and Picture Archiving and Communication Systems (PACS). This market in Germany is worth approximately 100m Euro per year, although the award of large-scale projects may distort the picture in individual years. The need to improve efficiency and maintain diagnostic quality requires customers to analyse processes within their departments and improve workflow. As a consequence, customers increasingly aim to integrate and upgrade existing IT systems. In this context, German customers are putting considerable emphasis on the use of reliable standards and open, practice-oriented interoperability requirements. For example, most calls for tender name compliance with DICOM and certain DICOM services as compulsory. In order to promote the interoperability of IT solutions across technical borders and different providers, the German X-ray Society and ZVEI jointly support the Integrating the Health Care Enterprise (IHE) initiative in Germany. This initiative has found strong interest among radiologists in Germany and is now being applied in other medical domains with considerable success.

Germany Remains an Attractive Imaging Market

The German market is the single largest market within Europe and capable of absorbing innovative medical imaging technologies. At the same time, the high number of qualified users provides a powerful platform for the further development of medical imaging technologies. However, ZVEI estimates the investment backlog in Germany from previous years to be between 5 to 7 billion Euro for medical imaging equipment alone. Based on this, there is considerable need for the modernisation of the existing infrastructure.
The climate for investment began to improve in 2005. There are indications that the adjustment to the new economic and organisational conditions for medical imaging has been largely completed. Customers are now increasingly looking at investment in medical technologies as a way to further improve the quality and efficiency of their departments. From a business perspective and despite its complex nature, the German market for medical imaging equipment therefore remains highly attractive.

GERMAN RADIOLOGICAL SOCIETY

Profile of the Deutsche Roentgengesellschaft (DRG)

On May 2, 2005, the Deutsche Roentgengesellschaft (DRG) celebrated its 100th anniversary. Founded in 1905 in Berlin, its illustrious list of founding members includes Conrad Wilhelm Roentgen. Today, the society has grown to include nearly 6,000 members.

AUTHOR

Prof. Maximilian Reiser
President
German Society of Radiology (DRG)
Berlin, Germany
office@drg.de

Origins of the Society

The initiative for founding a national society of radiology came from the ‘roentgenvereinigung’ (community of radiologists) in Berlin, which was at that time in existence for seven years. Roentgen’s findings created great enthusiasm and found wide acceptance among the medical community not only in Germany but also worldwide. Since 1896, radiology has already been an exciting science marked by the installation of a ‘roentgen laboratory’ in the surgical department of the famous Charité hospital in Berlin. The plan to invite ‘roentgenologists’ from all over the world to participate in the 1st German Congress was developed in Berlin and was embraced by the radiologic community worldwide.

From Annual Congress to National Society

The initiators of the Congress decided therefore to create a national society in order to organise an annual scientific meeting and thus to improve the exchange of knowledge amongst its members. 180 participants applied onsite for membership. Since then, 87 German congresses of radiology have taken place.

As with other medical fields, specialisation in radiology led to offshoots which then became independent societies. The majority of our members are active in diagnostic and interventional radiology. Close cooperation with radio-oncology, nuclear medicine and medical physics is a necessity that has additionally been cemented by written agreements.

Mission

The original ideas of the founding pioneers have not changed during the last century. Our mission is still to encourage and support research in all fields of radiology, to offer a forum for national and international exchange of knowledge and expertise, to support continuing radiological education, to foster the cooperation and interaction with radiological subspecialties, as well as with the medical profession at large, and to offer political institutions the know-how of our experts.

With specialisation and with the rapid development of new technologies, specialist groups have been founded within the framework of our society. Today more than twenty working groups, task forces and commissions are supporting the Board of Directors and promoting radiology wherever possible.

Board of Directors

The board of directors is elected biannually. It consists of ten members and combines radiologists from both university and public hospitals, as well as private practice. As well as myself, the Vice-president is Prof. Dr Bernd Hamm from Berlin and the President-elect is Prof. Dr Michael Laniado from Dresden.

Continuing Education

In 1998, our society founded an Academy of Continuing Medical Education in Radiology which became one of the most powerful tools to certify and evaluate seminars and courses in radiology. Participants from all courses certified by the Academy evaluate individual lectures by filling in a standardised questionnaire. The electronic evaluation of the forms allows each lecturer to compare his results with the averaged results of all lectures within the programme of the Academy. This procedure, which has been adapted by a number of other medical societies in Germany, led to an improvement of the didactic quality of the courses and the individual presentations. 3,600 radiologists so far have become members of this Academy.

