

I M A G I N G

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Promoting Management
and Leadership
in Medical Imaging

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Medical Imaging in Iran



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Prof. Fulvio Stacul

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Financial Management

Dear readers,

I am honoured to introduce myself as the new Editor-in-Chief for IMAGING Management, with the inspiring challenge ahead of continuing in the established footsteps of my predecessor, Prof. Iain McCall. I would like to take this opportunity to thank Prof. Iain McCall for his long commitment and hard work for IMAGING Management, and extend my promise of continuing to develop the high standards of the journal. I have long followed the progress and quality content of this journal, which has shown to be a leader in its field, standing for development in management trends across the spectrum of the evolving field of medical imaging; with my long-standing participation in professional societies, from the regional level to the international level, I look forward to providing an innovative contribution.

Let me start this issue by introducing our first hot topic: financial management in medical imaging. Amidst the myriad of challenges that directors are faced with in this expanding sector, is the management of financial resources, along with better value-for-money, low-risk investments and cost savings; this is the arena that we explore in this issue's Cover Story, with Prof. Stephen Baker beginning the discussion with his article on maximising economic resources for academic radiology, stressing the importance of strategies on every level, including relationships, leadership, clinical practice, education and research. Dr. Bernd May then provides us with a focus on new ways of optimising imaging servicing via cost management, while Wilhelm Frewer and Prof. Dr. Hans-Peter Busch emphasise the significance of integrating specialities in a multidisciplinary approach to financial planning, improving efficiency and competitiveness. Prof. Mathias Goyen concludes this informative Cover Story by telling us about Service Level Agreements and their use in budgeting, monitoring and assessing workload within an imaging department.

In our Tech Horizons section, Simone Carron-

Peters explores the advancements that have been made in hybrid imaging, including an overview on the evolution of hybrid solutions such as PET-MR and SPECT-CT, boosted by the success of PET-CT. Following on the topic of innovation, Carly Reed enthusiastically highlights the changing face of ultrasound in the wake of advances in image quality and functionality. This is followed by a paper from Prof. Francesco Sardanelli, which discusses the growing effectiveness of breast MRI and the special attention that must be paid to high risk patient groups, and then by Prof. Fulvio Stacul who provides updated guidelines from the Contrast Media Safety Committee of the European Society of Urogenital Radiology.

Next on the agenda is another area of innovation: that of imaging biomarkers. Here, Prof. Luis Marti-Bonmati and Prof. Angel Alberich-Bayarri cover ground from the proof of concepts to that of the structured reporting of data. To finalise our features, Adam McLean and Prof. Małgorzata Szczerbo-Trojanowska express the importance of not just advances in imaging and interventional techniques, but also of multidisciplinary care, in the evolving role of interventional oncology.

We finish off with an interview-style piece on developments and challenges in the medical imaging sector in Iran, with valuable feedback from Prof. Abdolrasoul Sedaghat, President, Iranian Society of Radiology.

I welcome your feedback on any of the papers included in this issue, as well as any management expertise you wish to share; I cordially invite you to contact me at the journal on editorial@imagingmanagement.org.

Sincerely,




Prof. Lluís Donoso Bach

Editor-in-Chief
editorial
@imagingmanagement.org

Financial Management in Medical Imaging

This issue, we take a look at some of the financial practices being implemented in medical imaging departments, to provide some take-home tips and strategies to maximise economic resources, optimise services and above all, to reduce waste and avoid unnecessary imaging exams. As well as a look at Service Level Agreements and their use, we also look at some individual challenges for reimbursement of medical imaging services.



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IMAGING MANAGEMENT WELCOMES INCOMING EDITOR-IN-CHIEF

PROF. LLUIS DONOSO BACH TAKES THE HELM OF LEADING MANAGEMENT JOURNAL

IMAGING Management, the official media platform for senior chairmen, business managers and decision-makers in the field of medical imaging, announced during this year's European Congress of Radiology (ECR), which took place in Vienna, Austria (March 1–5), that Prof. Lluís Donoso Bach, Director of the Department of Diagnostic Imaging in Hospital Clinic of Barcelona, and Executive Director of the UDIAT Diagnostic Centre in Sabadell, will take over the reins of the journal as the new Editor-in-Chief. **Prof. Donoso Bach's predecessor in this role, Prof. Iain McCall, states, "I am delighted that Prof. Donoso will take over this important work. The journal will remain in excellent hands and I look forward to following the journal's continued development".** Prof. McCall will retain honorary membership of the Editorial Board of the journal in recognition of his contribution to its growth and success.

Prof. Donoso, a native of Sabadell, Barcelona, received his MD and PhD from the Autonomous University of Barcelona School of Medicine. He trained in radiology at the Hospital de Sant Pau in Barcelona. Between 1986

and 1989 he was on the faculty of the Hospital Germans Trias i Pujol in Badalona (Barcelona), after which he returned to the Hospital de Sant Pau as a staff radiologist until 1992. He was appointed Chairman of the Radiology Department of the UDIAT Diagnostic Centre at the Corporació Sanitària Parc Taulí in 1992, becoming Executive Director in 1998. Since 2006 he has held the positions of both Director of the Diagnostic Imaging Department of the Hospital Clínic Barcelona and Professor of Radiology of the University of Barcelona.

Prof. Donoso has been involved in numerous research projects. Early in his career, his focus was on abdominal imaging, especially liver diseases, later shifting to the development and implementation of IT in diagnostic radiology and digital imaging. Under his leadership, a large R&D team was constituted at the UDIAT centre, leading to several patents and products widely used across Spain. He has published over 90 articles, seven book chapters, and has given numerous invited lectures at prestigious universities, congresses, and courses.

Prof. Donoso has always been active in the professional societies, from the regional level to the international, serving as President of the Spanish Society for Diagnostic

Radiology (SERAM) from 2002 to 2006. Currently he is board member of the International Society of Radiology, President of the Spanish Foundation of Radiology and Chairman of the Professional Organisation Committee as well as Executive Council member of the European Society of Radiology (ESR).

He has received numerous honours for his contributions to the discipline, including the Gold Medal of the Spanish Society of Radiology and the honorary memberships of the Argentinean Society of Radiology, the Mexican Federation of Radiology, the Italian Society of Radiology, the French Society of Radiology and the German Society of Radiology.

Christian Marolt, Publisher of IMAGING Management states that: "We are delighted that Prof. Donoso will step in as Editor-in-Chief. He not only has decades of professional experience at a top managerial level, which in itself is a great asset for IMAGING Management, but increasingly his growing involvement in organisations such as Management in Radiology (MIR) and the European Society of Radiology (ESR) make him the best choice for this role. We hope that together, we will reinvigorate and strengthen the vision of our media platform. ■

IN RECOGNITION OF AN OUTSTANDING CAREER

PROF. IAIN MCCALL AWARDED GOLD MEDAL AT ECR 2012

Adding to his 2010 award of Honorary Membership of the RSNA, Prof. Iain McCall, M.D., D.M.R.D., F.R.C.R., and Editor-in-Chief of IMAGING Management (2006 – 2012), was in March presented with the Gold Medal of the European Society of Radiology (ESR) for outstanding contributions in the field of medical imaging. Not only was Prof. McCall lauded for his significant accomplishments in the field of musculoskeletal radiology, but also his contribution to the development of European radiology both with his Presidency of the European Society of Radiology (ESR) and on a political stage in advocating for and developing a legal framework for teleradiology in Europe.

Prof. McCall has received many honours throughout the span of his career, including honorary membership in the German, French, Austrian and Hellenic radiology societies and the European Society of Skele-



tal Radiology, the founders' gold medal of the International Society of Radiology and the gold medal of the Turkish Society of Radiology. Since 1996, Prof. McCall has been a professor of radiologic sciences at the University of Keele in Staffordshire, U.K. For the

past 33 years, he has also worked as a consultant musculoskeletal radiologist at the Robert Jones & Agnes Hunt Orthopaedic & District Hospital. He subsequently served as Medical Director of the NHS Hospital Trust where he worked. Prof. McCall served

as Editor of Skeletal Radiology from 1997 to 2007, was Deputy Editor of Clinical Radiology from 1987 to 1994 and has been editor of IMAGING Management since 2006.

Prof. McCall's tireless commitment to radiology extends on many levels. As well as rising to Dean of the Faculty of Clinical Radiology of the Royal College of Radiology, he also served as the U.K. representative for radiology to the Union of European Medical Specialists (UEMS) and President of the Radiology section. He has served as Chairman of the Professional

Organisation Committee of the European Association of Radiologists (EAR), which later became the ESR, and was responsible for revising the five-year radiological curriculum that was adopted by most EU countries. He established and ran a programme assessing radiology teaching centres in Europe and helped to develop the continuing medical education and development policy for European radiologists.

On an international level, Prof. McCall remained deeply involved with the union of the EAR and ECR to form the European Society of Radiology through

the drafting of the ESR statutes, which he developed over two years, becoming the first directly elected President of the ESR from 2008 – 2009. Not only this, but he has carried out tremendous work for the development of a legal framework for teleradiology within Europe, to ensure continued high quality of patient care. He represented the EAR on the International Radiology Quality Network during the development of the international standards for teleradiology, and produced guidance documents on Good Radiological Practice and Teleradiology. ■

ASSOCIATION NEWS



ANNUAL MIR CONGRESS PROVIDES A FORUM FOR IDEAS EXCHANGE

Following the success of the recently-held Management in Radiology (MIR) inaugural workshop as part of the European Congress of Radiology (ECR) which took place in Vienna, Austria, the association are pleased to invite all those with an interest in management, health economics and medical business management, to join them for the forthcoming Annual Scientific Meeting of Management in Radiology (MIR), chaired by Prof. Peter Mildenerger, which takes place October 11–12, in Milan, Italy. This yearly gathering of leaders in health-care will address the following areas:

- *Workflow Issues;*
- *Benchmarking and Costs;*
- *Building and Managing Imaging Services;*
- *Strategies in Radiology;*
- *Quality Issues;*
- *Appropriateness and Radiation Aspects;*
- *Ultrasound; and*
- *Management Around the World.*

Taking place one day prior to the congress, a junior course for young radiologists aims to provide advice and direction for those inter-

ested in advancing their career in medical imaging after qualification. This year's MIR junior course will take place on 10 October, 2012. The organisation welcomes junior radiologists to use the event to combine the junior course with the main MIR conference. You can download a full version of the event's programme by visiting the association's website on www.mir-online.org.



ECIO Congress Becomes Annual Fixture

In light of the rapid growth in the field of interventional oncology, CIRSE are delighted to announce that the annual congress dedicated to this important field, European Congress on Interventional Oncology (ECIO), is to become an annual event as of 2012. This upgraded role reflects the need to explore not only technological developments but also issues relating to training and practice. The ECIO makes an important contribution in this regard, as it offers comprehensive coverage of new developments and offers opportunities for interventional radiologists to keep up to date with this subject, which has great strategic importance for the specialty. Featuring an enhanced scientific programme, world-renowned faculty and expanded technical exhibition,

ECIO remains at the forefront of education and innovation.

CIRSE 2012 will be held in Lisbon, Portugal, from 15–19 September; and covers a broad array of topics, including training in interventional oncology, renal denervation for therapy-resistant hypertension, and the future of simulation, amid many others.

Among other awards presented at the opening ceremony, a gold medal will be handed to Prof. Peter Mueller. Prof. Mueller has been intimately involved with the development of novel techniques such as the Brown-Mueller T-Tack for use in percutaneous gastrotomy and percutaneous gastro-jejunostomy, and the Dawson-Mueller drainage catheter for fluid drainages. A wide range of product launches, seminars, learning centers and networking opportunities were provided throughout the congress, with details available on the organisation's website.

The next CIRSE congress will take place in Barcelona, Spain on 14–18 September, 2013.

The organisation welcome you to join them at the Annual European Conference on Interventional Oncology to enhance your clinical practice in interventional oncology, foster interdisciplinary collaboration, strengthen your knowledge and further your expertise of current therapies and the latest research, stay up to date with the advancements in medical technology and meet with over 1,000 peers from all over the world. Further updates are available on the association's website: www.cirse.org

» CONTINUES ON PAGE 8

Management In Radiology



European Society of Radiology



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MANAGEMENT IN RADIOLOGY

Annual Scientific Meeting

October 11–12, 2012, Milan/IT

mir-online.org

combined with
JUNIOR COURSE
October 10, 2012

MIR is a subcommittee of the ESR Professional Organisation Committee.

Programme

Wednesday, October 10 – Junior Management Course

13:00 – 15:00	Leadership in Radiology
15:30 – 16:30	Surviving as a Radiology Department
16:45 – 18:30	How to be prepared

Thursday, October 11 – Annual Scientific Meeting

09:00 – 09:30	Welcome and Introductory Talk
09:30 – 10:30	Strategies in Radiology
11:00 – 12:30	Quality Issues in Radiology
12:30 – 13:30	Keeping ultrasound within radiology
14:30 – 15:30	Management around the world – Poster Session
15:30 – 17:00	Benchmarking
17:30 – 19:00	Building and managing Imaging Services in Eastern Europe

Friday, October 12 – Annual Scientific Meeting

09:00 – 10:30	Radiation and Appropriateness
11:00 – 13:00	Managing Workflow and Workload
14:00 – 16:00	Session of the Management in Radiology Section of the Italian Radiological Society
16:30 -17:30	Debate Session on Imaging departments of the future: Your vision within a 5 year time frame



13th Annual Connectathon to be Held in Istanbul

The 13th annual IHE-Europe Connectathon will take place from 15–19 April 2013, in Istanbul, Turkey. IHE Connectathons provide the exclusive opportunity to test the interoperability and connectivity of healthcare IT systems. The 2013 edition is expected to draw participation from across Europe, with more than 90 companies and 300 engineers. The hosting of the next event in the iconic city of Istanbul is significant since it connects Europe and Asia, with organisers anticipating widespread social interaction.

Besides the testing event, Projectathon and many side events and daily round-tables and seminars on specific healthcare topics will also be held in a waterfront congress centre by the famous Golden Horn. Guided tours will also be organised during the week on demand. For more information on Connectathon 2013, including on the programme, accommodation and important dates, please visit www.connectathon2013.org.



Register Now for Annual CARS Congress!

Taking place in Heidelberg Convention Center in Germany from 26–29 June, 2013, the annual Computer Assisted Radiology and Surgery (CARS) congress is an occasion where medicine and technology meet to present and discuss the key innovations that shape modern medicine on a worldwide basis.

New picture archiving and communication systems (PACS) applications, including IT-infrastructures adapted for the operating room, related results from the DICOM and IHE working groups, but in particular, new methods and IT-tools for modelling the patient and medical

processes are increasingly shaping the scope of CARS. As is traditional, the ISCAS, EuroPACS, CAR, CAD and CMI societies will join CARS holding their own meetings are part of this large event.

At CARS you will have the opportunity to meet scholars and experts in the fields of radiology, surgery, engineering, informatics and/or healthcare management who have an interest in topics, such as:

- Image- and model-guided interventions;
- Advanced medical imaging;
- Image processing and visualisation;
- Computer aided diagnosis;
- Medical simulation and e-learning;
- Surgical navigation and robotics;
- Model-guided medicine; and
- Personalised medicine.

Further information can be found on www.cars-int.org.



COCIR Showcases EU Health IT

COCIR, the European trade association for the medical technology industry, on 15 March hosted a meeting with the European Commissioner for Health and Consumer Policy, John Dalli, and senior representatives from hospitals and other healthcare providers. The meeting in Paris showcased how integrated IT and innovative financial partnerships are optimising patient care.

Commissioner Dalli is supporting Member States on national efforts in improving health for millions of patients across Europe. Innovation, technology and smart financial investment are crucial in helping to resolve the increasing financial and demographic pressures common to all healthcare systems in Europe. As part of an ongoing dialogue, Commissioner Dalli accepted COCIR's invitation to spend some time

looking in detail at examples of European best practice, including where EU funding is helping transform healthcare delivery.

"I was pleased to see and discuss innovative technologies from different industrial sectors combining with innovative healthcare models as well as financing solutions to enable better patient care and increased efficiency within this care setting," said Commissioner Dalli. "I have no doubt that healthcare systems need to use appropriate new technologies and other innovative solutions, if they are to emerge stronger from the current economic challenges," Dalli added.

Many of Europe's leading hospitals and healthcare providers have recognised the potential to use smart investment in medical technologies and IT to become 'healthcare hubs', forging improved networks with physicians and local clinical services to better manage the needs of patients in local facilities, even in their own homes.

The European healthcare system is in a period of change, driven by demographic change, evolving skill shortages, rising consumer demands for better health and advances in healthcare technology. In the context of financial austerity, more local and regional hospital-centred networks are being developed to provide improved service to an ever more demanding and informed patient. Public and private partnerships and investments in healthcare technologies and research are driving a steady evolution in healthcare, set to benefit the lives of millions of Europeans and contribute to economic prosperity.

"Hospitals of tomorrow, and healthcare professionals and administrators working within the healthcare system, need to have the tools and investment to cope with growing healthcare demand," said Heinrich von Wulfen, COCIR President. "Today, many leading hospitals will be critical players in an integrated healthcare delivery system which engages the consumer and understands the patient's disease and patient's biology in order to stratify the treatment. Such a system is digitally accessible in people's homes, community clinics and physicians' offices. This is what we have been showing to Commissioner Dalli with a view to identifying best practices and facilitating their dissemination."

