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Hybrid imaging: PET/MR climbs the diagnostic ladder

Experts across Europe believe the combination is beginning to demonstrate its broad potential as a hybrid imaging tool

Report: Mark Nicholls

Whilst PET/CT remains the gold standard in hybrid imaging at this stage, PET/MR has shown great promise for imaging of head and neck cancers, prostate and breast imaging and, over the last two years, radiologists have recognised its value and potential as a diagnostic tool.

However, evolution has not been pain-free for those pioneering its development. During the PET/MR: *A marriage made in heaven or hell?* New Horizons session (ECR 2012, 9 March. NH8. 8-10 a.m.) when the latest position on PET/MR will be presented, it will also serve to underline only too well that the journey has not been easy.

Professor Osman Ratib, Chairman of the Department of Medical Imaging and Information Sciences and Head of the Division of Nuclear Medicine at the University Hospital of Geneva, Switzerland, is among the speakers. His department was the first in Europe (2010) to have whole body PET/MR.

With questions over whether such technology will replace, or complement, PET/CT, he said that the session would offer a clinical perspective on this new hybrid modality. 'We know there are problems; that's why we have the 'heaven and hell' scenario. It can be hell in terms of protocols and the logistics of putting two complex modalities together, but can be heaven by having all the answers in one study.

'In some areas, we have demonstrated it has really improved the quality of the diagnostic process by having those two modalities perfectly aligned and perfectly superimposable.'

Professor Ratib said one area where they were particularly challenged was how to protocol the studies with the standardisation and complexity of MR protocols in this context 'uncharted territory'.

His team had to be creative about how to protocol to obtain high quality MRI swiftly in 3-D for the whole body, select specific MRI sequences to apply and how to optimise and standardise the protocols.

However, he said, 'We are now reaching the stage of 'heaven'. After a year of struggling with protocols and with the help of radiology experts of different subspecialties of our department, we have identified and optimised most of the protocols for clinical routine – particularly in head and neck imaging, because we think that is where a PET/MR has a great impact.'

The same applies for prostate and breast imaging, though they continue to work to improve protocols for paediatric cases.

During the ECR session, Professor Ratib will speak specifically about PET/MR in oncology where he believes it has major potential. 'PET has new tracers; MRI has new protocols like diffusion-weighted imaging, which shows tissue density and has a very good correlation with tumour versus non-tumour tissue. Having both is having the best of both worlds.

'The future is in multi-parametric diagnostic criteria, which will combine things you see on PET with the different behaviour in functional MRI. Having those two together we believe brings more diagnostic accuracy and more diagnostic confidence and that is something that is very important clinically. We saw a clear improvement with PET/CT when the reports became more conclusive and we are seeing the same with PET/MR.'

Patients benefit from having one study instead of two and more conclusive diagnostic results, which will lead to better treatment as well as the reduction of radiation exposure with MRI.

The future

Professor Ratib believes this lies in the coupling of the two rapidly evolving technologies - a quantum leap in PET with fully-digital detectors compatible with the MRI magnetic field and new MRI imaging protocols and multi-transmit detection – combined with the development of new tracers.

With PET/CT and PET/MR now more widely available, the development of biomarkers and tracers that was slow because of limited access to machines, he said, has suddenly accelerated and seen the availability of specific tracers for specific cancers, and also specific biological receptors.

One final wish for Professor Ratib is that this hybrid technology will breach a gulf in radiology and instead of having a radiologist and nuclear medicine physician there will soon be training and certification of hybrid physicians who have capability in both areas.

Professor Osman Ratib is Chairman of the Department of Medical Imaging and Information Sciences and Head of the Division of Nuclear Medicine at the University Hospital of Geneva. Previously, he was Professor and Vice-Chairman of the Department of Radiology at the University of California Los Angeles (UCLA). His clinical activities and areas of expertise include cardiovascular MR, CT and PET/CT imaging. Prof. Ratib is active in medical imaging research in Europe and is a member of several societies of computed radiology and telemedicine and the former President of the EuroPACS society. He has pioneered several innovative projects including the first whole-body PET/MRI unit in Europe.