The Congress Today

As was the case from the very beginning, one of the core activities of the Deutsche Roentgengesellschaft is the organisation of the annual radiology congress in Berlin. It attracts about 7,000 participants annually from Germany and its neighbouring countries. With the introduction of an 'International Day' where experts from abroad present state-of-the-art lectures on highly attractive topics, the congress welcomes increasing numbers of participants from colleagues of other European countries. During 2007, the central topics of the International Day will be mammography and prostate cancer.

The international lectures are presented in English, whereas most of the other presentations are in German. More than 1,000 abstracts are submitted annually. Abstracts are evaluated and rated by a reviewing board. The final selection is done by the congress President and his team. Only 55% of submitted papers will be accepted. Since the last congress, all posters are presented electronically within the EPOS system.

IT AND WORKFLOW ORGANISATION

Information Technology in a University Radiology Department

The Johannes Gutenberg University Hospital is a fairly typical example of university hospitals in Germany. It has about 1,500 beds, serving 55,000 inpatients per annum as well as a large number of outpatients.

AUTHOR

Dr Peter Mildenberger

Senior Radiologist

Department of Radiology
Johannes Gutenberg
University Hospital
Mainz, Germany
milden@
radiologie.klinik.uni-mainz.de

We provide a wide range of radiology services, dispersed throughout different departments, including General and Interventional Radiology, Neuroradiology, Nuclear Medicine and Paediatric Radiology. For example, in the main department (General and Interventional Radiology), more than 130,000 studies are performed each year, including 23,000 CT studies and 3,000 interventions. A wide variety of different multi-slice CT scanners are available, including a 64-row, 16-row and 4-row scanner in the main department and a 32-row scanner in Neuroradiology.

Current Information System

All departments are linked by one general information system (RIS), which has been in operation since 1988. The RIS (Lorenzo RadCentre, iSoft) is used for patient data (ADT), scheduling, documentation, reporting, analysis and various other tasks. Also, for analysis and benchmarking we have initiated a proprietary small 'business warehouse' application. At the present moment, speech recognition is under evaluation and will become part of the reporting process in order to improve turnaround time. We also have an interface for the transmission of patient data, reports or documentation within the administrative system.

Growing Uses for PACS

As one of the earliest users in Germany, our PACS has been operational (including ProVision, Cerner, and Lumigo, ConVis) since 1996. As of 2000, PACS is used as a general image management solution available for all departments of the hospital which acquire digital images, for example, cardiology, endoscopy and microscopy, among others. More than eighty modalities are now connected within the PACS. The amount of new data is about 13TB per year, with ever-growing numbers due to new techniques in CT, MRI and other new image sources. However, about 50% of this data comes from CT alone.

The second most significant image source is ultrasound, particularly with echocardiography, where cine-loops as DICOM multi-frame-objects are part of the study. A hospital-wide image and report distribution system is available, which is very well integrated and heavily in use, with more than 2,500 requests per day.

Open and Scalable PACS

In 1996, we began a new concept for an open and scalable PACS based on the relatively new DICOM standard, inaugurated in 1993/94. At the beginning of our PACS activities, it was very often cumbersome to connect new devices with this new information system, because of limited knowledge by the vendors about interfacing with new DICOM services. Over the years, this issue of integration has been dealt with. Today, connecting a new device is almost easy. 'Integrating the

Health Enterprise' (IHE) profiles and experience have proven very helpful for users, because of the standardised processes generated by them that have created defined guidelines for interfacing.

In each new request for proposals we initiate, we now ask for specific IHE profiles, even for modalities like CT or MRI as well as for information systems. Today we use IHE profiles for Scheduled Workflow (general workflow), Patient Information Reconciliation (updates between different IT systems), ConsistentTime (for synchronisation of system time in different computers) and Patient Data Interchange (Generating DICOM-CDs). Other profiles like Key Image Note, Enterprise Wide User Authentification or Personal White Pages are under evaluation or in implementation.