Please visit www.cocir.org to find out more about the organisation. ■



MANAGEMENT IN RADIOLOGY

Winter Course

January 10–12, 2013, Seefeld/AT

Inspiring Healthcare Leaders

The MIR Winter Course is an interactive and informative programme with its aim to build a practical skill set over a three day period. Each delegate will leave with new insights and practical solutions to implement immediately.

Explore the following key topics

- Advanced Influencing Skills
- Conflict Resolution
- Situational Leadership
- Motivating your team
- Writing an effective business case
- How to improve a dysfunctional team

Ask the expert

In addition, there will be the opportunity for "Ask the Expert" workshops. Delegates will have 1:1 support on confidential areas of their work with the focus to help individuals to uncover issues that exist in their department and to identify suggestions to move things forward.

Tickets are limited. Early registration is recommended.

For further information and registration visit our website www.mir-online.org or contact us at office@mir-online.org

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Centre Duroc, Known for Using High End, Innovative Imaging Equipment, Adopts Breast Tomosynthesis

Montparnasse, Paris

Since its foundation 25 years ago, Centre Duroc has become widely known for having high-end, innovative imaging equipment for use in screening, early diagnosis and monitoring of breast disease. Early on the Centre recognized the advantages of digital mammography and adopted the technology long before the results of the Digital Mammographic Imaging Screening Trial (DMIST) were published.

Currently the Centre uses three digital mammography systems, including a new Hologic Selenia Dimensions breast tomosynthesis unit. The Centre performs approximately 20,000 mammograms annually and nearly 2,000 tomosynthesis exams have been performed since installation of the Dimensions system.

When considering the advantages of breast tomosynthesis over conventional 2D digital mammography, Dr. Jean-Yves Seror, a radiologist at The Centre reports, "We use tomosynthesis as an adjunct to 2D mammography. Tomosynthesis allows a better characterization of suspicious areas, in particular for subtle images of mass or structural defects. Tomosynthesis also provides a more detailed visualization of the margins and borders of the abnormalities, making it easier to confirm the existence of a lesion. Due to slice by slice analysis, tomosynthesis eliminates some 'false images' and confirms the appearance of benignity. Tomosynthesis also allows us to better define the extent and size of lesions. This information, combined with improved visualization of multifocality, is an essential contribution to pre-treatment assessments."

Dr. Seror notes that "In our short experience with tomosynthesis, we also found an advantage of the technique in its ability to easily and accurately show the precise location of lesions, essential information before biopsy. Another advantage of breast tomosynthesis is that, due to its sensitivity, its negative predictive value in the event of structural distortion or high density helps halt unnecessary investigations and reassure the patient that no disease is present."

Dr. Seror reports that tomosynthesis is very useful for BIRADS 3 and BIRADS 4 cases, providing better characterization, evaluation and localization of lesions. In the case of a suspicious mammogram, BI-

RADS 4 and 5, even when lesions are evident in 2D, tomosynthesis analysis (especially with dense or difficult to analyse breasts) has the potential to detect additional lesions, give better visibility of edges and more accurate determination of the actual size of the lesion.

Currently, detection of micro-calcifications and their characterization remains a limit for some very fine calcifications and 2D magnified views should remain the preference for their detection and analysis. The Centre finds that use of the slabbing tool on the Hologic SecurView diagnostic workstation can facilitate the characterization of micro-calcifications to give improved contrast, better contouring and volumetric assessment of a cluster of micro-calcifications. The slabbing tool allows multiple tomosynthesis slices to be

combined for display and review.

According to the Centre's radiology team, tomosynthesis works well in dense breasts, especially for granular breasts classified as BIRADS 3 or 4. There are some limitations for very dense breasts when there is a complete absence of fat component. In some cases, the Centre has found it useful to examine images for breasts with density ranges previously considered "easy" to assess, as this category is sometimes the source of false negatives.

As to benefits of tomosynthesis, Dr. Seror sees better detection, characterization and determination of extent of abnormality as some of the major advantages of tomosynthesis. Overall, it provides a higher degree of confidence in the diagnosis (positive or negative) when compared to 2D only.





Radiologists of Center Duroc: From left to right: Dr GHENASSIA-VIDA, Dr SCHEUER-NIRO, Dr SEROR, Dr SCETBON, Dr DUVAL and Dr ZEMMOUR-EL FERSI

Overall, patient workflow hasn't changed at the Centre. Reading time has increased slightly, but the increase is thought to be due to the learning curve. The Hologic breast tomosynthesis system offers combo-mode imaging, an easy and practical way to acquire 2D and tomosynthesis data in the same breast compression, a feature the technologists quickly mastered and appreciate. The very fast acquisition and display of images on the high resolution monitor for the technologist was seen as progress. The biggest workflow challenge has been to define when tomosynthesis should not be performed.

Apart from recognizing a brand new machine, patients noticed very little, if any, difference in the exam. At the very begin-

ning of their experience, some patients judged the compression to be "more effective." Some patients were very interested in the new technology and asked questions to fully understand and appreciate the contribution of tomosynthesis.

Training in tomosynthesis workshops is certainly a must for the Centre in order to optimize diagnostic performance as the semiology and detection of abnormality on tomosynthesis slices are seen as different from conventional mammography.

Dr. Seror sums up, "We are very pleased with our decision to acquire the Hologic Selenia Dimensions tomosynthesis system. It provides extra confidence with our diagnoses."

The views and opinions expressed herein are those of Dr. Seror and his colleagues at the Centre Duroc and are not necessarily those of Hologic.

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MAXIMISING ECONOMIC RESOURCES FOR ACADEMIC RADIOLOGY

Strategies for Success



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Recently, the Organisation for Economic Cooperation and Development (OECD) provided to the public, annual health-related data from 1960 to the present for its 34 member countries – 24 in Europe and 10 outside the continent including the United States. Forty-eight separate indices were presented, with one of the most telling statistics being the yearly percent of healthcare funded by public expenditures. Among European OECD members, Italy at 57 percent had the lowest percent supported by governmental auspices. In contrast, in the United States it was only 47 percent.

The marked difference between US and most other industrialised nations starkly reveals evidence of why the United States healthcare system is unique not only in its cost structure but also in the strategies medical organisations must adopt to survive and even thrive in it. No institution is immune from this imperative, not even academic medicine in general and radiology in particular. Although the spectrum of sources of compensation to sustain American academic radiology departments is wide, for most of them, continued success requires the chairperson to be entrepreneurial in outlook and, to a varying extent, in action as well.

Leadership Vital to Capture Needed Resources

In departments that are entirely hospital-based, equipment, salary and benefits are frequently provided by a single payor, usually the hospital alone or the hospital and the medical school in combination. In these facilities, the chairperson is primarily a manager but he or she can still be innovative in the provision of education, the establishment of research programmes and in the type and extent of collaboration with referring services. Even under these constraints, the ascription of responsibility for various imaging procedures is not fixed but is subject to the operational and the tactical plans of the chairperson vis-à-vis his fellow chairpersons who may be both colleagues and competitors with respect to the capture of new imaging business.

Yet in most departments, a guaranteed source of support for all expenditures and initiatives is lacking, be it for personnel, research, hardware or informatics. The capture of

some, or all of it, depends on the skill and assertions of the chairperson as a leader, as one who must establish and sustain competence as a strategist and administrator in each of the major realms that encompass an academic enterprise.

Clinical Practice

In most departments, save those primarily serving the poor and those in which there is a pure salary arrangement to support professional staff, physician incomes, either in part or in whole, come from payments earned by the performance of procedures or the interpretations of images. This requires the chairperson to seek to take in from payors all the moneys his faculty has generated in professional fees for work done. Hence, an efficient collection system is necessary to harvest as much of the dollars sown by the department's professional services. The size of the population in the catchment area in which most patients are referred to the department will help anticipate the scale of revenues. If it serves an affluent region with many prospective patients having adequate private or employer-supported insurance, then the department is at an inherent advantage to grow as long as the national or local economy has not turned negative.

Moreover, if the patient mix includes a high percentage of elderly patients who possess generally adequate reimbursement from Medicare and other sources, then there is another available and reliable income stream to support the chairpersons and his staff. But the chairpersons must first realise that his or her department is not the only place a referring physician will send the sick and injured. Hence, the chairpersons must endeavour to market the department's products well, to provide excellent customer service and to introduce and manage new product lines that are attractive to clinicians and patients.

Economic Differences: EU Versus US

A natural tension, however, is built into this business arrangement - one that in large part is emblematic of the high aggregate cost of medicine in the US when compared with the determinants of expenditures in most European

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countries. While the chairperson must promote appropriate, judicious imaging based on sound clinical indications on the one hand, he or she must also serve the bottom line. Thus, there is also the tendency to encourage more imaging and, ineffably or by design, to promote increased and sometime excessive utilisation. In great measure, an extravagant reliance on imaging is a significant component of the high cost of Medicare in the U.S. And to a large extent it is within the chairperson's purview.

Most chairpersons realise that siting their department only in a hospital limits growth and binds the department snugly to the hospital's economic activity and prospects. In this era of consolidations and closings of in-patient facilities throughout the US, an exclusively hospital-based department is extremely vulnerable. Thus chairpersons will attempt to look for opportunities to participate at outpatient radiology practices. These can either be owned and managed by outside companies, or the department itself will own and run them. This stratagem tends to expand revenue options and, when successful, enables the department to grow. By so doing, it can bring on board more subspecialists, thereby widening the department's capacity to realise opportunities in education and even in research.

Another goal of the chairperson in this regard is to take control, whether through direct investment or through prudent deal making, of part or all of the technical fees derived from the performance of high technology procedures utilising CT, MR, PET or interventional radiology. For many procedures and from most payors, the technical fee - the payment to reimburse for the cost of the purchase of the machine, as well as its service, maintenance and depreciation - is much higher than the professional fee per imaging study. Hence often the biggest payoff per investment accrues to those who have purchased all or part of the devices in which relatively generous payment is made at least in respect to their technical component.

So for the securing of clinical income, the most successful departments are those having a stake in several outpatient centres and a piece of the technical fee in modalities in each one.

Education and the Workforce

Unlike many European countries in which the education of trainees is focused toward the production of general radiologists, some of whom may later become subspecialists, in the US, currently more than 90 percent of residents in radiology not only achieve board certification at the completion of their four-year training term, they also pursue and complete an additional year or two in a dedicated fel-

lowship programme. The curriculum for residency training is highly prescriptive and supervised by a national organisation, the Accrediting Council for Graduate Medical Education, (the ACGME), and approximately 50 percent of fellowship programmes are also under the constraints of ACGME's regulations. For the most part, chairpersons seek to have as many residents as their clinical and tutelary capabilities can manage.

“The chairperson must endeavour to market the department's products well, to provide excellent customer service and to introduce and manage new product lines that are attractive to clinicians and patients”

Many of the larger departments also try to have as many fellows as they can. Some chairpersons even regard fellows as more desirable than residents with regard to meeting their clinical and investigational initiatives. Why? Even though first year residents are in a sense burdens because of their limited knowledge, they become benefits as they advance through their multi-year term of training. Better still are fellows who can assume more responsibility immediately, and even in large measure function independently as interpreters of imaging studies and as researchers. Residents and fellows are paid very little when compared with the salaries earned by faculty members. Through Medicare, many trainee salaries are in essence free goods because their salaries are supported by Medicare reimbursement provided that elderly patients comprise a share of hospital admissions.

The larger the number of older patients a hospital has, the more the institution is paid per trainee. Although the number of Medicare supported trainee positions was fixed in 1996, radiology resident and fellowship positions have increased by 50 percent since. Therefore, even if departments have to pay their trainees' salaries, they

are still so low that adding more of them is usually an excellent bargain for the department.

Funding of Imaging Research

It is a tacitly acknowledged obligation of academic radiology departments to participate in grant-funded research. In fact many chairpersons will look at increasing grant revenues as one mark of the department's success inasmuch as Deans themselves are also measured by this metric. The record over the 15 years of funding of imaging research supported by the National Institutes of Health (NIH) has revealed a steadily increasing allocation of funds for imaging investigations, for many of which the grantee was a professional member of a department of radiology in an academic institution. Industry, too, supports imaging research. Consequently the chairperson must develop personnel and institute policies that foster the department's efforts to win such awards. He or she can seek to have the medical school build and staff special facilities and equipment that will promote the securing of grants. But he or she must also recruit and help nurture the faculty who will conduct the research.

The chairperson can do that by giving their radiologists protected time each week to pursue their ideas and reify them into completed preliminary studies that can

form the basis for a successfully funded grant proposal. And the chairperson must also recruit and support PhDs, some at the earliest phases of their careers as well as others who are already seasoned investigators. The latter may have begun their work elsewhere and could be attracted to a chairperson's department by offers of generous terms involving salary support, personnel positions and laboratory space. By and large, PhDs are less expensive than radiologists. For that reason, they can provide the department a faster pay off in terms of research dollars accrued and prestige earned per professional hired.

Conclusions

In sum, the chairperson of radiology in the US must assume multiple responsibilities. He or she needs to possess organisational and personal relationship skills. At the same time he or she must know how to delegate, how to inspire, how to listen and how, at times, to be bold in response to or despite advice. But most importantly, the chairperson must have a vision, a realistic yet optimistic sense of mission to develop the department's capability to meet the tripartite obligations of state-of-the-art clinical service, effective medical student and graduate education and the creation of new knowledge through the stimulation and sustenance of innovative research. ■

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NEW WAYS OF OPTIMISING IMAGING SERVICES

The Golden Rules of Cost Management

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Both managers in the medical imaging department (MID), as well as hospital managers, are seeking new ways to provide an optimised service within a climate of shrinking healthcare budgets, competition from private imaging centres, and increased demand for evidence-based medical provision. In this article, I will outline four key ways in which the MID can attain these goals, and demonstrate through a comparison of the performance, cost-effectiveness and management of several types of medical imaging facilities, that there is much work to be done to remain competitive. The following are key factors for optimised cost management:

- Select appropriate exams to reduce length of hospital stays;
- Recognise that labour is one of the key cost drivers in the department;
- Hospital managers must realise the impact of the high costs of running and maintaining equipment; and
- All types of medical imaging facilities would benefit by considering a public-private cooperation for provision of imaging services.

Selecting Appropriate Exams

Financial management in the MID in a diagnosis related group (DRG)-driven hospital can be assessed by looking at both revenue and cost. Revenues are generated, for example, from diagnostic services provided to outpatients as well as from treatments provided in interventional radiology, based on specific DRGs. Costs are strongly tied to the diagnostic function and effectiveness of an MID. However, as there are no specific DRGs allocated for diagnostic service provision in our present system, costs are being charged to the referring departments according to the amount and structure of utilisation (fee-per-service, e.g. an ultrasound ~ 60-70 euros, conventional x-ray ~ 50-60 euros, CT ~ 100-160 euros, MRT ~ 200-400 euros, depending on the specifications of modality, average daily load and staffing).

In an ideal world, the diagnostician would stream the patient's pathway, as follows:

1. Respond to the requirement of any referring department on demand;
2. Verify the indication for referral by trained diagnosticians;
3. Control the diagnostic pathway in the MID using trained radiologists;
4. Employ an imaging procedure that delivers adequate

sensitivity and specificity;

5. Avoid any diagnostic sequences with various modalities (same or different); and
6. Make findings available in the referring department the same day (≤ 3 hours after exam).

These criteria are all about optimising the financial and budget management issues of any MID. However, these are merely ideals. In the real world, there are two major financial issues to be defined: the total running costs of diagnostic service and the outcome of inpatient care per DRG. Nevertheless, we can clearly see that the provision of inpatient care has a significant overall financial impact on medical imaging.

Reducing Length of Stay by Streamlining Exam Selection

Our analysis shows that the total costs of the medical imaging department range from about 4-7 percent (on average 5 percent) of overall DRG turnover in the hospital. The cost saving potential amounts to about 20 percent of total cost of the MID, i.e. about one percent of DRG turnover of the hospital. We examined data from our radiology information system (RIS) to estimate the financial impact of inpatient imaging services, and found that on average, between 50 and 90 percent (with a mean of 75 percent) of all inpatients receive medical imaging services during their hospital stay, of which about two thirds are referred for multiple diagnostic services either with the same or a different modality, i.e. 50 percent of all inpatients are being diagnosed by means of at least two modalities resulting in at least 1.5 days of an extension of their stay in hospital. To estimate the cost impact of these multiple imaging exams, we must take a look into the relationship between

$$\text{DRG-turnover} = \frac{365}{\text{mean stay}} \times \text{number of beds} \times \text{average reimbursement per patient} \times U$$

U: degree of bed utilisation

Equation 1: Calculating DRG Turnover

DRG turnover, mean stay, number of beds per hospital and average reimbursement per inpatient (Equation 1): The most significant factor we should look at to drive down costs is the mean stay, which is about seven days per inpatient. We can reduce costs by

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ensuring that the first diagnostic exam prescribed is the optimal one, avoiding a spiral into further tests which prolongs hospital stays and wastes resources. This could potentially reduce the mean stay by 1.5 days for 50 percent of all inpatients, which can be shown by altering the equation (Equation 2).

$$\frac{1}{\text{mean stay} - \frac{1}{2} \times 1.5} > \frac{1}{7 - \frac{1}{2} \times 1.4} = \frac{1}{7} \times \frac{1}{1 - \frac{1}{10}} = \frac{1}{7} \times (1 + \frac{1}{10} + \dots) \approx \frac{1}{7} \times 1.14$$

Equation 2: Optimised Resources

This formula proves that the abovementioned outcome of better referrals and wiser exam choices, avoids a diagnostic domino effect and can optimise the total turnover of the hospital by 10 percent. This strategy of avoiding unnecessary exams for all inpatients in the hospital, most of whom will require some sort of diagnostic imaging exam at some point in their stay, clearly supports a quality foundation for the management of medical imaging services.