Cardiac imaging

PET/MR: The opportunities are almost unlimited

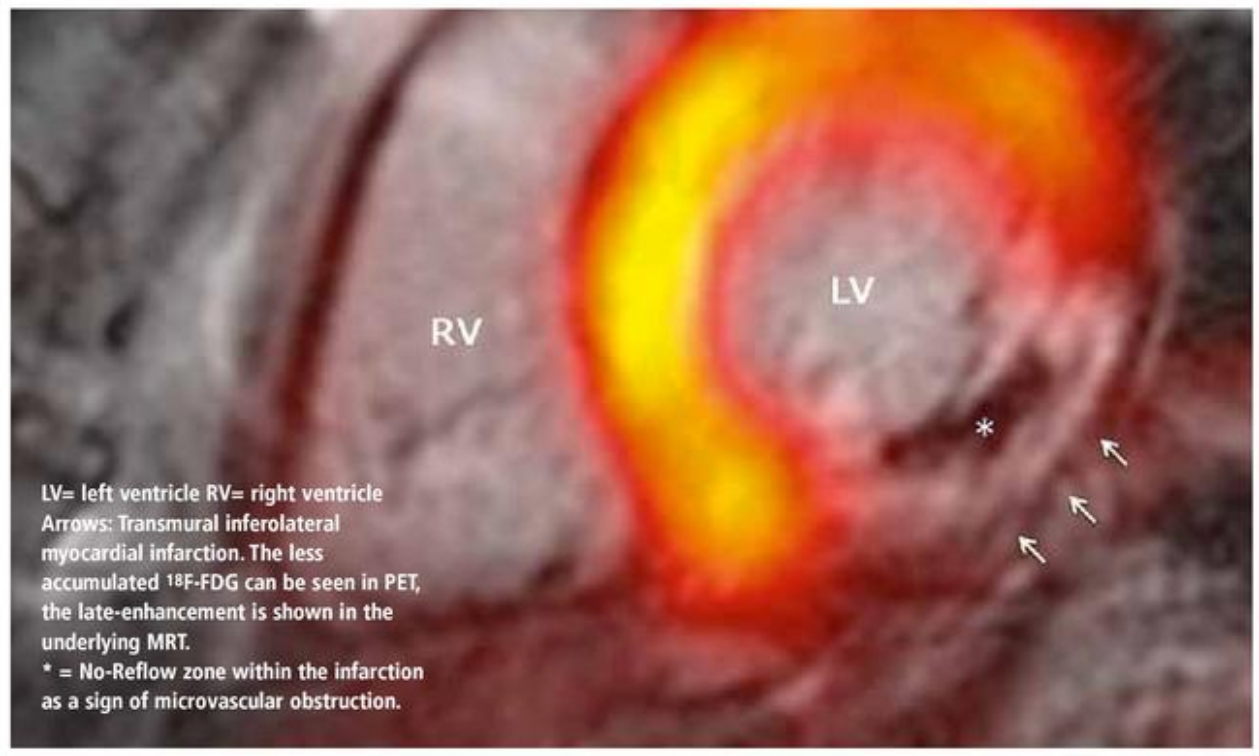
MRI has become the gold standard for many indications in cardiac imaging, apart from imaging the coronary arteries. For function and morphology assessment, MRI is the leading technology. A further advance into as yet unknown territory is myocardial imaging aided by one of the first integrated 3-Tesla PET/MR systems currently used at the Institute of Radiology, Essen University Hospital, Germany.

Last year, the Essen team published the world's first case report on PET/MR cardiac imaging in the renowned journal Heart. Opportunities for cardiovascular imaging are nowhere near being fully known and explored, enthused Felix Nensa, a member of Essen's Cardiovascular Imaging Working Group. 'MRI has the advantage that it lets us assess the individual anatomic compartments and different soft tissues much better than CT. The heart is not simply positioned in an axial transverse but in a quite complex position in the body. With the help of localisers, we position the MRI scanner along the anatomic axis, rather than the body axis, and we can also determine many different axes, planes and contrasts,' he said, explaining some MRI advantages over CT. An MRI examination initially starts with a standard protocol that provides an overview over the heart and surrounding areas. This is followed by different, specific heart protocols, and often includes an assessment of the heart function, i.e. moving heart imaging.

Myocardial Infarction: How T-2 weighted sequences and late enhancement can provide information on the point in time when an infarction occurred

'If the heart function measurements, such as 3-D volume reconstruction or four-chamber view, result in conspicuous findings we perform further diagnostic evaluations with T-2 weighted sequences. As fat is suppressed in these examinations and water becomes more visible, this is a particularly good way of visualising oedema within the myocardial wall (tissue classification). Increased build-up of water in the tissue is clear evidence of an acute infarction or inflammatory heart disease.'

Myocardial blood-flow is assessed with a dynamic contrast-enhanced perfusion examination. This is followed by one of the most important sequences of the cardiac examination: Around ten minutes after the perfusion with contrast media, it is possible to detect the so-called late enhancement – bright areas that result from the contrast media accumulating in certain parts of the myocardium. This is clear evidence of perished myocardial tissue, which could have been caused by an acute infarction or a chronic scar. 'This sequence is incredibly sensitive and anatomically of a very high resolution, therefore also making very small scars in the myocardium visible. But we can only determine how long the tissue has been dead by assessing it in combination with the T-2 sequence. Only once an oedema is also visible in late enhancement can we be sure that it is an acute infarction; however, if no oedema is visible in this location it is an older scar, Felix Nensa explained. This is important because it impacts the treatment and the chance of a cure.



LV= left ventricle RV= right ventricle
Arrows: Transmural inferolateral myocardial infarction. The less accumulated ^{18}F-FDG can be seen in PET, the late-enhancement is shown in the underlying MRT.
* = No-Reflow zone within the infarction as a sign of microvascular obstruction.

Tricking cardiac metabolism with glucose

Many of the examinations described can also be carried out with procedures used in nuclear medicine; in this context, PET images have a significantly higher resolution than, for instance, those from myocardial scintigraphy. The basis of PET scanning is the imaging of the metabolism, which is also utilised for PET/MR scanning: Under normal circumstances the heart specifically metabolises fatty acids; however, if it is exposed to a real 'glucose shock', with the patient taking 75 grams of glucose, the heart changes its metabolism to sugar. 'This is helpful to assess infarctions. In a healthy patient, the radio-labelled glucose 'glows' homogenously in the left ventricle; if it doesn't, then this indicates a type of pathology. The lack of glucose metabolism is an indication of dead tissue,' he pointed out.

However, there are other situations – for example, where the myocardial tissue is still intact, but no sugar or only a little sugar is being metabolised, as is the case with the so-called 'stunned myocardium'. If it was possible to open the coronary artery very soon after an infarction occurred the damaged tissue in this area might recover, which is why an oedema is normally visible on the MRI scan but no late enhancement, because the tissue has not died yet. In those cases the PET scan provides complementary information that might help to further assess the state of the jeopardised myocardium.

Radiographer Sebastian Blex plays an important role in the PET/MR on-going research projects carried out at Essen University Hospital

There are also cases where the left ventricle 'glows' very intensively. This can be an indication of a 'hibernating myocardium', characterised by chronic under-perfusion. The MRI scan shows that this area is less perfused, which may point towards a problem with heart wall motion. 'One assumes that the tissue acts auto-protectively and that a stimulus sends signals to the heart tissue to use as little oxygen as possible to stop it from dying. Normally one would also expect that less glucose is used in this area, but the opposite is actually the case. Unlike beta-oxidation during the fatty acid metabolism, anaerobic glycolysis requires almost no oxygen during the glucose metabolism.