Teleradiology Solution

We are currently engaged in developing tools for an independent and open teleradiology solution (www.tele-x-standard.de). This solution connects the different hospitals within the overlying university hospital structure, and is in use for radiological examinations in emergency situations, consultation or follow-up studies. Also, a very new application is the transmission of cardiological studies from the cath lab to our heart surgeons. The technical basics of the solution are encryption and signature, based on PGP (which could also be extended to s/mime), transmission with SSH or DICOM email. This approach has been approved by a national initiative, supported by the Geman Society for Radiology (DRG). Professional support is also available from different companies such as Aviconet. Medical image processing is another important topic, because new CT and MRI studies allow quantification and functional analysis, e.g. tumour measurements, growing factors, heart function and tumour activity. We are active in this area with our own experts and also a member of a related national research group, VICORA (www.vicora.de).

IT in Education

One of our most significant activities focuses on promoting IT in education, not only for students but for physicians, too. Basic training experiences such as implementing a learning platform and building a case collection are becoming more and more important.

Internal Organisation

Because of so many different acitivities in IT, we have our own experts, a group of four people, as part of the staff in the radiology department responsable for RIS, PACS, teleradiology, hardware and so on. This underpins a strong cooperation with the central IT department, which is providing the network or internet access. Radiologic IT staff are also supported by various developers for teleradiology, eLearning or image processing solutions.

EDUCATION AND TRAINING FOR RADIOLOGY

The Experience in Germany

To become a radiologist in Germany, several important educational steps must be taken during and after completion of the study of medicine. Knowledge acquisition ranges from basic information during medical study, to practical education in a hospital and finally, to continuing education and special courses after board certification to become a radiological specialist.

AUTHOR

Prof. Dr Berthold B. Wein

Associate Professor of the Department of Radiology Medical Centre of the Technical University of Aachen and Private Practice Radiologist,

Gemeinschaftspraxis im Kapuzinerkarree, Aachen

Foundation Studies in Medicine

Already during the foundation studies in medicine, several general lessons make students familiar with the physics and methodologies of radiology, coupled with exercises to show the most important exams and their signs for selected diseases. In former times, these lessons were guided by an experienced radiologist and images were adapted to the lessons' topics. Some German universities have now launched a new course of study, where quite early (i.e. in the 3rd semester of the study) students are taught radiology during courses in anatomy and clinical disciplines beside the intrinsic information of that discipline.

In addition, there are courses to make students aware of radiation protection methods. During the last year of study, four months can be spent in a radiology department of a teaching hospital where live practice may be experienced by the student shortly before passing the medical state examination. In some clinical environments, first experiences are also made with interpreting radiological images. Having passed the medical state exam, basic knowledge has been acquired about radiology and its methodologies.

Residentship: Achieving Board Certification

To achieve board certification as a radiologist, interested physicians must enter a five-year assistantship, mainly performed in a hospital environment but to a limited extent also in a private teaching practice. A one-year assistantship in a clinical discipline is also accepted as a training period. During this time, certain obligations must be fulfilled by the resident, including self-performed exams monitored by an experienced radiologist. With an attestation of his period of education and exams performed, he can apply for board certification which obligates him to pass a 30-minute exam conducted by the Board. This certification permits performance of exams under his own responsibility. Federal Medical Associations are liable for those curricula and exams, which differ for every federal state in Germany and may have different rules for the certification process. However, recent homogenisation efforts are being undertaken to end up with nearly equal education regulations for all federal states all over Germany.

Continuing Medical Education

The next step is to apply for a hospital working place or for work in the medical supply system in the compulsory health insurance (CHI) system, which increases familiarity with more complex exams or facilitates specialisation in specific subdomains such as neuroradiology or paediatric radiology, for an additional period of two to three years.

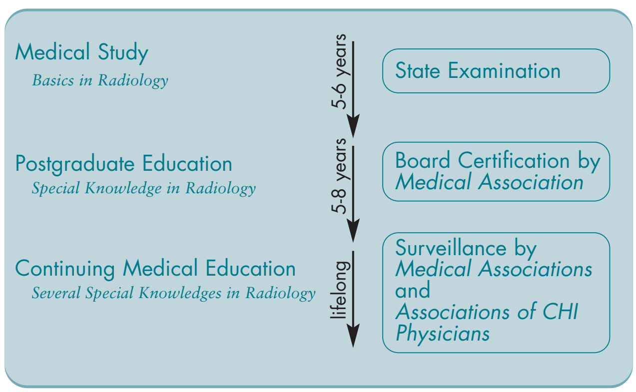
At the end of that period there will be another board certification that testifies knowledge in the respective subdomain. If the decision is to enter the CHI services, quality assurance measures exist to ask members in the CHI medical supply system to prove continuing medical education (CME) by courses and visits to specialised centres. The CME is assessed by national medical associations via credit points of which 50 per year must be collected. There are some detailed differences between distinct courses, but in general, one point equals one hour of certified and monitored education in a medical topic. Approval is given by the medical associations and they oversee the courses. Normally those courses are paid by participants and no reimbursement is given.