Do Oncologic and Trauma Patients Really Need Multiple Exams?

One argument presented by the directors of medical imaging to the above cost management method is their belief that the majority of inpatients suffer from either oncological or trauma-related diseases, which require multiple diagnostic exams before and after treatment. From the analysis of RIS data from many large- and medium-sized hospitals as well as university clinics, we have been seeing a different result, as oncological and trauma patients in particular are experiencing highly redundant diagnostic exam pathways of the same organ with different modalities, which easily can be reduced by at least a factor of two if proper case management is applied.

We concede that the analysis of clinical and diagnostic pathways and the discussion of the results with clinicians and diagnosticians will always be a challenging task to fulfill, but it is worth doing, since it is beneficial for the quality of service for patients as well as the performance and revenue of the hospital.

Hospital Managers and Imaging Costs

The majority of hospital managers concentrate their efforts on controlling the direct costs of the MID, which only has a maximum financial impact of up to one percent of DRG turnover. About 80 percent of the total running costs of any MID consist of both labour costs, accounting for up to 60 percent, with costs of equipment (depreciation and interest of financing modalities, running costs for customer service, etc.) accounting for the remaining 20 percent. Hospital managers would be better placed if they would turn their attention to labour and equipment financing and maintenance as significant cost drivers for medical imaging.

To get to an estimate of the cost saving potential of focusing on labour costs, we recommend using a benchmarking tool. The primary benchmark is the productivity of medical staff (radiologists and technicians, see Figure 1). The overall costs of labour are divided into about 75 percent going towards medical staff cost and the remaining 25 percent being allocated to administrative staff (in a DRG environment, the cost of medical staff accounts for 90 percent of costs for CT and MRI, about 33 percent of costs for conventional x-ray and approximately 25 percent for ultrasound). The productivity graph allows you to discriminate the productivity of the MID between four groups of hospital:

- University clinics (UC);
- Large acute hospitals (LAH);
- Medium acute hospitals (MAH); and
- MAHs that work with a private imaging practice (P).

These tend to be the best financial performers of each of the four in this group, followed by MAH, LAH and finally the university clinics.

University clinics, being burdened by the heavy costs of teaching, educating and training young academics, have traditionally meant reduced productivity and increased labour costs. However, one way in which university clinics are addressing this sluggish performance is by separating research as an entity from the management of inpatient care, which means that the productivity of physicians can be increased (see U2 on the productivity graph). From the productivity graph you can easily see one important result at first glance, which is that the ratio of maximum and minimum productivity of radiologists is about 2.5 whereas the same

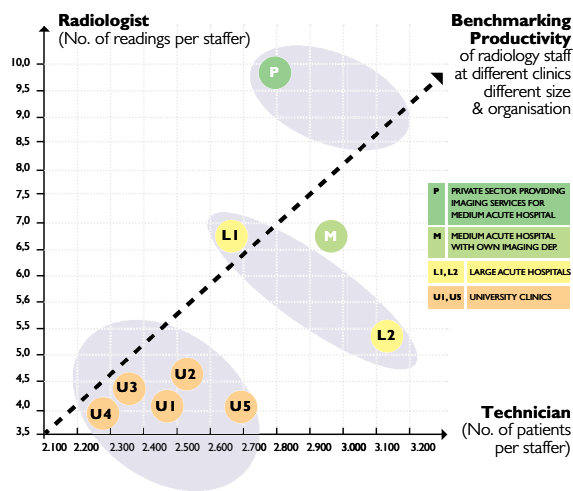


Figure 1
Productivity Graph Comparing Different Types of Medical Imaging Department

ratio of technicians is about 1.4. The radiologists in the private imaging practices (marked, P in the graph) are the best performers in terms of productivity.

For the group labelled L2, large acute hospitals, the productivity is accounted for as CT technicians were receiving an incentive

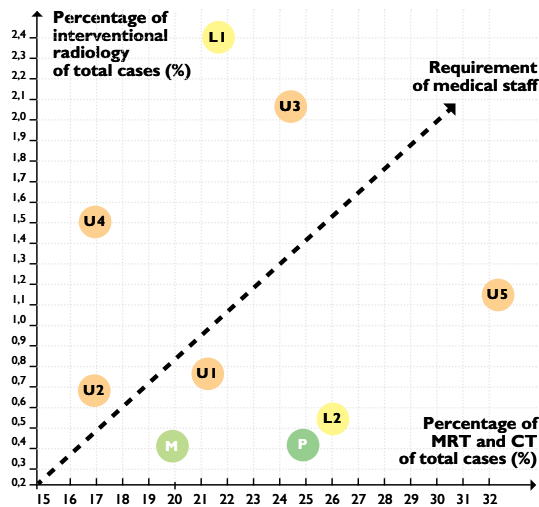
for increasing their productivity (in this case, a very high case load of 12,000 patients between 8.00 a.m. and 5.00 p.m. on one CT). The performance of the technicians in the medium acute hospital (here, labelled, M) was the result of a low number of MRIs being performed in favour of a high percentage of conventional x-rays (a case cycle for MRI of about 30 to 40 minutes and for conventional x-ray of about 10 minutes).

Modalities that Require High Staff Numbers Drive Costs

Managing an imaging department in the face of financial restrictions requires looking into those exams which require a higher number of medical staff (see Figure 2). Interestingly, in our graphs you can see that a large acute hospital (L1) is on the same level as two high-end university clinics (U3, U5), whereas the productivity of the L1 staff is better than all of the university clinics. This indicates a dedicated workflow management process is the key factor for success. Interventional radiology and particularly MRI are fast-growing areas within MID, requiring more medical staff than conventional x-ray.

Figure 2

Medical Staff Requirement Correlation with Exam Type



Another important indicator for medical staff is the correlation with complexity of diagnostic effort, measured by the average number of investigations per patient and the number of readings per investigation, the first one correlating with the number of times a patient is visiting a modality (technician), the second one with the number of organs per investigation to be analysed and read by a diagnostician (see Figure 3). If the management of the MID adheres to the quality criteria 2, 3 and 4 in the early part of this paper, the complexity of diagnostic efforts will be significantly reduced, consequently impacting labour cost. Budgeting for labour costs need not necessarily mean neglecting the quality of services provided, it simply means that a logical approach to streamlining treatment pathways and making sensible, evidence-based choices of imaging exams will tie in with an overall approach to cost management.

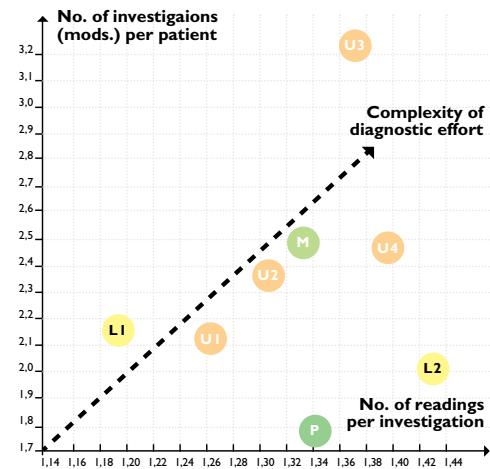


Figure 3: Medical Staff Requirement Correlation with Complexity of Diagnostic Effort

Another way of benchmarking cost issues is to take account of innovations of modalities which are improving specific productivity, and finally proper IT to support an efficient workflow (RIS/PACS, networked with KIS) and overall approach to cost management.

Consider a Public-Private Cooperation

We briefly discuss the issue of gaining additional revenues with MID from serving outpatients. The most rewarding and self-sustaining approach is being represented by the group labelled P (Figure 1), in which a private practice cooperates with a hospital to provide imaging and interventional radiology services to its inpatients. To consolidate such a cooperation financially, organisationally and economically, it is recommended to set up a legal body shared by both parties. This approach is applicable to all types of imaging facilities, even large acute hospitals and university clinics. The organisation of such a cooperation aims at leaving inpatient and outpatient care with the private practice and financial controlling with the hospital. Radiologists in the private practice are thusly incentivised and rewarded for their high productivity. This type of contracting of inpatient care is based on a pay-per-exam model. Generally, a hospital will save at least 20 percent of the total running cost of its MID before the cooperation and get additional revenue from the earnings per share.

In addition, this kind of cooperation leaves the door open for an expanded collaboration in which the private practice can use their clinical strengths to serve outpatients (e.g. non-invasive cardio-imaging, interventional radiology, onco-imaging, paediatric imaging, etc) and generate additional DRG turnover for the hospital. In some of these cases, patients will need inpatient care in a further step which generates increased DRG turnover.

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A MULTIDISCIPLINARY APPROACH TO FINANCIAL PLANNING

Clinical Aspects and IT Requirements



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Public health authorities face massive strain on their financial capacity and resources due to the explosion in the development of new medical technology, and the aging population. New reforms in legal initiatives prompted a radical change of the market structures which are being replicated in today's health systems. The EU, for example, intends and has planned for some time, to reform previously monopolistic, traditional ways, because public services of general interest are more and more evolving into competitive structures. The establishment of health services as competitive structures will inevitably lead to a process of natural selection and only economically successful participants will survive to lead the healthcare market.



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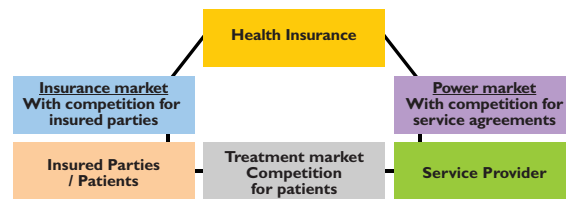


Figure 1: Impact of Competition on Health Insurance and Service Levels

Competition in the healthcare market will impact both the health insurance and service levels (Figure 1). Consequently, there is a continuous need to increase effectiveness and efficiency, and thus to improve processes, in the healthcare sector generally and in the organisation of hospitals and medical practices in particular. The concept of competition in healthcare refers to both performance and cost competition, with a given emphasis on improved quality. "It is not the major players that will push the smaller ones out of the market, but the fast will push out the slow" (W. von Eiff, Medical Data Institute, Münster). Thus, the successful management of hospital departments and medical practices requires suitable structures and optimisation processes in the fields of medical quality, service quality and efficiency.

Medical Centre Manager	Medical Technology Manager
▶ 6 Section Heads	6 Area Managers
▶ 18 Doctors	35 Technology Assistants
• Radiologists	Organisational Forces
• Surgeons	
• Internists	
• Nuclear Medicine	
• EDV Specialist	EDV Specialist
• Angiologists	Graduate Economist

Table 1: Allocation of Employees

Organisational Structures in Brüderkrankenhaus Trier

The Department for Radiology, Ultrasound and Nuclear Medicine in the Brüderkrankenhaus Trier has 69 employees, allocated as shown in Table 1.

Medical imaging greatly influences the optimisation of the entire treatment pathway for patients in the hospital, as it plays a central part within the hospital, providing services to a large number of internal hospital departments as well as referring third parties (e.g. local practices). The imaging diagnostics and interventional treatment divisions are therefore particularly meaningful as service providers to all clinical departments of the hospital (Figure 3).

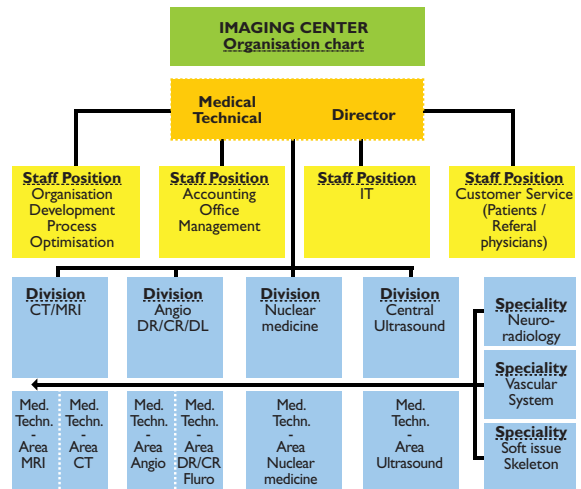


Figure 2: Imaging Department's Organisational Chart

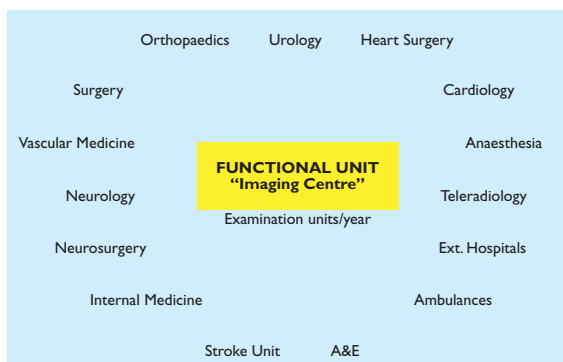


Figure 3: The Imaging Department at the Intersection of Interdisciplinary Treatments

How Processes Impact Payment

It is essential that the organisation of the treatment process be viewed holistically, as a complete and entire process in order to execute a well-managed payment system. Along with the provision of individual services, interdisciplinary counselling must be provided prior to the diagnostic and treatment of disease patterns (e.g. vascular diseases), in particular in the context of medically and economically efficient diagnostic and treatment paths. Avoiding a CT examination through set treatment paths or interdisciplinary team meetings creates value both for the patient, potentially leading to less or no radiation exposure, and for the overall value creation chain of the hospital. In a system of diagnosis-based fixed reimbursement, the unperformed exam will be compensated in any case, while still respecting patient safety and a high medical quality.

How We Do It

Our department's revenue streams include:

- Outpatient services;
- Private patients;
- Internal activity allocation;
- External referrers; and
- Additional revenue from new offerings (Cardio-CT; screening, leasing of equipment and personnel from other health providers, increasing the number of private patients, etc.)

Increasing your service offering also generates new revenue when carried out in an efficient way. For us, our efficiency increased with the establishment of two ambulatory care centres. These systems allow for better utilisation, additional margins and the integration of ambulatory and stationary spheres, representing extension of the value chain. Cost savings are derived from the ratio of total costs to total rev-

enues and internal transfer pricing. The positive difference between revenues and costs allows an increase in budget in the areas of personnel, equipment and investment.

Organisation of Our Budget

An interdisciplinary framework is not just useful for high quality medical treatment and process optimisation. In terms of budgetary planning, we carry out annual budget meetings that involve the administration personnel as well as the central management team, who create the frame for an overall targeted planning for the economic management of the medical imaging department (MID). This is subdivided into service area planning, cost planning and revenue planning. The parameters we use to measure the success of this plan include the service volume, which is rated by service points, and the cost of personnel and materials. Overall cost-effectiveness is the result of the relationship between revenues and costs.

Operational sector budgets set the targets for the upcoming year and are generally based on the data of the preceding year. The size of the service volume is determined to a high degree by the internal service allocation of the referring parties, who are responsible for the effectiveness of the service request but also for the involved prices. The MID's management is responsible for the productivity and the cost-effectiveness of the service provision (Figure 4).

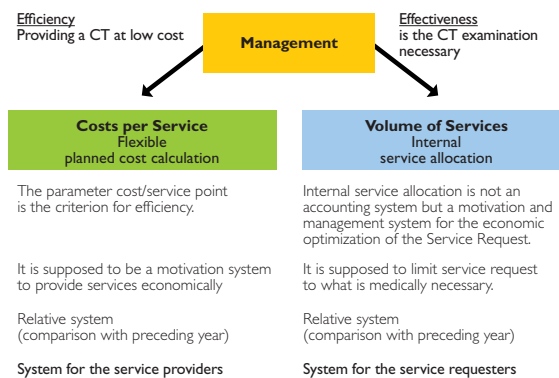
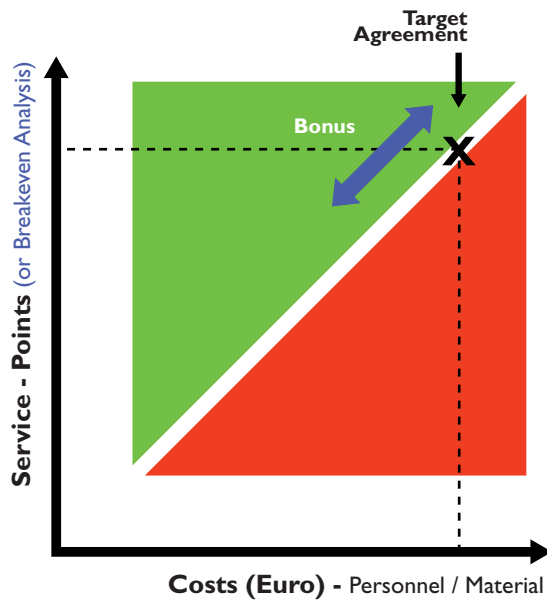


Figure 4

The medical imaging department from an economic perspective

In this way, any deviations that arise between planning and execution becomes apparent and can be addressed by management. In the hospital, parameters offering service and cost information are particularly important in preparing the annual budget meetings between a department and the hospital management. Well-prepared target-oriented

Figure 5
Flexible Planned Cost Calculation



meetings, with a proper analysis of the service development and costs, can be crucial for the department's future development.