Although researchers don't yet agree, one possible explanation may be that the myocardium switches to the lowest-impact metabolic procedure when there is little oxygen available. Assessment of vitality in under-perfused tissue is also particularly important for planning of further treatment because revascularisation of obstructed coronary arteries only makes sense if the tissue has not yet completely died, Dr Nensa explained.

Tracers as keys for metabolic information

With PET/MR, excellent anatomic resolution is combined with the metabolic information delivered by the PET. The most established tracer for the myocardium is ^{18}F-FDG, a radio-labelled glucose. For myocardial perfusion examinations radio-labelled ammoniac (^{13}N-NH_3) is commonly used. These two tracers are also the basis of purely nuclear medical PET examinations without MRI, as only the combination of the two tracers allows for a safe diagnosis.

In Europe, radio-labelled water and rubidium are less established tracers for perfusion. Rubidium has the advantage that it can be manufactured with a generator on site while its half-life is only 90 seconds. Perfusion assessment with classical MRI contrast agents suffer from contrast agents entering the intercellular spaces and remaining there for some time – an effect that is very welcome for late-enhancement but less so for perfusion, as it makes the conversion into absolute flow rate very difficult. 'In the case of a patient with three-vessel disease we are then missing the point of reference. Water, which can freely diffuse, is ideal for perfusion. However, not all tracers can be combined in one examination because they all emit the same radiation of 511 keV. When several tracers are to be combined, such as ^{18}F-FDG with a

Directly after completing his final school exams, **Felix Nensa** freelanced as a software developer for the Research Institute for the Diagnosis and Treatment of Early Lung Cancer at the Augusta Hospital in Bochum, where one of his projects included programming new diagnostic software for automated sputum cytometry. At that time he also took a distance learning degree course in IT (2000).
His medical studies at Ruhr University in Bochum (2001-2007) included two semesters spent at the University of Strasbourg in France. During this period he continued work at the Augusta Institute and, in 2008, began his dissertation – Comparison of spirometry and body plethysmography as detection methods for bronchial constriction in an unspecific provocation test with methacholine.
In 2011, Nensa became a registrar at the Institute for Diagnostic and Interventional Radiology and Neuroradiology at Essen University Hospital and manages research projects on PET/MR, Cardio-MRI and DCE-MRI.

perfusion tracer, the nuclear team carries out an overlay, meaning that an image with a certain tracer and a certain intensity is over-framed by a tracer with a markedly higher intensity.

On the trail of cardiac insufficiency

Further, very promising tracers are C-11-hydroxyephedrine (^{11}C-HED) and iodine-marked MIBG (^{124}I-MIBG), which act as a nor-/adrenaline analogues, taking the neurotransmitter's place, i.e. in the heart's sympathetic nervous system. With these tracers the regrowth of synaptic connections between the heart and the nervous system can be verified in patients with heart transplants.

A further important area of application for nor-/adrenaline analogues is cardiac insufficiency. As more and more people survive cardiac infarctions these days there is an increasing number of patients with heart failure because of reduced cardiac output due to areas of myocardial scarring. Left ventricular ejection fraction, which is reduced in the case of cardiac insufficiency, is an important parameter for the assessment of cardiac performance. 'The big advantage of PET/MR is the fact that it not only allows us to determine the left ventricular ejection fraction but also the sympathetic innervation, which is usually also compromised. We can now visualise this with the PET/MR,' the radiologist explained. ^{123}I-MIBG has been used for single-photon emission computed tomography (SPECT) for some time, although so far without good anatomic reference –which is now possible through PET/MR.

Inflammatory changes and tumorous diseases

In future, PET/MR scanning is also likely to play an important role in the diagnosis of cardiac inflammatory changes and tumorous diseases. Myocarditis, an inflammatory disease affecting the myocardium and most often found in young people as a result of protracted flu, is very dangerous. So far, inflammation of the myocardium has only been possible to confirm via biopsy, which, although highly specific, is not particularly sensitive, meaning that an inflammation can only be pathologically confirmed if the tissue has been sampled in exactly the right location. If the myocardium is completely switched to fatty acid metabolism, therefore becoming 'silent' for the ^{18}F-FDG tracer, it is possible to confirm that there is an inflammation in those places where glucose accumulates, as inflammatory cells are not capable of a fatty acid metabolism and only able to perform glucose metabolism.

This means that an ^{18}F-FDG scan after one day of Atkins diet makes it possible to distinguish between inflammatory cells and normal cells. The same applies to tumorous diseases of the heart. Tumour cells also metabolise sugar to a great extent. This even makes it possible to distinguish between benign and malignant tumours. It also enables detection and treatment of diseases that are hard to diagnose, such as cardiac sarcoidosis, at an early stage. 'It's specifically the combination of both procedures that is so promising and where there are almost unlimited opportunities for cardiovascular imaging,' he noted.

Essen benefits from good interdisciplinary co-operation, along with input from Siemens

Presently, the Essen team is entering considerable uncharted territory and the relevance of their results is not always obvious and clear. However, in many cases, the response to certain treatments can already be assessed with more ease.