Quality Control in Mammography

Mammography is one specific field where radiologists must show continuing quality and education. In curative mammography, every two years the radiologist must sit an exam where cases from a mammographic database have to be solved. The exam is conducted by the CHI, supported by the Cooperative Initiative for Mammographic Screening, Germany. Also overseen by the CHI is the quality of mammographies and reports, surveyed by dedicated medical colleagues, assessing images and reports on a random basis from year to year for each association member. Both exams stimulate radiologists to keep a high level of quality. In screening mammography even higher efforts for quality are laid out, including thorough examinations of reading radiologists on a yearly basis, as well as extended observation and supervision of the decisions of those reading radiologists. If the level of quality is lower than a fixed margin, additional courses and teaching materials are implemented.

Conclusion

Becoming a radiologist in Germany is, for more than 6,000 radiologists, a certified and continuously supervised task. Thorough educational courses allow a continuing medical education and guarantee a high level of skills and knowledge.



Education of Radiologists in Germany

AUTHOR
Harry Granito
Chief Operating Officer
Ross School of Business
University of Michigan
Michigan, United States
hgranito@bus.umich.edu

HOW TO...
MANAGE EMPLOYEES IN A RADIOLOGY DEPARTMENT

PART ONE OF A TWO-PART SERIES EXPLORING EMPLOYEE MANAGEMENT STRATEGIES IN RADIOLOGY DEPARTMENTS

Radiology departments, due to their size and complex patient care processes usually have a full-time administrator to oversee these activities. In my former position as administrative manager of the radiologist group at the University of Michigan medical school, a department that performs over 500,000 procedures per year in two main hospitals and six satellite locations in a two-county area, it was essential that each potential area of conflict was tightly controlled by policies and procedures.

What are the Requirements?

To effectively manage an organisation of this size and complexity requires you to manage other managers, and to develop strategies for organisational success. The responsibilities of the clinical department administrator are to not only support the Chairman, but generally to ensure the department is adequately staffed, financially sound and delivers high-quality care in a cost-effective manner. Typical areas of responsibility include:

- Financial management
- Information Technology
- Human Resource management
- Billing & collections
- Technical patient care services
- Patient care clerical support
- Nursing
- Equipment
- Regulatory

Need for Sound Administration

Another aspect of this type of organisation is that physicians are organised separately from the hospital and are also faculty in the med school. Since they bill patients for the services they provide, professional managers are needed to oversee and manage this financial aspect of their activities. Further, since research is also emphasised, with significant amounts of funding, managing the financial aspects of grants is also needed. Because of this, radiologists also usually have a full time manager, reporting to the radiologist Chairman, to manage their billing/collection activities as well as the research grant finances.

Rules and Guidelines

To effectively manage employees and processes one needs sets of rules and guidelines to promote consistent action. Too many rules choke innovation and stifle creativity – too few promote chaos and variability in quality and action. Finding the right balance is critical. We developed many departmental policies to guide the actions of both staff and supervisors. Generally, these policies were about how the department should take care of employees and patients:

- Employee related: e.g., timekeeping rules, conduct, dress code, leave policies, disciplinary actions, hiring requirements, etc.
- Technical and quality: e.g., exam protocols, patient exam restrictions, image quality standards, certification requirements, radiation safety, etc.

We had both physician and a technologist Quality Assurance (QA) committees to develop and approve technical policies. Employee policies were developed by the department Senior Administrative committee as well as by both the HR and finance department of the school and hospital.