In a monthly reporting of internal controlling, carried out in close coordination with the department of business administration, the data is provided to the responsible managers of the relevant cost centres in the MID. Budgets consist of both a value based cost component (input) and volume based services (output).

Cost adjustments in personnel and material costs are made using a flexible planned cost calculation that takes

any resulting potential higher or lower revenue into account. For example, productivity increases in the form of more services at lower costs are rewarded by a bonus for the medical imaging department's employees. In case of a productivity increase, this will be negotiated as planned/target parameter for the next year, so that the efficiency criterion is continually driven upwards (Figure 5).

When Does Fee-for-Service Work?

By setting up a budgetary management system that operates under the umbrella of optimised efficiency, a hospital or medical practice is better equipped to survive and will add some protection in the face of challenging or changing financial conditions. In a hospital, efficiency, which in this case refers to the relationship between revenue and costs, refers to the sum of individual services (e.g. out-patient services, emergencies), but beyond this also to the realisation of treatment complexes – diagnosis related groups (DRG). Approximately 70 – 80 percent of the revenue of hospitals consists of diagnosis-based fixed compensation. The DRG system is a service-based compensation scheme that follows the motto "fee for service". A comparison of the annual volume of personnel and material costs with the sum of the corresponding DRG portions can be used as a criterion of efficiency. This applies especially to the personnel costs, which represent the largest cost pool.

Benchmarking Costs and Services

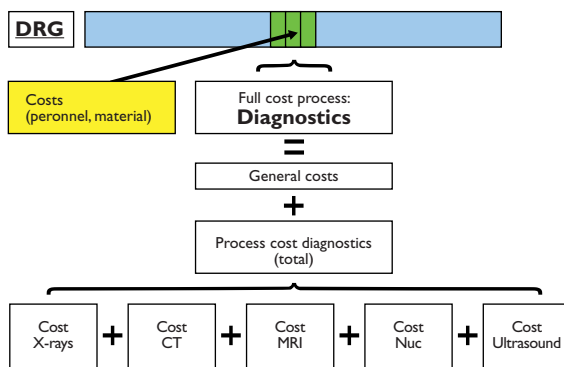
In order to evaluate the results of productivity external hospitals are used as comparators (external benchmarking). This way, costs for personnel and material may be compared e.g. with the cost data of the DRG calculation, and analysed (Figure 6).

Revenue, the process sequence and the type and number of the procedures used must be compared and reviewed for optimisation needs. The same applies to service data, the comparison of which allows for the deriving of effectiveness assessments. How the examination mix in a complex diagnosis-based, fixed compensation case (e.g. B70B, stroke) looks in retrospective comparison with other hospitals is shown in Table 2.

Benchmarking against the procedures used on average in the German Institute for the Compensation System in Hospitals (InEK) calculation shows the possible optimisation need of the clinical treatment path.

Further, utilisation management within the scope of external benchmarking against 500 hospitals in Europe (Philips Utilization Services) enables the assessment of the quality

Figure 6
The Costs of DRG for Imaging



DRG	Cost Medical service actual	Cost MTD* actual	Cost AD*/MTD actual	Medical service acc. to INEK with baserate BKT (target)	MTD acc. to INEK with baserate BKT (target)	AD/MTD acc. to INEK with baserate BKT (target)	Diff. actual/target personal
Gesamt	811.728,74	1.033.031,86	1.844.760,60	790.791,60	1.137.746,04	1.928.537,64	-83.777,04
E71B	24.098,73	23.500,74	47.599,47	19.303,47	27.762,80	47.066,26	533,21
B70B	18.141,97	24.099,52	42.241,49	22.632,01	25.667,07	48.299,08	-6.057,59
F54Z	16.946,57	22.768,72	39.715,29	18.219,06	19.710,80	37.929,86	1.785,43
B70D	16.827,91	22.510,68	39.338,59	18.297,89	23.513,81	41.811,70	-2.473,11
F59B	16.429,40	22.030,25	38.459,65	17.698,29	19.846,84	37.545,13	914,52
B76G	13.624,15	18.281,40	31.905,55	10.757,95	15.264,54	26.022,49	5.883,06
I53Z	12.580,82	16.303,26	28.884,08	16.837,86	23.283,40	40.121,26	-11.237,19
B20B	11.721,26	15.704,04	27.425,30	20.899,34	24.628,04	45.527,39	-18.102,09
B81B	10.777,46	14.378,51	25.155,97	8.231,30	11.348,85	19.580,15	5.575,82
A09C	10.660,20	14.322,61	24.982,81	12.025,52	15.709,22	27.734,74	-2.751,93

Table 2

Comparison of Personnel Costs with the Calculated Data sets of InEK for the DRGs with the Highest Number of Radiological Service Points in the Krankenhaus der Barmherzigen Brüder Trier
 * AD – medical service
 * MTD – medical technical service
 Source: Busch H.P. 2010

of the process workflow based on the criteria of patient flow management, examination flow management, schedule logistics management, optimisation of the procedures.

Process Optimisation

The optimisation of the organisational structure has a direct impact on the value chain of medical imaging departments. In the DRG context, the entire treatment path in the hospital is compensated, so that a continuous optimisation of processes in the areas of medical quality, service quality and efficiency is necessary to secure revenue. (See Zapp, W./Dorenkamp, A. (2002), page 65). On these three pillars, the centre must be managed according to the rules of a business enterprise.

Diagnosis based fixed compensation (the price is a "Date") requires an optimisation in the areas of effectiveness (i.e., looking at whether the indication and/or the MR

examination was necessary) and efficiency (i.e., analysing the way in which the examination was conducted). In this context, productivity (costs per examination) must be used as criterion of success. Further, it is necessary to use resources where they are needed the most according to the rationality principle.

The difference between the revenue determined by the DRG compensation and the costs can be enlarged by the increase of productivity and the avoidance of unnecessary examination numbers. New equipment (e.g. 3-Tesla MRT, flat plate detectors) afford the possibility to increase patient throughput.

The economic success of the MID requires continuous efforts in order to be able to succeed in the areas of medical quality, service quality and efficiency. ■

For references please send a request to editorial@imagingmanagement.org

DRG	OPS	OPS - Text	BKT rel. Share OPS/Case	DRG Browser rel. Share OPS/Case	Difference BKT/DRG Browser
F59B	3-607	Arteriographie of the lower limb vessels	73,23%	57,63%	15,60%
F59B	8-836.0b	Percutaneous transluminal vascular intervention	54,33%	54,21%	0,12%
F59B	3-605	Artriography of the vessels of the basin	32,28%	45,38%	-13,10%
F59B	8-83b.c3	Additional information to materials: use of a vascular Closure System, Clipsystem	24,41%	0,00%	-
F59B	8-836.09	Percutaneous transluminal vascular intervention: Angioplasty (balloon): other abdominal vessels	22,05%	22,33%	-0,28%
F59B	8-840.06	Percutaneous transluminal implantation of not drug-eluting stents: one stent other abdominal vessels	22,05%	0,00%	-
F59B	8-840.0b	Percutaneous transluminal implantation of not drug-eluting stents: one stent vessels thigh	14,96%	0,00%	-
F59B	8-836.0c	Percutaneous transluminal vascular intervention: Angioplasty (balloon): vessels lower leg	11,81%	11,92%	-0,11%
F59B	3-828	Magnetresonanztomographie of peripher vessels with contrast medium	11,81%	3,84%	7,97%

Clinical pathway!

Table 3

From the DRG-Portion to the Analysis of the Clinical Treatment Paths
 Source: Busch H.P. 2010

PRE-PLANNING OF IMAGING WORKLOAD

How Implementing Service Level Agreements Can Help



Author
Prof. Mathias Goyen

Clinical Development
Director
GE Healthcare

Managing a continuously increasing workload is a major challenge for many imaging departments. However, effective workload management can be achieved through service level agreements, and will help radiologists in their interaction with hospital administrators, as well as helping purchasing groups to enable appropriate resources to be provided for the imaging services. The goal of implementing a service level agreement is to manage the workload of an imaging department in a proper and efficient way, which is linked to the facilities and resources available on a planned rather than a random basis. Pre-planning of work volumes should enable imaging departments to manage the flow of patients and to remain flexible in responding to changes in clinical practice. Achieving a balance between the resources available to undertake the work and the level of workload is fundamental to imaging departments that provide a service to others.

“The level of qualifications and skills of the individuals undertaking procedures and reporting the images should be specified”

A service level agreement enables the clinically requesting group and the radiological deliverer of the service to agree the amount of work that is possible for an agreed budget and, in particular, to agree the quality of the service that is to be provided. This overview familiarises the reader with the concept of service level agreements and is based on the paper by the Royal College of Radiologists (RCR) in the UK on service level agreements.

Basis of Budgeting

Item-for-service budgeting

Each and every item of service is paid for on an individual basis, thus accurate cost analysis of the service delivered will set the correct price for the work.

Health related groups

The total caseload of the hospital is divided up into groups of conditions, and the treatment of these conditions is priced. There will be a slice for radiological investigations, and the total cost will represent the contract price for the group of

conditions. The commissioning bodies would then contract for a specific number of cases within each group, and the payment to the individual hospital would cover the total cost of those cases.

Cost and volume contracts

Cost-and-volume contracts represent a less sophisticated version of health related groups. A clinical specialty service or commissioning group may agree to contract for a block of work at a specific price, which may be variable in its content, but which would be agreed on the basis of an average costing of the case mix, and an agreed volume of work.

Cost Analysis

Cost accounting is an essential tool in accumulating relevant cost data. It is one of the basic components in evaluating the use of resources in order that an appropriate service level agreement may be concluded. It assigns costs to the smallest segment of a business for which meaningful costs can be calculated, and serves as a database for decision-making and planning.

Before implementing cost accounting, it is important to decide the level of accuracy required. Complicated systems should be avoided. In developing such a system it is important to concentrate on the major cost factors, but the level of detail depends on the accuracy that is required of the data. Most of the data required can be extracted from examination lists, inventories and budget sheets.

Service Level Agreements

Content

Some parts of the service level agreement are generic, those that would be accepted as an integral part of the radiological service, including the agreement to comply with all relevant radiation safety, health and safety, and data protection legislation. Other features might include the quality of patient facilities. These should be covered in general terms within the agreement.

The specific features of the service level agreement relate to the quality of the service provided. The level of qualifications and skills of the individuals undertaking procedures and reporting the images should be specified.

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Patients

The type of patient referred to within the agreement should be clearly identified. This may include severely bed-ridden inpatients, more-active patients, and outpatients. The expected turnaround time of the patient within the hospital should be agreed. The expected numbers of patients in all categories, with the likely case mix, must also be defined.

“Many service level agreements have failed, due to inadequate monitoring of the agreement and failure to implement the penalty clauses and/or the financial transfers identified in the agreement”

Availability of the service

The timing of service provision should be explicit. The clinical commissioner would be expected to identify the likely times for service requirements, to expect a guarantee of adherence to those required times; and to accept an undertaking not to change them without due consultation and agreement. The agreement may include uninterrupted radiographer availability and on-call radiologists' service, 24 hours a day, seven days a week, or may restrict the service provided to office hours or to specific times.

Requests for reports

The quality of requests should be agreed. The referring clinician must agree to provide adequate clinical information dependent on the complexity of the case and the sophistication of the investigation or therapy requested.

Clinical commissioners should agree to the level of notice required for requests, within clearly defined limits. The criteria for non-urgent but acute and chronic cases should be identified, and the relationship to hospital expenditure should be clearly defined. The referring clinician must identify the level of reporting services that are required for specific requests, including immediate access to a consultant radiologist, clinico-radiological conferences, advice levels, and reports.

Quality of reporting services

The quality of the reporting service should be defined in terms of the speed with which the reporting is undertaken and the reports are dispatched to the referring clinician. This may also contain agreements regarding clinico-radiological conferences and ways of accepting urgent cases by direct access to radiologists.

Transfer of reports

This would include an agreed speed for typing of reports, the methodology of transfer of reports to the clinicians, and an outline of the responsibilities of each party for ensuring that the report is made available for the requesting clinician.

Service Level Agreements: Service Deliverer Agreements

The commissioner of the service would expect to agree a number of specified criteria regarding volume of work and quality of service required. The imaging department must cost the agreed volume of work and quality of service. Careful cost analysis and a quantum of income budget must be agreed in order to provide the desired quality of service.

Within the agreement, variability clauses must be included. These may take the form of an increase in income at an agreed level if the workload increase is beyond a specific percentage overall, or if the case mix changes to more expensive investigations. Clear examples would include a transfer of back-pain investigations from plain x-rays to magnetic resonance, or a change of policy for treating biliary tract stenosis from surgery to stents. Penalties for poor service provision should be included, and similarly a recognition of the implications for the clinical commissioner if the quality of the referral pattern is not followed. This must be explicit within the service level agreement.

It is important in the management of a service level agreement that excess usage is identified early so that appropriate discussions and reviews can take place, to avoid a sudden cessation of service.

Conclusion

Service level agreements are required to monitor and assess workload within an imaging department. Many service level agreements have failed, due to inadequate monitoring of the agreement and failure to implement the penalty clauses and/or the financial transfers identified in the agreement. Ultimately these agreements will only work if applied rigorously and effectively by the service departments.

References

- 1) Board of the Faculty of Clinical Radiology and The Royal College of Radiologists (1998): Service Level Agreements. Royal College of Radiologists, London. ■

AUTHOR GUIDELINES

Content

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Structure

Article texts must contain:

- Names of authors with abbreviations for the highest academic degree;
- Affiliation: department and institution, city and country;
- Lead authors are requested to supply a portrait photo (see specifications below);
- One contact name for correspondence and an e-mail address which may be published with the article;
- Acknowledgements of any connections with a company or financial sponsor;
- Authors are encouraged to include checklists, tables and/or guidelines, which summarise findings or recommendations, and
- References or sources, if appropriate, as specified below.

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Main authors are invited to supply a portrait photo for publication with their article, as well as other images and visuals. This and any other rel-

evant images for publication with an article should be sent by e-mail as separate files (only high resolution images with 300dpi) and their order of placement in the article must be clearly indicated. Only the electronic formats `_.tif_` or `_.jpeg_` can be used for images, i.e. not Microsoft Word or PowerPoint. Images must be no smaller than 9cm x 9cm at 100% scale. Only images meeting these specifications can be published. If an image has been published before, permission to reproduce the material must be obtained by the author from the copyright holder and the original source acknowledged in the text, e.g. © 2012 Marianna Keen.

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Please use the Harvard reference system. Citations within the text for a single author reference should include the author surname and year of publication; for a citation with two authors include both author surnames and year of publication; for more than two authors, include the first author surname followed by "et al." and the year of publication. Multiple citations should be separated by a semicolon, and listed in alphabetical order. Example of within text citation: (Marolt 2012; Marolt and Keen 2012; Miller et al. 2012).

The format for listing references in submitted articles should follow the Harvard reference system. Example of standard journal reference: Sydow Campbell, K. (1999) "Collecting information; qualitative research methods for solving workplace problems", *Technical communication*, 46 (4) 532-544. Readers will be provided with an e-mail contact for references, which will be kept on file and supplied on request. Authors are responsible for the accuracy of the references they cite.

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*Thank you,
The IMAGING Management Editorial Team*

TECHNOLOGY HORIZONS IN HYBRID IMAGING

Broadening the Possibilities for Diagnosis



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Research Analyst
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Frost and Sullivan

Hybrid imaging systems and their applications have gained widespread acceptance and continue to grow. Enthused by the success of PET-CT, medical imaging is witnessing the further development of hybrid solutions such as PET-MR and SPECT-CT through the collaboration of radiology and nuclear medicine. The emphasis lies in combining the strengths of functional and anatomical modalities into one system to provide a powerful hybrid imaging and diagnostic tool.

PET-CT

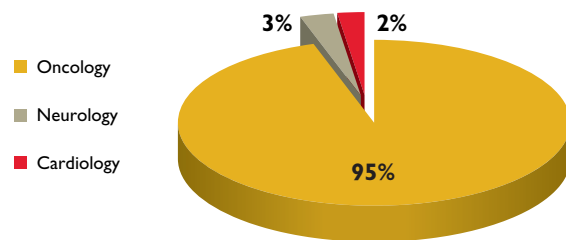
Since its advent in 2001, PET-CT has established itself as a clinical tool for oncology: diagnosis, staging and restaging of cancers. This hybrid imaging modality has a proven sensitivity of 90 percent to 100 percent, specificity of 70 percent to 100 percent, and an accuracy of 90 percent to 96 percent for characterisation of tumours. PET-CT provides high-quality clinical data making it a potentially attractive modality for radiation oncology applications. This hybrid system proves beneficial to patients and provides overall cost savings as the need for separate scans are reduced. It also proves economic for imaging centres and healthcare facilities as the modality is not only used for fusion imaging but can also be used as a dedicated PET or dedicated CT depending on the facility's needs.

However the delaying factors for PET-CT are the inability to perform simultaneous scans as PET and CT images are acquired in sequences. Other drawbacks of the system include poor soft tissue contrasts and artifact generation due to patient and organ motion as well as varied breathing protocols for PET and CT.