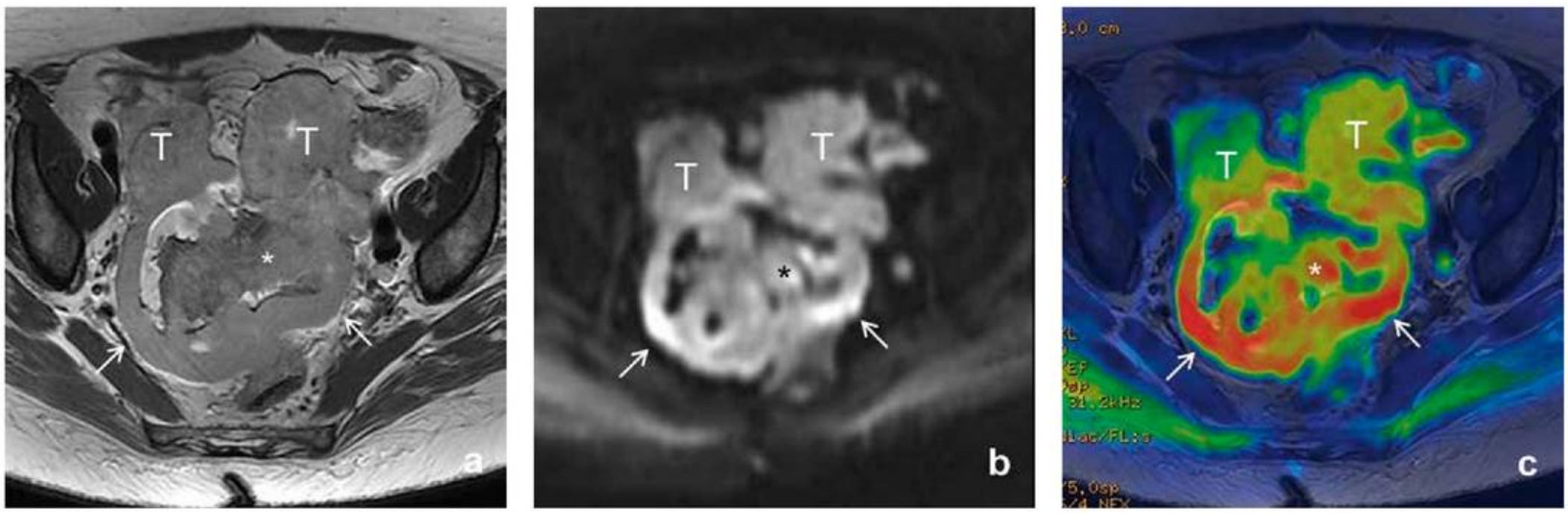
Essen's traditionally close cooperation between radiology and nuclear medicine on the one hand and device manufacturer Siemens on the other hand greatly facilitates the clinical evaluation of that complex technology. 'We've come a long way and are now in the process of implementing the first, concrete studies,' Nensa revealed.

Only with clear clinical indications the project PET/MR will become truly established and economically viable. As a reference centre for Siemens the Essen team are among the first to clinically evaluate newly developed technology. On the other hand, Siemens are also happy to listen to experiences and suggestions from Nensa and his colleagues. 'This exchange is extremely important for both sides; it's give and take – we have the very latest technology at our disposal and deliver the latest findings about it. Both sides have the same objective: to advance technology even further to ultimately improve patient care,' the radiologist is happy to report.

In the control room at the institute where all incoming information from the PET/MR equipment is supervised

The importance of MRI for gynaecological malignancies

Hedvig Hricak, Chair of the Radiology Department at the Memorial Sloan-Kettering Cancer Center, New York, USA, describes emerging applications and potential trends in gynaecological cancer treatment described at the 15th International Symposium *Crossing Barriers*



High-grade serous papillary adenocarcinoma of the ovary. Axial T2W FRFSE (a), DW (b) and fused images (T2WI +DWI) (c) at 3-Tesla demonstrate bilateral solid adnexal masses (T in a, b and c), peritoneal deposits outlining the pelvis (arrows in a, b and c) and serosal deposits along the sigmoid serosa (* in a, b and c). The latter are better appreciated on DW and fused images.

Combining technological advances, new clinical management paradigms and discoveries from epidemiology and biology has been and remains the hallmark of our specialty. The presentations at the 15th International Symposium, Crossing Barriers, are in keeping with this tradition and show how our profession continues to elevate the quality of clinical care by applying increasingly powerful imaging techniques to clinically relevant questions.

MRI has become integral to the diagnosis and management of patients with gynaecological malignancies, as it provides exquisite anatomical detail and allows quantitative, multiparametric functional assessment of tumours. Adding functional sequences – such as dynamic contrast-enhanced MRI (DCE-MRI), diffusion-weighted MRI (DW-MRI) and most recently Intravoxel incoherent motion (IVIM) MR imaging – to conventional MRI, has been found to be particularly helpful for lesion characterisation, assessment of tumour response to treatment and differentiating post-treatment changes from tumour recurrence.

The emerging hybrid imaging modality PET/MR has the capacity to combine anatomical detail with an even richer supply of functional and metabolic information and will fundamentally change the way we evaluate gynaecological cancer patients. Its application in the laboratory as well as the clinic will aid drug discovery and enable the delivery of substantially more individualised cancer care. The value of PET/MR will be further enhanced by the advent of clinical hyperpolarised MRSI (HP-MRSI). Clinical HP-MRSI can increase the MR signal 10,000–100,000-fold, allowing imaging of nuclei other than 1H with unprecedented sensitivity and speed. Thus, it not only can identify the location and quantity of a targeted hyperpolarised agent, but can also identify the agent's downstream enzymatic products, elucidating an entire chain of metabolic events in vivo. Multiple hyperpolarised substances can be injected and examined simultaneously, enabling multiple metabolic pathways to be probed in the same imaging session. With clinical HP-MRSI, imaging is crossing a threshold into a new level of real-time, quantitative assessment of tumour biology that will open up unprecedented opportunities for developing powerful predictive, prognostic and early response biomarkers for cancer management.

HP-MRSI, conventional MRI, and PET have different, yet complementary strengths. In the future, combined PET/MR/HP-MRSI will allow results from the various imaging approaches to be precisely correlated – providing new insights into cancer biology and increasing the value of imaging biomarkers in both drug development and clinical care.