Potential Staff Problems

In common with most institutions, potential problems faced by radiologic staff fall into four general categories:

1. Poor supervisors treating them inconsistently and unevenly
2. Poor equipment
3. Poor environment
4. Workload exceeding staffing levels

The first three problems, unaddressed, negatively influence staff recruitment and turnover which creates a larger problem (#4) as staff vacancies increase. My department and hospital were profitable which greatly reduced problems 2 and 3, and we focused much attention, effort and resources to educate and improve our supervisors and managers. We believe that this singular strategy provides more positive, cost-effective returns than any other. Our department requires over 125 technologists and our needs increase every year consistent with our growth in exams requested. Our primary focus therefore is on tech (and all employee) retention and good supervisors are the best way to achieve high employee retention. The added benefit is that when techs don't want to leave your department, other techs want to join this 'good thing' and recruitment becomes easier.

Turf Battles

Providing great levels of service is a good way to eliminate potential turf battles, as it negates the argument that, since you can't provide the service at the level another department needs for its patients, they will do it themselves. Our principle strategy was to develop a joint operational programme whereby faculty physicians from both departments would use the hospital radiology department and staff to provide the services. From the tech's point of view, they were providing services to doctors of multiple departments for the same patients and the impact was minimal. The stress, however, was felt by the radiologist who now had to share turf.

INTERVIEW WITH PROF. ERIC POISEAU

What is IHE Europe and what are its aims?

IHE is a non-profit organisation sponsored by professional bodies and healthcare suppliers that gathers users and vendors to address the problems of healthcare systems' interoperability. We believe that interoperability should be built around a core of common requirements, taking differences between EU Member States into account, but enabling manufacturers to market their products at both European and even global level with only minor variations.

IHE in Europe organises activities to achieve the interoperability of existing products and facilitate the development of new interoperable products. Some of these activities consist of:

- Development of workflow descriptions and associated integration profiles based on user requirements;
- Organisation of live interoperability testing between vendors (connect-a-thon), and of live interoperability demonstrations at the European level;
- Support to national IHE activities in order to incorporate national requirements into interoperability requirements; and
- Promotion of products that implement IHE Integration Profiles through educational activities, success stories, integration statements, etc.

What are IHE Technical Frameworks?

The IHE Technical Frameworks, available for download, are a resource for users, developers and implementers of healthcare imaging and information systems. They define specific implementations of established standards to achieve effective systems integration, facilitate appropriate sharing of medical information and support optimal patient care. They are expanded annually, after a period of public review, and maintained regularly by the IHE Technical Committees through the identification and correction of errata.
There is an IHE Technical Framework for each of the IHE domains. Volume I provides a high-level view of IHE functionality, showing the transactions organised into functional units called Integration Profiles that highlight their capacity to address specific clinical needs. Volume II provides detailed technical descriptions of the IHE transaction used in the domain.

How is an IHE Integration Statement developed?

IHE Integration Statements are documents prepared and published by vendors to describe the conformance of their products with the IHE Technical Framework. They identify the specific IHE capabilities a given product supports in terms of IHE actors and integration profiles.
Users familiar with these concepts can use Integration Statements to determine what level of integration a vendor asserts a product supports with complementary systems and what clinical and operational benefits such integration might provide. Integration Statements are intended to be used in conjunction with statements of conformance to specific standards (e.g. HL7, IETF, DICOM, W3C, etc.).
There is no requirement for a vendor to participate in an IHE Connectathon in order to be able to publish an integration statement. IHE integration statements help users by comparing products functionalities.

What are some of IHE's biggest successes in Europe?

I guess the biggest success of IHE in Europe is to have successfully developed IHE in Europe. IHE started in the US! IHE Europe was successful in importing the initiative, but more than that, in adapting it to the European context. IHE Europe is now contributing on an international level and is, in a way, forcing IHE to become more international in its focus.

INTERVIEWEE
Prof. Eric Poiseau
IT Manager
Integrating the Healthcare Enterprise (IHE) Europe
University of Rennes
Rennes, France

IHE Europe is contributing at an international level with:

- Laboratory profiles;
- IT-infrastructure XDS and PIX profiles; and
- Radiology PDI profiles, which found their origins in Europe.

What integration challenges do you think healthcare IT managers in Europe should be most concerned about?

In my opinion, access to information, document sharing and security are the biggest challenges facing healthcare IT managers in Europe. Healthcare information systems will more and more need to interoperate to exchange documents, images, patient identifiers, exchange about user rights.

Software applications are also more frequently required to interact with:

- Audit trails: sharing of logs, security requirements to centralise logs;
- User rights: authentication, authorisation... rights that may depend on the role and the context; and
- Patient identification: document sharing requires sharing of identification.