PET amyloid specific radiotracers are currently being developed to distinguish between Alzheimer's disease (AD) and frontotemporal dementia (FTD), and dementia with Lewy Bodies (DLB). Other amino acid PET tracers include F-18 fluorothymidine showing potential for the imaging of brain tumours. Flurocholine 11C choline is also undergoing trials and being assessed for its potential in prostate cancer. Other radiotracers being developed and investigated for hepatic and prostate cancer include 11C-methionine, 68Ga-DOTA-NOC, 11C-acetate, 11C-thymidine, and 18F-DOPA.

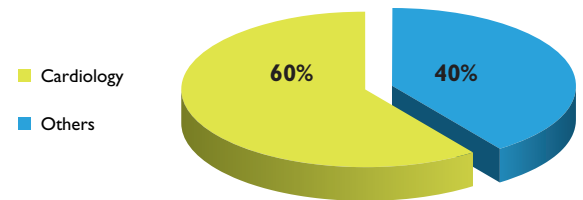
Although the use of PET-CT in cardiology and neurology is not as significant as in the case of clinical oncology, the development of novel radiopharmaceutical agents is expected to widen the scope of PET-CT applications beyond oncology and towards cardiology and neurology. Recent studies suggest that PET-CT-based MPI using Rb-82 has comparatively better diagnostic characteristics than the traditional SPECT-based MPI studies done using Tc-99. SPECT-CT is also being used in bone disease diagnosis and management.

Figure 1
Current and Emerging Applications of PET-CT



The primary applications of PET-CT are for oncology which accounts for almost 95 percent of all clinical utilisation. Cardiology and neurology comprise two percent and three percent respectively.

PET-CT's use is widespread in the field of oncology with the exception of a very few cancers that are not 18F-fluorodeoxyglucose (FDG) avid. FDG is the most frequently used tracer. Currently there are other tracers that are undergoing clinical trials to assess their capabilities in oncology and other medical fields.



Cardiology accounts for 60 percent of SPECT-CT procedures with CT angiography and calcium scoring being major applications. The remaining 40 percent comprises of other procedures in oncology, neurology, orthopaedics and infection.

Figure 2: Current and Emerging Applications of SPECT-CT:

Current and Emerging Applications of SPECT-CT

SPECT-CT is gaining momentum in the orthopaedics, disease and infection diagnosis. The hybrid modality has been clinically proven to evaluate and diagnose infection and inflammation. SPECT-CT offers an edge above conventional SPECT systems owing to its ability to localise cardiac disease states. Other emerging applications for SPECT-CT in cardiology include myocardial perfusion imaging. Recent clinical studies suggest that attenuation correction using hybrid SPECT-CT improved specificity in the right coronary artery, but decreased specificity in the left anterior descending. SPECT-CT has also been proven useful in diagnosing non-FDG cancers such as prostrate, neuroendocrine, thyroid and parathyroid cancers.

Current and Emerging Applications of PET-MRI

In comparison to CT, MRI offers endogenous contrasts and is preferred for imaging of soft tissues. Some of the current and emerging applications of PET-MRI are within the cardiology, oncology, neurology and preclinical imaging space. In addition PET-MRI does not deliver high radiation doses and can exploit soft tissue contrast of MRI to a great extent. The benefits of this hybrid modality have increased its clinical utility. This modality is gaining acceptance and being widely used for applications such as brain imaging wherein MRI has proven to be more effective than CT. Other applications include those that require excellent spatial resolution as this hybrid modality is known to provide good resolution. However, there are some technical challenges to be addressed such as attenuation correction and electromagnetic interference.

Some of the trends being witnessed in the PET-MRI space are the development of cardio PET radiotracers and specific nanoprobes for MRI which could positively impact the early diagnosis of ischaemic heart disease, acute coronary syndrome, and acute and chronic myocarditis. PET-MRI is also gaining momentum in the detection of lymphomas and lung nodules and is considered a more effective alternative as opposed to PET-CT.

PET-MRI has high potential in the neurology sector. Recent studies suggest that PET-MRI is more useful for brain studies than FDG-PET; for example, Alzheimer's disease. While FDG-PET findings are based solely on estimates, perfectly aligned MR-PET data presents findings with greater levels of accuracy.

SPECT-MRI

SPECT-MRI is also an emerging hybrid modality. Though

it may be a nascent technology, MRI-fMRI (functional MRI) is expected to be a growth driver for SPECT-MRI in the long run. SPECT-MRI is looked upon as a competing technology for SPECT-CT in the future and is also expected to fare better for brain studies than SPECT-CT. The hybrid modality is expected to be effective initially for cardiology and for neurology and oncology in the long term.

According to the research team from John Hopkins University, led by Benjamin Tsui, PhD, SPECT-MRI is expected to be a viable technology that could enhance the diagnostic capability of SPECT alone and provide additional information that could not be provided by SPECT-CT. The modality is now in a preclinical prototype stage to be extended to clinical brain studies with clinical trials expected to begin within three or four years.

Market Watch

On the market front, the reimbursement coverage for FDG-based procedures is increasing, resulting in high competitiveness among FDG distribution networks to meet the increasing demands for FDG. A steady growth in the number of radiopharmaceutical suppliers is expected to decrease the average selling price of FDG. Low costs, availability and demand of FDG are expected to drive the deployment of PET-CT. The adoption rate of SPECT-CT has rather been slow as opposed to PET-CT; this could be mainly attributed to lack of reimbursement policies for SPECT-CT based studies. This hybrid modality is expected to witness growth in infection and bone imaging applications, creating market opportunities for radiopharmaceutical vendors. The sales of this hybrid modality are expected to overtake sales of stand-alone SPECT systems. SPECT-CT will continue to show moderate growth as new clinical applications emerge.

On the other hand the emergence of PET-MRI is expected to hinder market growth of SPECT-CT in the neurology market in particular. This owes to the fact that PET-MRI's simultaneous imaging capability could aid in early diagnosis of neurological disease and offer high sensitivity and accuracy. Further PET-MRI is better placed in comparison with SPECT-CT, as it suffers from image mis-registration. These advantages of PET-MRI are likely to pose a threat to other nuclear medicine technologies in the long-term future.

Hybrid imaging has identified niche markets for penetration, which include orthopaedics such as bone scans, infection imaging, selective internal radiation therapy (SIRT), and apoptosis imaging, thereby creating the need for the development of novel diagnostic radiotracers to tap these potential markets. ■

IMAGING MANAGEMENT'S GUIDE TO CIRSE 2012 HIGHLIGHTS

Cardiovascular and Interventional Radiological Society of Europe Annual Congress 2012

The CIRSE Annual Congress is a major event in the imaging community – it is the world's largest meeting dedicated to image-guided, minimally invasive therapies. This dynamic, trend-setting congress allows the interventional radiology (IR) community to share the latest breakthroughs in research, trials and imaging modalities, as well as gaining robust training in procedural technique and clinical management.

CIRSE 2012 will be held in Lisbon, Portugal from September 15-19. In keeping with the continually evolving nature of IR, this year's congress will offer more Interactive Case Sessions, Workshops and Hot Topics Symposia than ever, as well as giving space to debate the specialty's most controversial therapies.

The programme is based around seven main themes – IR management, imaging, vascular interventions, transcatheter embolisation, interventional oncology and neurointerventions – ensuring that all aspects of the specialty, from established techniques to innovative novel therapies, are covered in a comprehensive and interactive way.

Topics:

- Medico-legal aspects
- Stroke Management
- Radiation Protection
- Imaging updates
- Honorary lectures

Medico-Legal aspects

In all areas of medicine, legal protection of both patient and practitioner are vital. This is especially true of innovative branches, such as IR, where new techniques and tools are integral to the specialty's success.

While bringing a host of novel solutions, this innovative character also raises special challenges for the hospital, in terms of informing patients and obtaining consent, off-label device use and minimising complications – which is aided by CIRSE's Patient Safety Check List, launched at last year's annual congress.

Congress-goers can brush up their knowledge of legal protection and protocol at the Special Session **Medico-legal issues and IR**.

Saturday, September 15 08:30, Auditorium 2

Stroke Management

IR has been widely incorporated into oncology and trauma teams with excellent results, and the same is true of stroke therapy. Quick and accurate imaging is essential for effective treatment, and im-

age-guided therapies are often required to treat the clot or haemorrhage itself. In recognition of this, IRs are being increasingly included in the stroke team set-up, and a series of sessions and workshops at CIRSE 2012 enables IRs to keep abreast of latest trial results, indications and strategies.

Sessions include:

Saturday, September 15, 10:00, Auditorium 2

Basics of acute stroke management: from diagnosis to treatment

Sunday, September 16, 08:30, Auditorium 8

Stroke management (Interactive Case Session)

Sunday, September 16, 10:00, Room 3.A

Stroke prevention: where do we stand in 2012?

Radiation Protection

All radiological specialties must consider adequate radiation protection for patients and staff, and all team members have a role to play in ensuring excellence. To this end, CIRSE is once again collaborating with the European Federation of Radiographer Societies, and is offering a series of workshops that caters for every member of the IR team, including nurses, radiographers and radiologists.

Saturday, September 15, 10:00, Auditorium 3

Radiation protection of workers and patients in the interventional lab - AITRI guidelines

Sunday, September 16, 10:00, Auditorium 3

The role of the radiographer in the angiography department

Imaging updates

Imaging is the backbone of interventional radiology, and updates on state-of-the-art technologies and imaging algorithms form an important part of every CIRSE congress. Imaging is key to every aspect of an IR's clinical practice, from diagnosis through to image-guided treatments, all the way to comprehensive follow-up. Hands-On Workshops, Interactive Case Sessions and an extensive exhibition area allow participants to stay abreast of the newest developments.

Running as a unifying thread throughout the whole congress, most of our Special Sessions feature imaging updates, discussing

patient assessment and selection, use of contrast agents and other challenges.

Additionally, CIRSE offers some dedicated imaging sessions, which provide congress-goers with in-depth information on cutting-edge technologies and applications, such as:

Wednesday, September 19, 8:30, Auditorium 6

Imaging after ablation: what you need to know

Wednesday, September 19, 10:00, Auditorium 2

Vascular imaging

Honorary lectures

This year's honorary lectures are especially exciting, as they will be directly followed by the popular and controversial Hot Top-

ics Sessions, offering a double helping of interventional food for thought. The Hot Topics Sessions address burning topics in a plenary session, with a round-table discussion in which the audience can participate.

Sunday, September 16, 14:30, Auditorium 1

Andreas Gruentzig lecture

New frontiers in musculoskeletal tumour management: A. Gangi (Strasbourg/FR)

Hot Topic Symposium: Vertebral augmentation

Tuesday, September 18, 13:00, Auditorium 1

Josef Roesch lecture

Preclinical IR research: what it does for you: D. Pavčnik (Portland, OR/US)

Hot Topic Symposium: Renal denervation (see page 34)

CIRSE'S IR SAFETY CHECKLIST HOW TICKING BOXES CAN SAVE LIVES

While it may be true that to err is human, making mistakes is also a luxury that is not afforded to all humans alike. For people working in high-risk professions, such as in the civil aviation or medical industries, a simple mistake can have fatal consequences and must be avoided where possible.

Numerous studies have been carried out examining the tragic impact human error can have on clinical practice. A landmark study released in 2009 was one of the first to draw attention to a simple yet effective solution to the problem – the safety checklist.

In 2011, the Cardiovascular and Interventional Radiological Society of Europe (CIRSE) created one of the first safety checklists for interventional radiology (IR). One year after it was published, the checklist is proving a valuable tool for improving IR patient safety in Europe.

Improving safety, one tick at a time

Many groups have a vested interest in patient safety and it is not hard to understand why – improving patient safety can save money, reputations and most importantly, it can save lives. However, it may not be clear how a simple checklist can help improve patient safety.

The minimally invasive nature of IR means that it leads to fewer complications than surgery. However, complications do occur. The unique combination of diagnostic and cutting-edge inter-

ventional techniques used in IR procedures gives rise to complex procedural steps – steps that must be strictly adhered to.

According to CIRSE President and main author of IR Safety Checklist, Professor Michael J. Lee “The advantage of a safety checklist for IR is that it ensures that human error in terms of forgetting key steps in patient preparation, intra-procedural care, and postoperative care are not forgotten”.

Another benefit the checklist brings was highlighted by Professor Patrick Haage of Helios Klinikum in Wuppertal, Germany, who implemented the checklist in his hospital in 2011. “The checklist has helped us to attain and maintain consistency and reliability for the benefit of patient safety.”

In Professor Lee's institution, Beaumont Hospital in Dublin, Ireland, the checklist had also “...helped build rapport within the IR team and most importantly, it has meant that all patients receive appropriate peri-procedural care and medications that help prevent complications.”

How it works

The checklist was created by an expert group of IRs and tested in four European hospitals. First published in 2011, the single-page document was based on the WHO Surgical Checklist and the Dutch RAD PASS Safety Checklist for IR.

Comprising three sections – “Procedure Planning”, “Sign-in” and



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Procedure Planning	<ul style="list-style-type: none"> ✓ Helps collect important information on the patient's medical history (e.g. allergies to contrast agents) ✓ Helps the medical team prepare for possible complications ✓ Completed by the IR or ward nurse
Sign-in	<ul style="list-style-type: none"> ✓ Lists the immediate checks that must be performed when the patient is in the IR suite (e.g. confirmation of patient identity) ✓ Completed by an IR resident, nurse or staff IR while the patient is in the room
Sign-out	<ul style="list-style-type: none"> ✓ Helps plan and collect information on follow-up tests and treatments required ✓ Completed by the operating IR

“Sign-out” – the checklist can easily be modified to suit the requirements of individual hospitals. Professor Lee also explained that “The checklist was designed to be general so it can be applied to a wide variety of interventional procedures.”

A forecast for success

Although checklists are commonplace in various other high-risk professions, their use in medicine is a more recent development. The renowned Surgical Safety Checklist, sponsored by the World Health Organisation (WHO), was the first medical safety checklist to gain widespread acclaim from various institutions around the world. The WHO Surgical Safety Checklist was used as a model for CIRSE's IR Safety Checklist and is therefore seen as an indicator of the possible benefits that implementing an IR safety checklist can bring.

The WHO Surgical Safety Checklist first came into the limelight when the results of a year-long pilot study on it were published in the New England Journal of Medicine in 2009. The study highlighted how the checklist had led to reductions in complication rates of over 33% and significant decreases in mortality rates.

Subsequent studies confirmed the findings of the initial pilot study, estimating that as much as half a million deaths per year can be prevented simply by implementing the WHO Surgical Safety Checklist. The WHO Surgical Safety Checklist is now being used in over 1,800 hospitals around the world.

A promising future

Despite its recent introduction, CIRSE's IR Safety Checklist has already seen its first successes. Currently in place in various hospitals throughout Europe, it has led to significant improvements in the safety dynamics of these institutions. The IR Safety Checklist was also well received by the European Commission's Health and Consumers Directorate-General and CIRSE representatives have been invited to Brussels for talks on patient safety in IR.

CIRSE hopes that the widespread adoption of the checklist will lead to improvements in patient safety within Europe and also well beyond its borders. The society has made the checklist available, free-of-charge, on its website. The checklist can be modified to suit individual institutions or IR practices.

To download a copy of the checklist, please visit www.cirse.org



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INTRA-ARTERIAL DELIVERY: LATEST APPLICATIONS

Catheter-directed delivery has revolutionised modern medicine, with applications for treating cancers, infections, stenotic disorders, clots – even diabetes. This is all made possible through the breakthrough of image-guidance, and this year CIRSE, home of interventional radiology, will be examining the latest advances and research in great detail.

Image-guided catheters have many applications, but today's chief area of research is that of catheter-directed delivery, as it offers a very elegant method to deliver medicines, stem cells or nanoparticles locally. Theoretically, any part of

the body can be accessed by skilled interventionists – the real challenge is to find what particles can have maximum effect under which circumstances, and how delivery can be tailored to maximise its effectiveness.

A boon to oncology

Oncology is a particularly fruitful field of research: being an essentially cellular and usually local disorder, it is particularly suited to local, targeted therapy. Local intra-arterial deliv-

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ery of chemotherapeutic or radioactive agents offers far better outcomes for the patients – not only are the discomforts of systemic treatment largely avoided, but also more powerful doses can be administered.

The real challenge, however, is to find the perfect vehicle, and many different polymer, liposome and even viral carriers have been modified to target specific cancer cells, often requiring extra image-guided involvement to activate or track them. The following CIRSE sessions will look at some of the most promising solutions.

Synergies between loco-regional and systemic approaches in cancer management

Monday, September 17, 08:30, Room 3.A

Synergistic approaches are having tremendous impact, attacking cancer cells from multiple fronts. Renowned specialist, Prof. Riccardo Lencioni of Pisa, Italy, will discuss combining transcatheter chemoembolisation (TACE) and anti-angiogenic therapy. While TACE has been established as a safe and effective therapy for many cancer types, it does face certain limitations. In obstructing blood flow to the tumour, TACE may encourage not only the desired necrosis, but also, paradoxically, angiogenesis.

To counter this, some phase II and phase III trials have been constructed to examine the possibility of combining TACE with Sorfenib (a multi-kinase inhibitor with anti-angiogenic properties), with highly promising results. Prof. Jeff Geschwind (John Hopkins, Baltimore, USA) will discuss other novel methods of using transcatheter therapy to attack tumour metabolism.

Prof. Ronnie Poon from Hong Kong, China, will examine thermally sensitive liposome carriers in combination with ablation. These liposomes encase a cytotoxic agent, which can be released via heat application. Prof. Poon will discuss how these liposome carriers can enhance thermal ablation and prevent recurrence of HCC, as well as preliminary indications from studies in other cancers.