MRI's role in gynaecological oncology

MRI has become integral to the diagnosis and management of patients with gynaecological malignancies as it combines exquisite anatomical detail with functional, multiparametric and quantitative assessment of tumour burden and its response to treatment. Techniques such as dynamic contrast-enhanced MRI (DCE-MRI) and diffusion-weighted MRI (DW-MRI) enable the radiologist to move from morphological to functional assessment of gynaecological malignancies.

In patients with endometrial cancer, MRI plays an important role in pre-operative evaluation and surgical planning: Not only does it allow non-invasive assessment of important prognostic factors such as depth of myometrial invasion, cervical stroma invasion, presence of peritoneal implants and lymphadenopathy, but through the use of functional imaging techniques, such as DW-MRI and DCE-MRI, it can also provide insights into tumour aggressiveness and micro-environment.

In patients with cervical cancer, MRI is the preferred imaging modality for evaluating primary disease, as it can determine tumour location (exophytic or endocervical) and size as well as invasion of the parametria, pelvic side-wall or adjacent organs, and lymph nodes with greater accuracy than clinical examination. Additionally, quantitative DCE-MRI and DW-MRI parameters serve as predictive biomarkers of response to chemo-radiotherapy, thus allowing for individualised tailoring of patients' treatment.

In patients with ovarian cancer, MRI is a problem-solving modality. There is growing evidence that DW-MRI allows more accurate mapping of the extent of peritoneal disease than does CT.

MRI plays an important role in patients with recurrent ovarian cancer by assessing the resectability of

Recurrent cervical cancer in a patient prior to pelvic exenteration. Axial T2W FRFSE (a) and fused axial PET/MR (T2W FRFSE +PET) image (b) demonstrate recurrent tumour invading the rectum (T in a, b). The second focus of recurrence posterior to and invading the pubic bone (arrow in b) is better appreciated on fused PET/MR images.

Born in Zagreb, in former Yugoslavia, **Professor Hedvig Hricak** MD PhD Dr (hc) studied medicine at the University of Zagreb and in the Karolinska Institute in Sweden. Today, she chairs the Department of Radiology in New York's Memorial Sloan-Kettering Cancer Center, and is professor of radiology at Cornell University Medical College and radiologist at Memorial Hospital in New York.
In 2010, she presided over the RSNA, and her professional awards include the Marie Curie prize from the Society of Women in Radiology and the Beclere-Medal from the International Society of Radiology.
Prof. Hricak's clinical activities include diagnostic radiology and oncological imaging of urogenital tracts.

solitary pelvic recurrences.

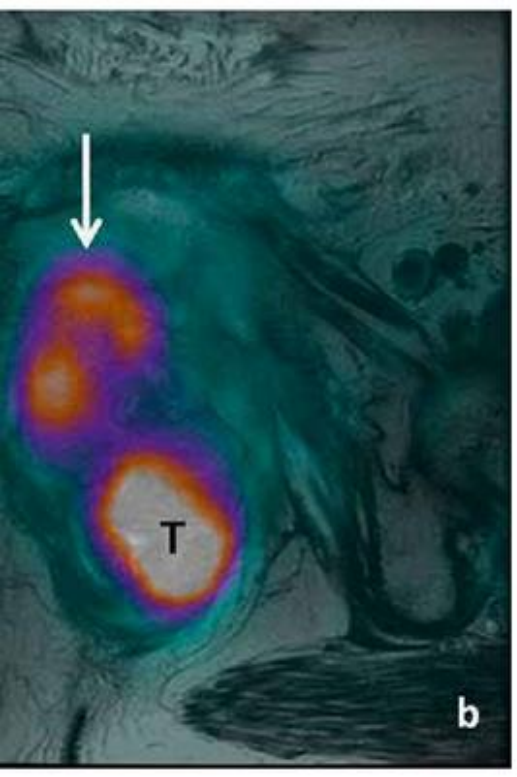
MRI can help to plan and tailor the pelvic exenterative procedure by accurately depicting local tumour extent and invasion of adjacent organs in patients with treatment-resistant or recurrent gynaecological cancer.

The gold standard

CT is still the gold standard for evaluating disease extent in patients with ovarian cancer, whereas PET/CT is routinely used to evaluate distant metastatic disease (including lymph nodes) in patients with primary and recurrent gynaecological malignancies. The maximum standardised uptake value (SUVmax) – a quantitative parameter derived from PET/CT – serves as a prognostic biomarker in patients with primary cervical cancer as well as in patients with recurrent ovarian cancer.

MRI's role in chemo-radiotherapy planning and monitoring

MRI plays a central role in planning chemo-radiotherapy and monitoring the response to such therapy in patients with advanced cervical cancer. DCE-MRI parameters reflecting heterogeneous tumour perfusion and subtle tumour volume changes early during chemo-radiotherapy are independent and better predictors of tumour recurrence and poor survival than are clinical prognostic factors. Preliminary data also demonstrate that the apparent diffusion coefficient (a parameter derived from DW-MRI) may serve as a predictive biomarker and has the potential to allow early assessment of response to chemo-radiotherapy.



The benefit of a higher magnetic field

MRI is the most sensitive technique for delineating small lesions due to its superb soft tissue resolution. A higher magnetic field strength improves image quality (due to an increased signal to noise ratio) and enables more effective use of functional techniques such as DW-MRI and DCE-MRI as well as more detailed metabolic imaging with MR spectroscopy.

Will PET/MR give additional clinical information?

This is a very new and exciting area of clinical research. The preliminary reports suggest that PET/MR may provide additional information for tumour staging and thus may influence patient management. In the future, with the development of new, targeted radiotracers, PET/MR will supply powerful biomarkers for multiple purposes.