Key Seminars & Conferences

NOVEMBER 2006

5 – 9 **48TH ANNUAL MEETING OF THE AMERICAN SOCIETY FOR THERAPEUTIC RADIOLOGY & ONCOLOGY (ASTRO)**
PHILADELPHIA, PENNS., UNITED STATES
www.astro.org

9 – 11 **46TH ANNUAL MEETING OF THE JAPANESE SOCIETY OF NUCLEAR MEDICINE**
KAGOSHIMA, JAPAN
www.jsnm.org

14 – 18 **MEDICA**
DÜSSELDORF, GERMANY
www.medica.de

26 – 1 **92ND RADIOLOGICAL SOCIETY OF NORTH AMERICA (RSNA) SCIENTIFIC ASSEMBLY AND ANNUAL MEETING**
CHICAGO, UNITED STATES
www.rsna.org

DECEMBER 2006

14 – 15 **5TH ADVANCED ANEURYSM TREATMENT SYMPOSIUM**
OXFORD, UNITED KINGDOM
http://www.medsci.ox.ac.uk/radiology/mscin/aats

JANUARY 2007

25 – 26 **12TH EUROPEAN SYMPOSIUM ON ULTRASOUND CONTRAST IMAGING**
ROTTERDAM, THE NETHERLANDS
http://www2.eur.nl/fgg/thorax/contrast

FEBRUARY 2007

1 – 3 **MR 2007: 12TH INTERNATIONAL MRI SYMPOSIUM**
GARMISCH-PARTENKIRCHEN, GERMANY
www.mr2007.org

25 – 1 **HEALTHCARE INFORMATION AND MANAGEMENT SYSTEMS SOCIETY ANNUAL MEETING**
NEW ORLEANS, UNITED STATES
www.himss07.org

MARCH 2007

9 – 13 **EUROPEAN CONGRESS OF RADIOLOGY**
VIENNA, AUSTRIA
www.ecr.org

15 – 20 **32ND ANNUAL SOCIETY OF INTERVENTIONAL RADIOLOGY (SIR) MEETING**
WASHINGTON DC, UNITED STATES
www.sirweb.org

19 – 21 **BRITISH NUCLEAR MEDICINE SOCIETY SPRING MEETING 2007**
MANCHESTER, UNITED KINGDOM
www.bnms.org.uk

APRIL 2007

25 – 28 **55TH ANNUAL MEETING OF THE ASSOCIATION OF UNIVERSITY RADIOLOGISTS**
DENVER, COLORADO, UNITED STATES
www.aur.org

MAY 2007

16 – 19 **GERMAN RADIOLOGY CONGRESS ANNUAL MEETING**
BERLIN, GERMANY
www.roentgenkongress.de

JUNE 2007

11 – 13 **UK RADIOLOGICAL CONGRESS 2007**
BIRMINGHAM, UNITED KINGDOM
www.ukrc.org.uk

12 – 15 **EUROPEAN SOCIETY OF GASTROINTESTINAL AND ABDOMINAL RADIOLOGY (ESGAR)**
LISBON, PORTUGAL
www.esgar.org

20 – 23 **JOINT EUROPACS AND CARS CONGRESS**
BERLIN, GERMANY
www.europacs.org

27 – 30 **CARS 2007 ANNUAL CONGRESS**
BERLIN, GERMANY
www.cars-int.org

IMAGING Management

EUROMEDICAL COMMUNICATIONS NV
28, rue de la Loi
B-1040 Bruxelles, Belgium
T: +32/2/ 286 85 00
F: +32/2/ 286 85 08
www.imagingmanagement.org

PUBLISHER
Christian Marolt
c.m@imagingmanagement.org

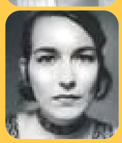
MANAGING EDITOR
Dervla Sains
editorial@imagingmanagement.org

INTERNATIONAL EDITOR
Edward Susman
ed@imagingmanagement.org

EDITORS
Amanda Heggestad
Ilze Raath
Rory Watson
Sonja Planitzer

GLOBAL COMMUNICATIONS
Dr Don I. Idrees
d.idrees.cd@imagingmanagement.org

JOURNAL MANAGEMENT
Catalina Ciolan
c.c@imagingmanagement.org



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