Many other novel carriers are under development, such as nanoparticles and nanorobots, light-activated drugs and magnetic labelling, and other sessions and exhibitions will offer updates on their development.

Innovations in oncologic IR

Tuesday, September 18, 08:30, Auditorium 2

Particularly fascinating is the research into oncolytic viral therapy, which will be discussed by Prof. Steven Rose from

San Diego, USA. Clinically innocuous virus particles can be modified to selectively infect and kill tumours. The virus then replicates within the tumour, killing the affected cells via lysis. Lysed tumour cells are then exposed for specific immune recognition and response by the body. Accurate intra-arterial or interstitial delivery is vital to the success of this treatment.

Another exciting therapy will be discussed by Dr. Bradford Wood (Bethesda, USA). Hepatic chemosaturation limits systemic toxicity through use of a special catheter system. This isolates the organ from the systemic blood circulation, and high-dose chemotherapy is directly infused via the hepatic artery to saturate the liver. The hepatic venous blood is then extracorporeally filtered.

By doing this, not only is systemic administration avoided, but both visible and invisible micrometastases are exposed to a higher dose of chemotherapy than would be possible by traditional administration. Chemosaturation by percutaneous hepatic perfusion with melphalan is now an EU-approved treatment option for unresectable metastatic melanoma in the liver.

The field of the future

Image-guided intra-arterial delivery offers huge potential for oncology, and even in its early stages, is already revolutionising treatment. The opportunities this elegant delivery system offers has implications for all areas of cancer research, as well as vascular disease and degenerative disorders. CIRSE 2012 will be examining the latest evidence, and asking where the future will take us next...

Other sessions of note:

Saturday, September 15, 11:30

HCC: The spectrum of interventions

Saturday, September 15, 11:30

Acute stroke treatment

Sunday, September 16, 10:00

Stroke prevention: where do we stand in 2012?

Sunday, September 16, 11:30

Genitourinary IR

Tuesday, September 18, 08:00

Trauma

Wednesday, September 19, 10:00

IR in the future ■

A RE(N)AL STEP FORWARD: IR IN THE KIDNEYS



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The kidneys are a work of engineering genius, regulating all manner of essential functions within the body: blood pressure, homeostasis and hormones, as well as filtering our blood. Nestled within the retroperitoneum, these small organs play a vital role.

Although well protected from external threats by our lower ribs, the muscles and fat of the abdominal wall, and the renal fascia, the kidney's complexity leaves it vulnerable to several disease entities.

However, their location within the abdominal cavity, not far from the skin's surface, mean that many conditions affecting the kidneys can be treated by a minimally invasive approach instead of open surgery, with obvious advantages in terms of reduced complications, the lack of a surgical scar and reduced time in hospital. Fortunately, interventional radiological solutions for many renal pathologies have already been developed.

Many of these innovative renal therapies will be discussed at this year's CIRSE congress, allowing attendees to keep abreast of the latest data and outcomes.

• Percutaneous nephrostomy

The most well-known job of the kidney is the filtration of the blood and production of urine, which then drains to the bladder. A blockage (whether caused by tumours, infection or kidney stones) can cause urine to build up, leading to increased pressure that may damage the kidneys. To relieve this pressure, interventional radiologists (IRs) insert a catheter through the skin and into the kidney under image-guidance, allowing the urine to be drained safely. This topic will be discussed during

Paediatric interventions, *Saturday, September 15, 10:00*

• Dialysis access

In patients suffering kidney failure, dialysis offers the vital blood filtration needed. IR plays a valuable role in placing and maintaining access shunts through which the blood can be filtered.

Dialysis access management, *Saturday, September 15, 11:30*

• Renal tumours

The kidney is no stranger to cancers, with renal cell carcinoma being the most common adult renal cancer. For small and multiple tumours, a range of IR treatments exist, notably the various forms of thermal ablation, such as radiofrequency, microwave and cryoablation. These techniques and follow-up imaging will be discussed at a wide range of sessions this year, such as

Renal and lung tumour ablation, *Sunday, September 16, 11:30*

Imaging after ablation: what you need to know,

Wednesday, September 19, 08:30

• Transplant complications

Urological complications after renal transplantation are relatively rare, but can include urinary leaks and ureteric obstruction. In such cases, IRs offer percutaneous nephrostomy, balloon dilation of ureteric strictures, and placement of stents or drainage catheters to restore patency, either alone or as a precursor to repeat surgical intervention.

How to manage renal transplant complications,

Saturday, September 15, 08:30

• Renal denervation (hypertension)

One of the highlights of this year's CIRSE congress will be a Hot Topic Symposium dedicated to catheter-driven renal denervation. This is a novel treatment for patients with resistant hypertension, one of the most prevalent cardiovascular risk factors. While the mechanisms of systemic hypertension are not yet fully understood, it has been shown that activation of the sympathetic nervous system (SNS) is an important factor. The response of the kidneys to SNS activation is to alter the levels of renin and sodium produced, and to induce vasoconstriction, which leads to increased blood pressure. By selectively targeting the renal afferent and efferent nerves, which lie within the renal artery, IRs can reduce SNS activation. The effectiveness of this therapy has been shown at Randomised Control Trial level (the Symplicity HTN-2 trial), and further trials are on-going. Interestingly, systolic decrease improves over time, with excellent results shown at 12 and 24 months, which also implies that regrowth of sympathetic nerves is unlikely. As sympathetic nerve activity also plays a role in disorders such as sleep apnea, ovarian cysts and insulin resistance, further studies are investigating the potential of renal denervation in these fields too.

Renal denervation, *Tuesday, September 18, 13:30*

• Renal artery stenosis

In a world of poor diets, sedentary lifestyles and smoking, narrowing of the blood vessels is sadly common. When stenosis occurs in the renal artery, outcomes can be extreme: despite their relatively small size, the kidneys receive almost 20% of cardiac output. As with other stenotic events, (balloon) angioplasty and stenting can be valuable in re-establishing patency.

Renal artery stenosis workshop, *September 15 & 16, 17:30*

• Trauma

Despite their protected location, severe trauma can cause bleeding within the kidney, or renal artery thrombosis. Transarterial embolisation is well established as a safe and effective method of stopping traumatic bleeding in the kidneys and retroperi-

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THE CHANGING FACE OF ULTRASOUND

Advances in Image Quality and Functionality Expand Traditional Uses

The wide extent of ultrasound adoption in many new clinical applications over the last decade was unexpected by most, considering ultrasound technology has been available for a long time. Improvements in image quality, application-specific technology and transducer design have been crucial in driving this penetration. Concerns in the medical imaging sector over radiation dose from CT and x-ray, paired with the increasing pressure on healthcare providers to cut costs, could yet drive even wider adoption of ultrasound.

With the current economic turbulence expected to further impact future healthcare spending, many might expect a grim outlook for the ultrasound market. Instead, the market is in robust health. Global ultrasound revenues are forecast to grow by 27 percent over the next five years, (source: InMedica). The highest growth over this period will be seen in the Asia Pacific region, increasing by 37 percent. In comparison, growth in the American and EMEA region is forecast at 26 percent and 16 percent, respectively.

“Interventional radiology has remained doggedly loyal to more advanced modalities, and ultrasound penetration is still in infancy. Yet, increased adoption of ultrasound could have wide-ranging benefits”

The compact ultrasound market continues to outperform the cart-based market in terms of annual global shipment growth. In mature markets, increasing demand for ultrasound in point-of-care applications, such as musculoskeletal and emergency medicine, core drivers in emerging markets, and the low cost and flexibility of compact equipment for basic healthcare provision are driving growth. Despite this, cart-based systems are industry standard and dominate, accounting for 81 percent of global revenues.

In both markets, advances in technology are essential to drive the expanding use of ultrasound. Intriguingly, it's also not brand new technology that is having the biggest impact. Optimisation of existing technology will lead to benefits for both users and suppliers of ultrasound equipment.

Fusion Imaging

Fusion imaging is used to integrate two images from different diagnostic imaging modalities. Ultrasound fusion allows physicians to

superimpose real-time ultrasound images with pre-taken MRI or CT images. Fusion imaging is not a new concept; the most well-known example is PET-CT, which has been in use for over a decade. However, the fusion of real-time ultrasound with MRI or CT is far less established.

In the last decade, the incumbent limitations of the first generation ultrasound fusion systems prevented widespread adoption. The technology was complicated and difficult to use, resulting in a less cost-effective and clinically beneficial procedure for healthcare providers, and more inconvenience for the patient. This was further hindered by limited image resolution, incomparable in quality to more advanced modalities such as CT.

More recently, there have been a number of systems with significant improvements on these issues: “Smart Fusion”, a new function in the Aplio 500 by Toshiba Medical Systems; “eSie Fusion” imaging, in the Acuson S3000 system by Siemens Healthcare; and Hitachi Real-time Virtual Sonography (HI RVS) in Hitachi’s HI VISION Ascendus. One such improvement is transducer positioning and navigation technology. The incorporation of advanced GPS positioning enables real-time feedback of needle position during interventional procedures. This allows highly accurate guidance and improves both the speed and quality of the scan.

New software and visualisation packages also allow automatic alignment between the ultrasound and CT or MRI image. This decreases the time taken to produce the fusion image, improving workflow and convenience for the user. Automation and simplification of complex ultrasound examinations, such as fusion imaging, is being facilitated by the application of both new and existing technology. This approach, combined with increased physician education, is a powerful tool crucial for widespread adoption.

Interventional Radiology

Ultrasound also has a wider future role in procedural guidance. Real-time ultrasound guidance for common clinical procedures has been rapidly increasing. The anaesthesiology sector is an example of how improved image quality, flexibility and cost reduction have driven increased ultrasound use. In contrast, interventional radiology has remained doggedly loyal to more advanced modalities, and ultrasound penetration is still in infancy. Yet, increased adoption of ultrasound could have wide-ranging benefits.

Recent technological advances in minimally invasive surgery have led to new therapies integrating interventional and surgical procedures. Hybrid operating suites are increasing-

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BREAST IMAGING IN HIGH RISK POPULATIONS

The Role of Contrast-Enhanced Breast MRI



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Recent evidence suggests that contrast-enhanced breast MRI is becoming an established technique that offers good quality in safety, performance and patient outcomes. In this article, Prof. Francesco Sardanelli, a frequently invited speaker and educator on this topic at international meetings, writes about the growing effectiveness of breast MRI, the special attention that must be paid to high-risk patient groups, and the need for radiologists to interact with other relevant medical professionals in an interdisciplinary paradigm.

Breast Cancer: The Case for High-Risk Patients

Breast cancer affects from 1:7 up to 1:11 women in western countries. Although this disease is mainly a sporadic one, about 15 percent of cases are clustered in families with highly or moderately elevated incidence. Pathogenic mutations in high-risk genes at autosomic dominant inheritance are held responsible for about 5 percent of cases, in which the disease may have early onset, with an estimated cumu-

“The general result of these studies is that MRI largely outperforms mammography and/or ultrasound in detecting breast cancers in asymptomatic high-risk women, as confirmed by reviews and meta-analyses”

lative lifetime risk as high as 50–85 percent. About 50 percent of hereditary breast cancers can be explained by mutations in BRCA1 and BRCA2 genes.

In women at high risk of developing breast cancer, screening mammography has shown a lower sensitivity (29–50 percent) compared with that of screening of the general female population (70–80 percent), with higher percentages of interval cancers (35–50 percent versus 20–25 percent) and a higher rate of nodal involvement (20–56 percent versus 22 percent). In the last decade, a number of prospec-

tive, non-randomised studies have been conducted in Europe and North America to assess the value of dynamic contrast-enhanced MRI as a screening tool to be used as an adjunct to mammography, or to mammography plus ultrasonography, for the surveillance of women at high genetic-familial risk of breast cancer. The general result of these studies is that MRI largely outperforms mammography and/or ultrasound in detecting breast cancers in asymptomatic high-risk women, as confirmed by reviews and meta-analyses.

Evidence Points to MRI as a Screening Tool in High-Risk Women

In 2007, on the basis of the early evidence available in the literature, the American Cancer Society issued a recommendation in favour of screening with MRI as an adjunct to mammography for high-risk women, a group defined as follows: women with an approximately 20–25 percent or greater lifetime breast cancer risk, including women with a strong family history of breast or ovarian cancer and women who were treated for Hodgkin’s disease between eight and 30 years of age with mantle radiation therapy.

Despite the general agreement on the use of MRI as a screening tool in high-risk women, breast cancer specialists face three problems:

1. **How to model the risk of breast cancer for an individual woman?** Software is freely available, also from certain websites, such as that derived from the Tyrer-Cuzick model (<http://www.ems-trials.org/riskevaluator>). However, all the models show relevant limitations. Better performance is expected with the inclusion of breast density (from mammography, or better, from MRI) as a parameter in risk modeling.
2. **Which level of risk justifies an annual MRI?** A cost-effectiveness analysis agrees on MRI screening for high-risk women, but further research is needed to clarify what to do for lower risk levels.
3. **Do we still need mammography and ultrasound if screening MRI is negative?** Evidence in favour of screening high-risk women with MRI alone comes from two recent studies from Germany and Italy, which demonstrate no significant added value from mammography and/or ultrasound when MRI is used as a screening tool.

The choice to reduce the use of mammography in BRCA mutation carriers is corroborated by the higher risk of breast cancer induction from x-ray radiation. Moreover, a word of caution is needed for triple negative cancers, defined by lack of oestrogen and progesterone receptor expression and absence of HER2 amplification, as there is a potential for false negatives also in MRI screening, especially in BRCA1 mutation carriers.

Development of Contrast-Enhanced Breast MRI

Contrast enhancement on breast MRI offers another avenue of diagnosis in the case of breast cancer imaging. The first analysis of breast tissues was closely connected to the origins of medical use of nuclear magnetic resonance (NMR), since Damadian's experiments during the 1970's. However, the first clinical studies using standard T1-, proton density-, and T2- weighted sequences were disappointing. A dramatic change came about in 1986, when S.H. Heywang firstly obtained contrast-enhanced (CE) MR images after intravenous administration of gadopentetate dimeglumine (Gd-DTPA). The availability of faster T1-weighted gradient-echo sequences allowed for dynamic imaging, permitting the combination of morphologic and dynamic parameters, the latter studied by W.A. Kaiser and finally classified by C.K. Kuhl in 1999.

Two methods for breast MRI followed, on either side of the Atlantic Ocean: dynamic CE imaging with temporal resolution in Europe and fat-saturated high-resolution CE imaging in the US, now partially unified by protocols which permit high spatial resolution and sufficient temporal resolution with or without fat-saturation. On the other hand, clinical research studies on 1-H (proton) MR spectroscopy using single-voxel technique were performed looking for the choline peak as a marker of malignancy, while during the nineties, MR-guided breast needle biopsy became available, finally filling a fundamental gap in clinical practice. Afterwards, especially in the last decade, technical developments such as strong and rapid field gradients, multi-channel dedicated coils and parallel imaging, high-field magnets (3T), new dedicated sequences, including those for diffusion-weighted imaging or 2D/3D multi-voxel proton MRS, made breast MRI technology more and more robust and attractive in terms of multiple options offered to clinicians and researchers.

Diagnostic Performance of Breast MRI

Notwithstanding the growing evidence for the increasing diagnostic performance of breast MRI, including high sen-

sitivity not only for invasive but also in situ cancers, there propounds a long-standing false idea, frequently repeated also by breast radiologists, that has unfortunately acted against its clinical adoption: that breast MRI as a diagnostic tool has high sensitivity but low specificity, a "mantra" to be abandoned, as recently remarked by W. A Kaiser.

In 2008, the large meta-analysis by Peters et al. finally offered a reference point for this discussion, demonstrating 90 percent sensitivity and 72 percent specificity, even though the diagnostic performance of each test depends on many factors, including the clinical setting and patient selection. Last but not least, new contrast materials with a higher di-

Q&A

How does digital mammography compare to contrast-enhanced breast MRI and in your opinion, in which cases is breast MRI superior?

Digital technology did not significantly change the diagnostic performance of mammography. Thus, contrast-enhanced MRI remains superior for all the defined indications.

Which contrast agents are safest for avoiding nephrogenic systemic fibrosis (NSF), and why is it important for radiologists to know this?

All contrast agents are very low risk if patients are screened for renal function and the standard single dose (0.1 mmol/kg) is administered. Notwithstanding there are "safer" contrast agents, listed here in alphabetic order: gadobenate dimeglumine; gadobutrol; gadoterate meglumine; gadoteridol. The most important recommendation that I can share is that practitioners should report precisely the type and dose of contrast agent.

What does the latest information on the risk of radiation-induced cancer in high-risk populations tell us about why breast MRI might be superior in terms of patient safety?

Mammography should be avoided in high-risk women at least up to the age of 36 years old. Two recent studies (Kuhl et al. 2010; Sardanelli et al. 2011) showed that mammography could be avoided completely without risking losing sensitivity.

Is there a prognostic role for breast MRI?

Yes, there are several studies on this but it is mainly a perspective for the future.

agnostic performance are now entering breast MRI with promising results in terms of higher diagnostic performance.

A large debate among breast cancer specialists is open on the indications for breast MRI. Some indications are largely accepted: high-risk screening, carcinoma unknown primary, breast implant integrity evaluation, and evaluation of the effect of neoadjuvant chemotherapy. Other indications, especially preoperative MRI, are under discussion.