Future roles

PET/MR, which has the capacity to capture an unprecedented diversity of functional and metabolic parameters in the context of exquisite anatomical detail, will change the way we evaluate gynaecological cancer patients and will greatly aid in drug discovery and the delivery of individualised clinical care.

Radiogenomics will provide the ability to match MR imaging traits with genomic information, furthering the development of prognostic and predictive imaging biomarkers.

Imaging (by MRI and or PET/MR) will be central to the way we design future clinical trials, as a more adaptive trial design is urgently needed.

The use of molecular imaging techniques, including HP-MRSI, will allow the development of more powerful predictive biomarkers, particularly for treatment selection and response assessment. Intra-operative molecular imaging will likely facilitate more complete tumour resection.

The development of sensitive molecular imaging biomarkers for ovarian cancer may enable repeat molecular imaging to substitute for preventative oophorectomy in high-risk patients by allowing detection of the disease before symptoms arise.

Richard III – modern imaging transforms a historical image

Mark Nicholls discovers how a CT scan at a British hospital played a critical role in identifying the long-lost remains of a 15th Century English king

For many centuries, the image of the English monarch King Richard III was that created by playwright William Shakespeare, who depicted the last Plantagenet King of England as an evil, hunch-backed murderer. That image endured virtually unchallenged over the centuries – primarily because of a lack of any contemporary paintings of the monarch, or the recovery of his remains.

The remarkable discovery of a skeleton a few months ago on the lost site of a forgotten church beneath a car park in Leicestershire, in the heart of England, was to change all that.

In February, DNA analysis confirmed the bones to be those of King Richard III, who is known to have been killed at the Battle of Bosworth on 22 August 1485.

It was modern hospital imaging technology that was to throw an added dimension on the remains and also help experts recreate his facial features. A team from the radiology department at Leicester Royal Infirmary scanned the bones using post mortem CT scanning protocols, similar to a normal clinical scan, to produce detailed images of the bones.

The unit has had a research interest and expertise in post mortem CT scanning for several years, so was well placed to offer the skills needed by archaeologists to unravel the mysteries surrounding Richard III's remains.

Claire Robinson, lead forensic radiographer at University Hospital Leicester carried out the scan with Professor of Radiology Bruno Morgan and Home Office pathologist Professor Guy Rutty and his team from the East Midlands Forensic Pathology Unit.

The bones were initially laid out on the scanner as close as possible to the anatomical position in which they were found. After the initial analysis of the images, a further scan of the bones was taken, using a bespoke polystyrene template to better position them, in order to reconstruct the images to make a 'virtual' three-dimensional model.

Professor Morgan said that as well as conducting a standard clinical scan using hi-res bone protocols, the University of Leicester team also used micro-CT to conduct a long but very high resolution scan of the skull. This was used to create the 3-D print used by the team at Dundee University to help reconstruct the facial features of the dead king (see above).

After his death, Tudor historians, as well as Shakespeare, portrayed Richard III as a villainous monarch with a curved spine who was rumoured to have murdered his brother's young sons in the Tower of London. He was eventually challenged by Henry Tudor (later Henry VII) and killed at Bosworth after only two years on the throne and given a hurried burial beneath the church of Greyfriars in the centre of Leicester city, in a clumsily cut grave with sloping sides and too short for the body, forcing the head forward. Greyfriars church was demolished in the 16th Century and its exact location was forgotten. However, a team of enthusiasts and historians managed to trace the likely area – and, crucially, after painstaking genealogical research, they found a 17th generation descendant of Richard's sister with whose DNA they could compare any remains. Joy Ibsen, from Canada, died several years ago but her son, Michael, who now works as a furniture maker in London, provided a sample.

The Leicester scans show that the skeleton's spine was indeed curved, a condition known as scoliosis, but there was no trace of a withered arm or other abnormalities described in the more extreme historical characterisations of the king.

Professor Morgan said: 'Richard III's bones were scanned three times and while it was relatively straightforward when compared to difficult clinical cases, there was the constant care needed because of the

A resurrected king: Using the skull dimensions, the mouth width could be determined precisely by the position of the teeth; the little bump on the outer orbit is the outer corner of the eye, which also guided the reconstruction of the King's features

From left: Claire Robinson, radiographer and advanced forensic practitioner, observing osteo-archeologist Dr Jo Appleby laying out the royal bones, watched by Dr Mike Biggs, pathologist from the EMFPU team.
Far right: Toshiba's Aquillon 64-multislice helped to extract secrets held in Richard's hand and arm bones for over 500 years

age, delicacy and importance of the remains.

'For us, one of the key elements was in trying to work out just how crooked he was. There is no doubt that the skeleton had scoliosis, but it was a case of working out just how bad it would have been and how easily it would have been to hide it.

'It has been a great opportunity to be involved in the project and learn a little more about Richard III's scoliosis and about the man himself. He did have scoliosis, though it was not as exaggerated as Shakespeare made out, but it was not made up.

'The big advantage of the scanning is it means that once the bones go back into the earth again, we have still got a very accurate facsimile of his bones, we have a permanent record for people to use for research in the future, especially as the CT images are being used to make a full 3-D print of the skeleton at the University of Loughborough.'

With University of Leicester osteo-archaeologist Jo Appleby and Piers Mitchell, anthropologist at the University of Cambridge and consultant paediatric orthopaedic surgeon for Peterborough and Stamford Hospitals NHS Foundation Trust, who have studied the skeleton's scoliosis, Professor Morgan will help produce a scientific paper looking particularly at how bad the scoliosis of Richard III would have been. He said that the Richard III project has been invaluable in promoting the role of the post mortem imaging team at Leicester and its capabilities. Post-mortem CT (PMCT) is becoming an option as a minimally invasive alternative to post-mortem examination. Leicester has become an established centre in PMCT, developing post mortem coronary imaging techniques and running a number of courses designed to introduce professionals to the use of computed tomography (CT) in the investigation of sudden death.