As radiologists, we should be more and more able to interact for clinical use of breast MRI with surgeons, oncologists, radiation therapy specialists, and other colleagues, in the European perspective of the breast unit. While future directions are already proposed in terms of technical developments, such as diffusion tensor imaging or MRI-PET fusion, a new change of paradigm is around the corner: breast MRI, from diagnosis to prognosis. ■

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AN UPDATE FROM THE CONTRAST MEDIA SAFETY COMMITTEE OF THE EUROPEAN SOCIETY OF UROGENITAL RADIOLOGY

Revised Guidelines for Patients Receiving Contrast Media

The Contrast Media Safety Committee (CMSC) of the European Society of Urogenital Radiology (ESUR) first produced guidelines on contrast medium-induced nephropathy (CIN) and on the use of metformin in patients receiving contrast medium in 1999. The committee decided to critically review the new literature and update its guidelines for reducing the risk of CIN and for the management of diabetic patients on metformin who receive contrast agents.

Definition of CIN

In 1999, the CMSC gave the following definition of CIN: "Contrast-medium nephrotoxicity is a condition in which an impairment in renal function (an increase in serum creatinine by more than 25 percent or 44 $\mu\text{mol/l}$) occurs within three days following the intravascular administration of a contrast medium in the absence of an alternative etiology". This definition is still widely used but the subject of extensive debate: Is it still appropriate to consider absolute and relative increases in serum creatinine (SCr) together? Can the same thresholds still be used? Should the same time interval be considered? Can alternative explanations for the serum creatinine changes be confidently excluded? The topic is complex and our understanding of it continues to evolve. Following its review, the CMSC considers it still appropriate to maintain the definition agreed in 1999.

Risk Factors for CIN

In the previous guidelines, a number of risk factors were listed, for example:

- Raised S-creatinine levels, particularly secondary to diabetic nephropathy;
- Dehydration;
- Congestive heart failure;
- Age over 70 years; and
- Concurrent administration of nephrotoxic drugs, e.g. non-steroid anti-inflammatory drugs.

The significance of these risk factors has been confirmed. Recent data on other risk factors indicate the significance of:

- Haemodynamic instability (for example when an intra-aortic balloon pump is used);
- Reduction of the renal blood supply during vascular procedures (hypotension); or
- Reduction of the renal oxygen supply (anaemia).

These factors have been added to the list of risk factors in the guidelines.

Other Recent Data

Recent data support a higher risk of CIN after intra-arterial contrast administration above the level of the renal arteries than after intravenous administration. Intravenous contrast medium for enhanced CT is usually given in lower doses than for arteriography and lower concentrations of contrast medium reach the kidneys. Also, with enhanced CT, there are usually fewer haemodynamically unstable patients and dislodged atheroemboli, which may occur during intra-arterial procedures resulting in cholesterol embolisation that can mimic CIN, and are not a risk.

The CMSC agreed that the risk of CIN is significantly lower following intravenous contrast medium administration and concluded that patients referred for enhanced CT are genuinely at risk of CIN if they have an eGFR $< 45 \text{ ml/min/1.73m}^2$. Patients referred for arteriography are considered at risk if they have an eGFR $< 60 \text{ ml/min/1.73m}^2$.

The previous CMSC guideline suggested the use of contrast media (CM) with low or iso-osmolarity in patients with risk factors for CIN. Having considered the many studies published in recent years, the Committee considers that this previous guideline should not be changed.

The CMSC agrees that the incidence of CIN is related to the dose of CM and therefore only the minimum amount necessary to answer the clinical diagnostic question should be used.

Multiple studies applying CM within a short period of time in at-risk patients should be avoided and the interval between procedures should be 2 weeks, if acceptable clinically.

Prophylactic Strategies

The literature published since the original CMSC guidelines has favoured volume expansion with intravenous fluid over oral hydration. However, there has not been adequate research on this topic. Preventive strategies for CIN include hydration (volume expansion), pharmacological support, extracorporeal therapy (haemodialysis and haemofiltration) and withdrawal of nephrotoxic drugs.

It appears that volume expansion with sodium bicarbonate provides equal or superior protection to isotonic saline. Therefore, the CMSC considers that there is enough evidence to recommend that either volume expansion regimen may be used. When normal saline is used, the CMSC recommends an intravenous regime of 1.0-1.5 ml/kg/h for at least six hours before and after contrast medium administration. For sodium bicarbonate, the most widely used regimen



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INNOVATION WITH IMAGING BIOMARKERS

From the Proof of Concept to the Structured Report



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Imaging modalities nowadays produce a wide range of information contained in high-quality digital medical images. This massive amount of data and technical developments in informatics have facilitated the use of computational image processing methods with the aim to aid in diagnosis and therapeutic decision-making. The combination of high-quality images with such computing techniques allow for the in vivo extraction of different parameters that are sensitised to different biological, physiological, chemical or physical conditions. These parameters may become innovative imaging biomarkers if their variations under healthy conditions are properly analysed and controlled, and if their values are proven to be sensitive and accurate to evaluate the pathologic process, assessing the main clinical endpoints in a surrogate way.

Which Biomarkers are Clinically Useful?

Although many research groups worldwide obtain several different indexes and parameters resulting from newly developed image processing algorithms, only a certain number of them will become clinically useful imaging biomarkers. Valid imaging biomarkers must give the answer to real biological and clinical problems; thus, they must be justified by clear proofs of concept and mechanism. The integration of new imaging biomarkers in clinical trials and patient evaluation is not straightforward and must meet strict conditions in terms of consistency, technical reproducibility, sensitivity and specificity. It is important to have a precise definition of the clinical problem to assess:

- Image acquisition procedures;
- Methods used in the analysis;
- Election of the proper computational models for biomarker extraction; and
- How the derived data is structured, reported and provided to the clinician.

Definition, development, expansion and implementation parts are the main segments of the innovation roadmap with imaging biomarkers.

Image Acquisition

With regards to acquisition, the gradual emergence of new generations of CT, MRI and also hybrid systems (i.e. PET-CT, PET-MR), have supposed a change of paradigm in medical imaging, since high amounts of new data are generated for each patient. For the success of imaging biomarkers' innovation, optimised image acquisition pro-

cedures providing excellent image characteristics must be developed, accepted and standardised by the radiological community. The way images are acquired has a crucial impact in the quality of the data that will be evaluated. This is a highly relevant step to guarantee that the signal changes of the object of interest are related to the underlying biological alterations produced by the disease and not produced by the acquisition technique itself.

As in any other analytical procedure, it is also mandatory to perform periodic quality assurance and calibration evaluations in order to follow up on the stability and proper performance of the image acquisition equipments. Phantoms with different modules must be used to check that the variations in frequencies, signal-to-noise ratios (SNR), uniformity and spatial distortion are stable and within given confidence ranges.

After image acquisition, several items for a proper data preparation and handling must be followed. Filters are one of the most used tools to minimise image noise. Also, interpolation algorithms can be applied for the maximisation of the spatial resolution and enhancing the detail of the images. An accurate spatial coherence between all the points of a tissue or organ during the entire study should be guaranteed by specific co-registration algorithms, which would help to ensure that a given area of an organ is represented by the same points in all the image series. Segmentation algorithms are also crucial since they allow tissue and organ isolation and classification, therefore limiting the image processing time to the tissue of interest. The most user-independent segmentation algorithms are preferred to minimise inter-subject variability of the methodology for the extraction of the imaging biomarker.

Data Analysis Methods

The methods for data analysis cannot be easily stratified due to the many procedures and characteristics that can be quantified. However, the most common are related to the assessment of volume and morphometry properties of structures, mechanical properties of tissues, metabolite concentrations, evaluation of new vessel formation (neovascularisation) and cell density (proliferation) quantification.

Imaging biomarkers can be measured and expressed in many different ways, from simple averages in a given region, parametric maps showing the regional distribution of a given indicator, and even multivariate parametric images for a more efficient assessment of the relevant clinical questions.

Implementation of Biomarkers in the Imaging Department

New imaging biomarkers will only have an impact in clinical practice if the information they provide answers the clinical/biological problem and the derived data is organised and exposed in a simple and intuitive way. Post-processing platforms with generation of integrated structured imaging biomarkers reports should be implemented and their communication skills tested. This would be the best way for a paradigm change in the radiological workflow in the radiology departments.

Some discrepancies may arise regarding the practical implementation of imaging biomarkers in most radiology departments. Generally speaking, there is a gap between the radiologist's daily heavy workload and certain time pressured technical issues as the control of image acquisition technology and its physical basis, the adequate interpretation of the information contained in images from different modalities, and the reproducibility and accuracy of imaging biomarker measurements. These reasons have motivated the progressive integration of biomedical engineers in the radiological scenario.

The adequate development, implementation and clinical incorporation of new imaging biomarkers would be the main role of bio-

medical engineers in the radiology department. Working together, radiologists and engineers may lead this personalised and precision-based revolution in healthcare. If needed, it should be noted that for image processing and quantification, the physical presence of engineers in the radiology department is not mandatory. In fact, imaging biomarker analysis, once they are defined and the image acquisition is structured, can be outsourced to specialised image processing companies or groups. ■



Figure 1

Main Steps for the Development and Clinical Implementation of an Imaging Biomarker. Adapted from Marti Bonmati L et al. 2011.

BOOKS IN REVIEW

Mammography Screening: Truth, Lies and Controversy

Peter C. Gøtzsche, Professor of Clinical Research Design and Analysis, Director, The Nordic Cochrane Centre and Chief Physician, Rigshospitalet and the University of Copenhagen, Denmark

Peter Gøtzsche, Director of the independent Nordic Cochrane Collaboration in Copenhagen, Denmark, has spent more than a decade analysing trials of breast screening. In his book, he explodes some of the assumptions made about breast screening and presents his own opinions about its effectiveness and its risks for patients. Written in a way that will appeal to the lay person as well as to scientific minds, in it he states that "... regular checks saved one life for every 2,000 women but harmed 10 others, including women who were diagnosed with cancerous cells that would have disappeared naturally or remained benign".

Mammography screening is one of the most hotly debated topics in healthcare today, and the book claims to examine the extent to which "some scientists have sacrificed sound scientific principles in order to arrive at politically acceptable results in their research". It also explains that "... neu-

tral observers increasingly find that the benefit has been much oversold and that the harms are much greater than previously believed".

This groundbreaking book takes an evidence-based, critical look at the scientific disputes and the information provided to women by governments and cancer charities. It also explains why mammography screening is unlikely to be effective today. All health professionals and members of the public will find these revelations disturbingly illuminating.

"If Peter Gøtzsche did not exist, there would be a need to invent him ... It may still take time for the limitations and harms of screening to be properly acknowledged and for women to be enabled to make adequately informed decisions. When this happens, it will be almost entirely due to the intellectual rigour and determination of Peter Gøtzsche."

From the Foreword by Iona Heath, President, RCGP



MULTIDISCIPLINARY CANCER CARE

The Growing Role of Interventional Oncology



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Interventional radiology (IR) is already well established within the field of oncology and the contribution it makes to cancer care continues to grow. Minimally invasive image-guided interventions started out having an ancillary role in oncology: treating the complications of cancer (e.g. clearing occluded ducts and vessels) or managing the side-effects of disease and of treatment (e.g. haemorrhage). However, over the past decade modalities to treat the tumours themselves have been developed and made available.

Interventional oncology, increasingly recognised as the fourth arm of cancer treatment, describes the range of procedures offered by IR in the field of oncology. This range includes many palliative and adjunctive therapies such as ablation, embolisation, chemoembolisation and radioembolisation. Innovation and development are characteristic of IR in general and this is no less true for interventional oncology, a specialty which is expanding, not only thanks to advances in imaging and interventional techniques, but also due to keen efforts supporting multidisciplinary collaboration.

Quality Imaging Vital

One of the defining features of IR is good quality and detailed imaging, which is absolutely crucial at every stage of image-guided interventions. Initially in each case, the most appropriate imaging modality for the particular patient must be selected; the lesion is then located and evaluated with high precision. This in turn allows an informed choice of the most suitable therapeutic procedure and a thorough planning of the treatment strategy, including selection of the most suitable devices and calculating the optimal trajectory to reach the lesion. Pre-procedural imaging is nowadays assisted by a range of technologies, not least 3D reconstruction.

During the procedure itself, imaging confers the ability to visualise the lesion, guide the instruments and devices, and assess the progress of the intervention.

Finally, post-procedural follow-up is of the utmost importance to accurately evaluate the success of a treatment, assess complications, and to detect any recurrence of the disease as early as possible. A general shift away from isolated technical service provision towards comprehensive clinical care has meant that IR is increasingly involved at each stage of therapy, including follow-up. The importance of imaging to the work of IR makes a close working partnership with diagnostic radiology a prerequisite.

Multidisciplinary Synergy

Cancer is a huge area of medicine and radiologists are necessarily involved, at the very least having contact with oncological patients many times each day. They are therefore part of the multidisciplinary team.

Modern medicine is not a one-man show and no single speciality can be the sole provider of care or the only driving force of innovation. It is especially true of oncology that all the new ideas and treatment modalities are coming about at the crossroads of many specialities. It is through biochemists, geneticists, oncologists, radiologists and many others working together that development and improvement is assured.

The increasing importance of synergy between the various medical specialities has already begun to influence and will continue to influence the way in which radiologists are trained. Modern imaging techniques now allow us to see more than just morphology; for example, the metabolism of tissues can be seen. Radiology residents and students must therefore be taught not only the relevant anatomy to read images but also much more clinical knowledge and the relevant basic sciences that underpin understanding and competence with the new technologies.

IR Conference Supports Teamwork

At the European Conference on Interventional Oncology (ECIO), one clearly sees that the scope of IR is widening at all clinical stages of cancer care. The conference acknowledges and fosters multidisciplinary collaboration through the recurring incentive programme whereby referring physician colleagues of IRs receive support to attend.

In this way, oncologists, surgeons, and physicians of other specialties can experience and contribute to the meeting. The mutual understanding and co-operation that arise out of such opportunities are crucial and ultimately lead to a better service provision for patients. IR can be present in a hospital and be ready to offer effective oncological interventions, but unless patients are referred nobody will benefit. All the specialities involved in oncology need to be familiar with what the others offer if they are to pool their expertise and achieve superior outcomes.

Co-operation at the Medical University in Lublin

The awareness of other specialities does not stop when the conference ends, but rather the spirit of teamwork and drive for multidisciplinary co-operation continues back at the hospital.

At the Medical University in Lublin, Poland, interventional radiologists have successfully established close co-operation with many other groups. This began with neurologists, as well as with endocrinologists and diabetologists, due to IR having the facilities and expertise to provide carotid stenting and below-the-knee angioplasty respectively.

Likewise, there is close co-operation between the various hospital departments involved in cancer care, including IR. This is not a new phenomenon; even before the new minimally invasive treatment options became available - now collectively termed interventional oncology - IR had been providing palliative tumour embolisation and catheter drainage for many years. Many patients with advanced malignant tumours were frequently referred to IR from the oncology department. This has meant that the oncologists at the hospital have long had an awareness of the skill base of IR and how this can translate into services for cancer patients.

For historical reasons there is a Department of Diagnostic Radiology and a separate Department of Interventional Radiology at Lublin, which is not the typical situation in Poland. The two separate units co-operate very closely, understanding each other's roles and sharing resources. The Department of Interventional Radiology has two MRI machines and two ultrasound machines and has free access to CT machines within the Department of Diagnostic Radiology, allowing diagnosis and the necessary pre-procedural investigations.

For interventions, the IR Department has three operating theatres equipped with up-to-date angiography equipment and a room for ultrasound procedures. There is also a bi-plain angi suite which is dedicated completely to neurointerventions. This capacity allows the treatment of many patients from Lublin and beyond and due to having the necessary equipment and trained staff, the department has been the site of introduction for many of the newest procedures.

Interdepartmental Cancer Care

Every day, interdepartmental meetings are held to discuss clinical cases, so the most suitable therapeutic procedure can be chosen for each cancer patient, whether it is provided by IR, surgery, or another oncology department. The oncologist remains in charge of the patient clinically, and is still very much involved even when the patient is referred to IR, being alongside the patient in the Interventional Radiology Department when the procedure is carried out. This makes the situation

much more comfortable for the patient, keeps two-way communication open between the oncologist and radiologist, and helps to streamline patient care.

There are no dedicated beds in the IR Department, but IR does have use of beds within the Vascular Surgery Department. The close co-operation with the various other departments enables patients undergoing IR neurointerventions, for example, to stay in the neurosurgery department, where there are beds reserved for neurointervention patients. This arrangement is duplicated in the various departments, including vascular surgery, gynaecology, and oncology.

The best clinical care is guaranteed as the patient is based in the relevant department with the required specialist support staff and equipment on hand. The interventional radiologists, however, do still attend to post-procedural monitoring and are integral to the ongoing team effort.

Developments in Interventional Oncology

IR as a speciality has been a major contributor to the recent revolution in the treatment of cancer. Its main advantage is the elegant and precise way in which lesions are targeted, thus minimising harm to surrounding areas.

This particular strength of interventional oncology is continually being refined, the next step being automated guidance, a technology already present in some kinds of surgery. At the moment, device trajectory during a procedure is corrected manually by the radiologist, but soon the navigation will be automatic, with the highest possible accuracy and precision assured by robotisation. One of the main technical challenges to overcome is that the organs IR often treats are not stationary, but continuous imaging with ultrasound or x-ray can be used to constantly adjust pre-procedural MR and CT images, thus making automated navigation possible.

Another area of development in terms of procedure guidance is virtual CT sonography and virtual MRI sonography. This fusion of two imaging modalities is very advantageous: if part of a lesion is not seen with one modality, but is seen with another, the images can be synchronised. Furthermore, being able to perform CT much earlier on, rather than during the procedure, reduces burden of radiation to the patient.

Similar to the growing tendency to merge imaging techniques, there is also a tendency to combine interventional procedures. When performing radiofrequency ablation of tumours, for example, systemic chemotherapy can be administered simultaneously. Particular cytostatic drugs are more effective at higher temperatures, so the heat generated by the ablation can boost the action of the chemotherapy.

Increasing sophistication in imaging allows us to not only localise the tumour, but also to see the structure in more de-

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MEDICAL IMAGING IN IRAN

Challenges for Public Radiology



Interviewee
Prof. Abdolrasoul Sedaghat

President
Iranian Society of Radiology



Interviewee
Dr. Mansoor Fatehi

General Secretary
Iranian Society of Radiology

Please tell us about your career in medical imaging.

Prof. A. Sedaghat: I originally graduated in general radiology from Tehran University of Medical Sciences (TUMS) and then passed a postgraduate course on MRI at the University of Miami, Florida. My professional areas of special interest are diagnostic neuroradiology and musculoskeletal radiology. Over the past 25 years of my career, I've held several positions in management, for example:

- General Director of Health Organisation in and General Director of Red Crescent in Bushehr Province;
- Chairman, Medical Imaging Centre in Imam Khomeini Hospital;
- Deputy of Education in Gorgan University of Medical Sciences;
- Founder of the first Medical Imaging Centre in Karaj, Alborz Province, since 1999;
- Member of Board of Directors and President of Iranian Society of Radiology since 2003; and
- Member of Board of Directors and Head of Medical Council Organisation (IRMC) in Karaj since 2004.

Dr. M. Fatehi: I studied medicine in TUMS (1986–1992), and later passed a radiology course at the same university (1994–1998). I began my practice in a community hospital, where I later established my imaging center. After achieving a fellowship on the subject of imaging informatics and musculoskeletal imaging from the University of Maryland in Baltimore (2009–2010), I was certified by the American Board of Imaging Informatics. Although radiology practice is not yet subspecialised in Iran, I am currently trying to focus my practice on musculoskeletal imaging. I spend part of my time attending activities organised by the Iranian Society of Radiology, of which I am a board member and Vice-President for Education and Research, while I also give lectures in universities in Tehran from time to time.

Please give us an overview of the department of radiology where you work.

Prof. A. Sedaghat : At present, I'm working in the private sector, in the Medical Imaging Centre (MIC) in Karaj. The MIC was founded in 1999, and is spread across five floors, each 450 m² and including all digital and advanced imaging instruments, including MRI, CT, radiology/fluoroscopy, DDR, mammography, BMD, ultrasonography, echocardiography, gamma camera and cardiac rehabilitation systems. At present, this centre employs

eight radiologists, eight cardiologists, two nuclear medicine physicians and two GPs working alongside 16 radiologic technologists and more than 55 employees in different services who make up the remainder of the workforce. The number of patients admitted to the centre is more than 400 per day and a total of over 120,000 per annum. The institute is equipped with PACS. Our next plan for development is founding a large, modern radiotherapy centre in Karaj.

Dr. M. Fatehi: Like most Iranian radiologists who prefer to work in more than one single institution, I am practicing privately, working in groups. Our groups cover a wide range of clinical services, both in hospitals and in out-patient radiology centres. We provide diagnostic and interventional radiology services, using rather high-end equipment, to more than 100,000 patients per year. One of the main institutions I work in is Pardis Noor Imaging Center of Tehran, where I am a shareholder. This centre has six floors, covering 1000 m² space, and employs 45 staff members, including 10 radiologists. Like most Iranian radiologists who prefer to work in more than one single institution, I am practicing privately, working in groups. Our groups cover a wide range of clinical services, both in hospitals and in out-patient radiology centres. We provide diagnostic and interventional radiology services, using rather high-end equipment, to more than 100,000 patients per year. One of the main institutions I work in is Pardis Noor Imaging Center of Tehran, where I am a shareholder. This centre has six floors, covering 1000 m² space, and employs 45 staff members, including 10 radiologists.

How are imaging centres spread around the country and are there areas that are underserved?

Prof. A. Sedaghat : Now, most of the large cities in Iran are equipped with advanced and new technology; however, Tehran is more equipped than others. None of the Iranian cities suffer greatly from a particular lack of imaging services. Naturally, small cities in remote places in our country do not have specialised services, for example MRI, CT or digital radiology.

Are teleradiology and remote imaging in use in Iran today?

Prof. A. Sedaghat : At this moment, teleradiology and web-based PACS are used in several imaging centres in Iran, but they are in the early stages and need further time for development and deployment. Both the Karaj and the Noor Medical Imaging Centres are involved in such projects at the moment.

How is the education of radiologists structured in Iran?

Prof. A. Sedaghat : More than 14 medical universities provide radiology residency training in a four-year training course in general radiology. The number of radiology residents is more than 100 at this moment. Some physicians who are interested in radiology and cannot find a position in Iranian universities are obliged to travel to other countries in order to get their career started, while other residents travel to the domestic cities to learn more and gain more professional experience.

Dr. M. Fatehi: The curriculum of radiology residency programmes is set by the Iranian National Board of Radiology. There are about 15 residency programmes in the whole country, run by medical universities that all act as governmental institutions. The duration of the course is four years, and acceptance onto the programme is very competitive. There is no private centre for radiology training in Iran.

For post-graduate training, all these radiology departments provide some yearly refresher courses; however, the role of the Iranian Society of Radiology is dominant in organising dedicated training courses and holding annual meetings, which cover diverse content and subject matter. Currently, there are no official fellowship training programmes in subspecialty areas and everyone who wants to get trained in one of these must apply for an international training course. The Iranian Society of Radiology has recently decided to establish an Imaging Informatics Training and Research Centre, with the aim of disseminating the knowledge and skills of informatics required in the radiology department. I am the Director of this center.

In my opinion, the major challenge in radiology education inside Iran is the suboptimal payment to academic radiologists leading to rather part-time positions. Another challenge comes from the lacking presence of high-tech modalities in academic institutions compared to private ones due to higher investment in new technology in the private sector. Residents, therefore, are not very exposed to the modern medical imaging world, and many seek training in this area after graduation, by working in private centres. Unlike governmental institutions, private sector radiology centres in Iran is rather up to date in terms of equipment.

How does involvement and interaction with an international community help to strengthen the development of both education and research in medical imaging in Iran?

Dr. M. Fatehi: Being in touch with the international radiological community has brought many new openings to Iranian radiology. Gaining international level refresher training, having the ability to share local experience (which is not always exactly the same as other countries), and networking with special interest groups through attending international meetings are some of the

things that can be achieved. Interactions have raised our profile in the international radiological community and this has led to international experts collaborating with our activities.

In what way are you involved in the professional development of research activities in Iran?

Dr. M. Fatehi: Our role in the Department of Research and Education of the Iranian Society of Radiology is to boost research activities in academic institutions as well as support researchers who are not necessarily involved in academic radiology. The basic requirements of this role have been accomplished through a variety of means, including: defining a national radiology research roadmap; collecting grants from national institutions; providing financial support to researchers, particularly young ones; running training courses on research methodology; and providing travel costs to those members who present their work in prestigious international meetings. One of our society's major activities has been to publish an English-language journal in joint collaboration with TUMS – The Iranian Journal of Radiology (<http://Iran-jradiol.com>).

What is the balance of private to public medical imaging providers in your country?

Prof. A. Sedaghat : The private medical imaging providers are more advanced in quality and quantity than the public sector. It means that the public and governmental hospitals and centres are less equipped than private facilities which have newer and more advanced medical imaging technology at their disposal, though the government has recently invested in this sector.

Please tell us about the Iranian Society of Radiology: What achievements in your role as President of the society are you most proud of, and why?

Prof. A. Sedaghat : The Iranian Society of Radiology was founded in 1965. This society has more than 1,500 individual (radiologist) members at this moment and has some provincial branches inside the country. We have an annual congress of radiology which more than 2,400 participants and more than 30 - 40 guest speakers from around the world attend. Participants from the US, Europe, Asia and the Middle East, are present. Many workshops are held in addition, plus a select number of two to three day national conferences, symposiums and joint sessions with other radiology congresses such as the European Congress of Radiology (ECR) and the Turkish Congress of Radiology (TCR).

I believe that one of the most important contributions I have made to the Iranian Society of Radiology is in fostering a sense of unity in the face of a potential risk for division of regional so-

cities and smaller divisions. To tackle this possibility, we decided to organise different committees for subspecialties such as: informatics in radiology, women's imaging, cardiovascular imaging, interventional imaging, etc. My other important role has been the provision of unity between the radiology society and companies who import or produce medical and radiological instruments in two important ways: economic and scientific. Another important role is our membership in the ESR and establishing a joint committee with the Turkish Society of Radiology.

What are the main professional challenges for a radiologist working in Iran today?

Prof. A. Sedaghat :

1. Interference of other non-radiologist physicians in radiology;
2. Low tariffs for radiology services (for example, the typical cost of some radiological services in Iran are: anatomical MRI = 90 US dollars, abdominal ultrasound = 25 US dollars, abdomino-pelvic CT scan = 100 US dollars and so on); and
3. International sanctions have resulted in several limitations

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The imaging department in the context of a public-private cooperation would be well placed to run on a much lower cost basis, as it benefits from a much better utilisation of the most expensive resources (labour, equipment, etc.).

A shareholder structure in this framework gives the hospital management the strategic power to plough entrepreneurial and medical resources into the imaging department, further strengthening it. Through this strategy, even the financing of innovations would be better placed, as young academics are receiving training in workflow management which builds their job prospects and the reputation of the medical centre. This creates a triple win-win situation, for the hospital, private practitioners and, last but not least, the patients.

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toneum, while mechanical thrombectomy devices (tiny catheter-mounted pincers or vacuums) have shown excellent results in retrieving the blood clots that can cause renal infarction.

Trauma, Tuesday, September 18, 08:30

• Renal artery aneurysms

Aneurysms can also occur in the kidneys, and interventional radiologists can place stent grafts to bypass or stabilise the aneurysm.

Visceral artery aneurysms and pseudoaneurysms,

Sunday, September 16, 10:00

for Iranian radiologists, including the purchase and import of equipment and spare parts, registration in international congresses or even the purchase of journals from them.

There are also troublesome visa procedures for visiting EU countries, the US and Canada when professionals wish to participate in congresses, courses or workshops that are so useful to our speciality.

Do you anticipate any threats to the profession in general, both inside and outside Iran?

Prof. A. Sedaghat : Radiology in all countries is in danger of collapse in the future due to the great advances in medical imaging technology, which encourage other physicians and even non-physicians to interfere in the use of medical imaging modalities and reporting and interpretation of images, respectively. So, the union of radiologists and radiologic technologists within countries and regions, and the setting of special international rules and conventions for protecting radiologists from these dangers, should be something the global medical imaging community places high on the agenda. ■

In Conclusion

Our studies, represented by the graphs provided, clearly show that clinical imaging within the MID is not always operated or managed in the best way. Without wishing to commoditise our profession, medical imaging cannot ignore modern business strategies and hope to remain competitive with private enterprises, particularly in this challenging financial climate of shrinking healthcare budgets. We must do our utmost to maximise revenue and manage our operating costs, while continuing to provide a high level of service to patients and referrers. I hope that within this paper, you have found some suggestions for new ways to manage the business of diagnosing and treating patients. ■

• Kidney stones

In the mineral-rich environment of the urinary system, small crystallised “stones” can form. These are rarely dangerous, but can cause extreme pain for the patient. The condition and its symptoms can be relieved by means of stent placement (to bypass the obstruction) or percutaneous nephrolithotomy (removing the stones through a small puncture wound).

Renal interventions workshop: stones, obstructions and leaks, Saturday, September 15, 17:30. ■

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ly used for these procedures, combining the conventions of a surgical operating room with imaging technology, such as x-ray, CT and ultrasound equipment. Increased use of hybrid interventional suites in developed and mature healthcare markets is driving initial demand of ultrasound equipment in IR, and exposing new users to the benefits of ultrasound. In the past, ultrasound was rarely used in these circumstances; yet the advancement of technology and strides in image resolution, workflow and automation are driving penetration and adoption.

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(3 ml/kg/h for 1 h before contrast medium followed by 1 ml/kg/h for 6 h after) seems appropriate.

Additionally, the current opinion of the CMSC is that the efficacy of N-acetylcysteine (NAC) and other drugs in reducing the incidence of CIN remains unproven and their use cannot be recommended.

The CMSC does not recommend prophylactic haemodialysis and has concerns in recommending haemofiltration because it requires management in the intensive care unit (ICU), is costly and affects creatinine levels per se.

Lack of evidence makes it difficult to produce a definitive statement about nephrotoxic drugs. The CMSC therefore recommends that the possible withdrawal of nephrotoxic drugs before contrast medium in patients at risk of CIN should be discussed with the referring physician and that the judgement should balance the relative benefits and harms.

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tail than was previously possible. The use of ultrasound contrast media, for example, is already making a significant clinical impact. Contrast-enhanced ultrasound (CEUS) provides images showing intra-tumoural vascularity and blood flow, comparable to the information obtained by computer tomography and dynamic magnetic resonance imaging. An advantage of CEUS is no exposure to radiation, and the absence of nephrotoxic contrast agents.

Tumour metabolism is indeed an area upon which research is now focusing, with the therapeutic goal to inhibit angiogenesis, tumour growth and proliferation. The future promises much more specific ways to treat tumours involving the exertion of influence over cell division processes and controlled initiation of apoptosis in targeted cells. The action of some of the drugs in this area could be induced by a controlled impulse, light being just one example. IR is set to play a central role in delivering these therapies, as it will in other biotechnological approaches such as gene therapy.

In context, while the growth of ultrasound in traditional radiology is forecast to remain slow, the IR market has strong potential to experience the same success as anaesthesiology, in which global unit shipments have grown between 10-15 percent annually in the last three years. The current challenge for suppliers is convincing healthcare providers of the unique benefits of ultrasound, both in cost and quality of care, compared to the heavily entrenched CT and x-ray modalities. With this considered, In-Medica forecasts revenue growth of between 4 and 6 percent globally for the emerging interventional radiology market in 2012. ■

Guidelines for Patients on Metformin

Finally, the CMSC updated the 2009 guideline on the use of metformin in patients receiving iodinated contrast media in the light of its new CIN recommendations and of the recent NICE guidelines. The new ESUR guideline has been relaxed and states that patients with an eGFR of 45 ml/min/1.73 m² or greater can continue to take metformin normally if they receive intravenous iodinated contrast medium. Patients receiving intra-arterial iodinated contrast medium with an eGFR of 30-59 ml/min/1.73 m² and patients receiving intravenous contrast medium with an eGFR 30-44 ml/min/1.73 m² should stop taking metformin 48 hours before contrast medium administration. Renal function should be re-assessed 48 hours after contrast medium and metformin should only be restarted if it has not deteriorated further. ■

Benefits to the Hospital

The availability of interventional oncology services in a hospital represents many advantages. As many of the procedures can be performed on an outpatient basis, hospitalisation time and the associated costs can be reduced. The lower level of discomfort reported by patients, compared to other procedures, is also noteworthy. Interventional oncology procedures are often effectively employed in connection with other therapies, such as surgery, improving the success of the latter, and may also provide options in cases where other treatment modalities are not possible.

Due to the complex nature of cancer care, hospitals that attract patients with interventional oncology services will increase the caseloads of other departments generally, due to the likely necessity of a range of follow-up investigations and procedures, which will be delivered by the appropriate specialists; all members of the multidisciplinary cancer team. ■

KEY CONFERENCES & EVENTS

OCTOBER 2012

- 11 – 12 **Management in Radiology (MIR) Annual Scientific Congress & Meeting**
Milan, Italy
www.mir-online.org
- 19 – 23 **Journées Françaises de Radiologie 2012 (JFR)**
Paris, France
www.sfrnet.org
- 27 – 31 **EANM Congress**
Milan, Italy
eanm12.eanm.org

NOVEMBER 2012

- 14 – 17 **Medica 2012**
Dusseldorf, Germany
www.medica-tradefair.com
- 25 – 30 **RSNA**
Chicago, USA
www.rsna.org

FEBRUARY 2013

- 9 – 14 **SPIE Medical Imaging**
Florida, US

APRIL 2013

- 14 – 19 **113th Annual Meeting of the American Roentgen Ray Society**
Washington, US
www.arrs.org
- 15 – 19 **13th annual IHE-Europe Connectathon**
Istanbul, Turkey
www.connectathon2012.org
- 21 – 26 **Radiology in Venice**
Venice, Italy
www.radiologyintl.com

JUNE 2013

- 26 – 29 **CARS 27th International Congress and Exhibition**
Heidelberg, Germany
www.cars-int.org

SEPTEMBER 2013

- 14 – 18 **CIRSE**
Barcelona, Spain
www.cirse.org

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- The Use of a Balanced Scorecard in a Radiology Department
- New Medical Imaging Service in Moldova

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