The bones are of a man in his late 20s or early 30s and have been carbon dated to 1455-1540. Richard was 32 years old when he died in battle. The skeleton had suffered 10 injuries, including eight to the skull, at around the time of death.

Dr Appleby said: 'The CT scans of the bones, carried out at Leicester Royal Infirmary by the Radiology Imaging Unit have been a crucial part of the investigations. The three-dimensional images of the skeleton that have been produced have played a central role in our interpretation of the injuries. In addition, the CT scans mean that we will have a full record of the skeleton even after the bones are reburied.'

While the CT scan provided a permanent 3-D record of the bones which cannot be obtained by other means, enabling images and models to be reproduced, minimising any potential damage that could be caused by repeated handling of the fragile bones and facilitating further analysis and comparisons after the bones are interred, the Leicester CT scans were also critical in helping build up an image of the much-maligned monarch's facial features.

When it came to reconstructing Richard III's face, the Dundee team used CT scans and photographs of the skull, which they ran through a computer programme. Caroline Wilkinson, Dundee University's professor of craniofacial identification, said clues from the skull were used to reconstruct features while a specific formula enabled researchers to predict what the soft nose would look like from the underlying bone and the shape of the brow.

'The width of the mouth can be determined exactly by the position of the teeth,' Professor Wilkinson explained. 'The little bump on the outer orbit is where the outer corner of the eye is. We can use these anatomical standards to help us rebuild the face.'

Over the centuries, some scholars sought to re-evaluate Richard III's brief reign and highlight his good work, such as reforming the English legal system. That debate is set to continue. But with the bones scanned and confirmed as the remains of King Richard III, planning is now under way for a formal reburial of a long-lost English monarch.

Improving X-ray technology

A new technique being pioneered in a UK hospital aims to help orthopaedic surgeons with spine and hip surgery

The Image Overlay Template Alignment (IOTA), now being used at Leicester Hospitals, improves on current X-ray technology and helps increase the accuracy of complex surgery, such as spinal fixation following a car crash.

Gareth Robinson, a senior radiographer at Leicester's Hospitals, who invented the technique, said: 'Currently, our very skilled surgeons use X-ray images to help guide operations, together with their knowledge of the body and their eyesight. However, X-rays can be difficult to interpret because their exact magnification is unknown and there is little information on the X-ray to suggest depth. In other words, they're rather two-dimensional. My technique uses laser lights and templates that can be laid over x-ray images to help surgeons make even more accurate surgical decisions."

Thus surgeons gain more information about precise angles at which pins and other prosthetics need to be placed and the system reveals parts of the implants or shapes of the bones into which the implants are to be inserted, which are normally hidden to X-rays and the human eye.

Accurate measurements would confirm lengths of screws and other implants to be fitted. These can be cross-checked with the surgeon's initial calculations.

Manangement In Radiology

Finding that perfect match

Advice from an 'old hand' for juniors wanting to work in a department where they fit in and which also suits their personal hopes and ambitions

The professor giving sound advice at the Junior MIR (Management in Radiology) course held in Milan in October

Report: Michael Reiter

At the end of residency physicians apply for a position in a department. More often than not, this process involves misunderstandings between the young applicant and the department's recruitment representative, as explained by Professor Yves Menu at last year's Junior MIR (Management in Radiology) course held in Milan last October. In his lecture, the chairman of the ESR Professional Organisation Committee spoke of several aspects that ought to figure prominently in this career phase.

Typically, the recruitment person is seeking someone who is ready to assume the role of a senior, someone who will attach him/herself very much to the department and the discipline. However, the applicant's self-assessment is as being someone between a junior and senior role, Prof. Menu explained.

Differing views

As an example for applicants who have finished residency, he quoted the 'Chef de Clinique Assistant' in France, which resembles a fellowship; it is a salaried university position. These physicians are expected to perform medical care as well as teaching and research activities. 'Obviously, to fill that position, the head of department requires someone who is able to diagnose and treat the patient, to train juniors and also to carry out research,' Prof. Menu pointed out. When applicants send in their documents, however, their message is 'I'd like to join your department in order to increase my knowledge'. Obviously the views from the two sides differ.

Consider key factors

There are turning points – moments that turn up in someone's life when s/he thinks a major decision should be made – on the assumption that s/he is aware of the relevant facts, skills required, within a context that includes external, family events and many more factors. Based on a firm foundation, it appears to be rather safe to go for an opportunity. 'However, someone who has just come out of residency is not endowed with the solid grounding that such a major decision would need – that point only comes perhaps two or three years later in life,' according to Prof. Menu, who adds: 'Young people should be aware of these kinds of factors and of turning points.'

Choosing a department does not mean choosing a fixed environment, he added. 'For example, if you decide in favour of a specific department in an organisation because of its modern equipment, this is not really a future-safe approach – because that equipment will be outdated at some point.' Many young physicians do not realise this, he said. 'If I were in a position to choose, I would vote in favour of a department with a lot of machines, but ones that are due to be replaced by brand-new equipment.'

Furthermore, applicants should not underestimate a department's and organisation's history, as well as the atmosphere within the team. Is the feeling compatible with his/her own way of interacting? Applicants should also analyse themselves, and never pretend to be some other person. 'Accept your weaknesses – you may be able to compensate them to some extent, but they will accompany you all your life. Therefore it's better to find a position and place where your weakness will not significantly impede your performance. For example, if you find it hard to get up early, don't join a department where you are expected to start work at seven,' he warns.

By keeping these pointers in mind, and looking beyond a department's work and equipment, applicants might avoid adaptations that might become painful – and such advice holds true beyond borders.

Having held key posts in several renowned French hospitals, **Professor Yves Menu** is currently Chairman of Department of Radiology at the Saint Antoine Hospital and Professor of Radiology at the University Pierre and Marie Curie (Paris VI). In 2011, he was ECR President and, within French and European Radiology Societies he is a member of the ECR Programme Committee as well as chairman of the ESR Professional Organisation Committee.

40 years of CT scanning

Report: Michael Krassnitzer

Forty years ago an article was published that would change medical practice. In the British Journal of Radiology, English electrical engineer Godfrey N Hounsfield described how he had made a patient's brain visible non-invasively by evaluating a large number of X-ray images of the skull taken from different directions. This was totally new – the birth of Computed Tomography (CT). 'It's possible that this technique opens a new chapter in X-ray diagnosis,' the engineer speculated. What an understatement. The new procedure revolutionised medicine. Two years later (1975) he was elected to the Royal Society and, in 1976, was appointed Commander of the British Empire. Three years on, he shared the Nobel Prize for Physiology or Medicine with Allan McLeod Cormack for his part in developing the diagnostic technique of X-ray computed tomography (CT). In 1981 the inventor became Sir Godfrey Hounsfield CBE FRS, following his knighthood by Queen Elizabeth II. He died in 2004.

'Modern diagnosis of carotid artery disease, as well as diagnostic confirmation of acute stroke, is unimaginable without CT angiography these days,' Professor Christian Loewe MD, at the Department of Cardiovascular and Interventional Radiology, Radiodiagnostics Clinic, Medical University of Vienna at a 40 years of CT scanning press conference held in the Austrian Radiological Society. 'It's possible,' he pointed out, 'to visualise and quantify stenosis of the carotid arteries and occlusion in the cerebral arteries and then to plan the adequate treatment in just a few seconds of examination time, without the need for arterial puncture in the groin and with high resolution and diagnostic safety.'

From left: Prof. Reto Bale, Dr Johannes Trenkler, Prof. Gerhard Mostbeck, Prof. Christian Loewe and Prof. Werner Jaschke, President of the Austrian Society of Radiology (ÖRG)

Technological advancement has not only increased the temporal and spatial resolution of CT angiography but also significantly reduced the exposure to X-rays from CT scanning. This has also made CT angiography the method of choice to investigate aortic disease and aortoiliac occlusive disease. 'Modern endovascular treatment procedures for aortic aneurysms via vascular endoprosthesis (stent graft) would be impossible without the above mentioned advances in CT angiography,' the professor emphasised. 'The modern procedures available now also facilitate imaging of the coronary arteries and any changes within them via modern CT scanning in mere seconds.'

The high validity of this technique, particularly to exclude coronary artery disease (CHD), was confirmed in numerous national and international publications. Only for patients with a clear clinical indication for the presence of CHD does CT scanning currently not deliver added value, the Austrian radiologist pointed out.

For many years, CT scanning has also played a central role in the diagnosis, treatment planning and monitoring of cancer patients. 'Modern multi-detector CT scanners produce images of outstanding quality and resolution and deliver the relevant information that doctors require for their treatment strategies and therefore for the best possible care of cancer patients,' explained Professor Reto Bale, from the of Micro-invasive Therapy (SIP) division of the Department of Radiology, Innsbruck Medical University. 'The number of systematic diagnostic and therapeutic CT interventions in oncology has increased substantially over the last few years. A histologic examination is the gold standard of diagnostic confirmation and the basis of any oncological treatment.' Lung and bone tumours are particularly inaccessible for sonographically precise puncture and are routinely biopsied percutaneously with CT help.

CT-navigated thermal ablation procedures, such as radiofrequency ablation, microwave ablation and cryotherapy, are increasingly used to treat liver, kidney, bone and lung cancers. Combined with modern 3-D navigation systems these procedures facilitate local curative treatment of various tumours of up to 10 cm diameter and thus represent a minimally invasive addition, or alternative respectively, to surgical procedures.

As an alternative to a colonoscopy, virtual endoscopy allows a quick evaluation of the entire colon using reconstructed 2-D and 3-D images. A 'fly-thru' programme lets the radiologist see into the intestine as if he was carrying out a colonoscopy. In this way colonic polyps can be detected and examined non-invasively. Modern software also facilitates the automated 3-D reconstruction and determination of the size of lung and liver tumours. 'This allows us to recognise changes in the tissue and to more objectively assess these over time,' Prof. Bale explained, concluding his outline of CT applications in today's oncology.

Zero-Field MRI

UK research team pioneers a new type of scanning system

Scientists at Aberdeen University, Scotland, are developing Zero-Field MRI (ZF-MRI), to enable diseases to be 'seen' at an earlier stage than with standard MRI. They also suspect that ZF-MRI may reveal biomarkers that could help pharmaceutical firms to develop new drugs for neurodegenerative diseases, e.g. Parkinson's and Alzheimer's, plus cancer and osteoarthritis.

The University of Aberdeen researchers – from medical physics, radiology, neuroscience and neurology – are creating the new technology in the biomedical physics building. Aberdeen has a long record of ground-breaking scanner developments, including clinicians there being the very first, worldwide, to scan the body of a patient using MRI in 1980.

ZF-MRI is a major departure from standard MRI because it takes the magnetic field within the scanner - including the Earth's own magnetic field - very close to zero, in order to see disease-related tissue changes not revealed by conventional MRI.

Dr Lionel Broche, a Research Fellow at the University, said: 'Right from the early days of MRI it has been known that the contrast that can be seen between normal and diseased tissue is greater at lower magnetic fields, because of the way in which molecules move around in tissues, altering the signals that are detected and used to form the detailed MRI pictures. At low magnetic fields the speed of the molecular motion is more closely matched to the frequency of the MRI signals, making the technique more sensitive to changes.

ZF-MRI should provide us with exquisite sensitivity to subtle changes in brain tissue, bringing the possibility of early diagnosis.'

ZF-MRI will be used with another MRI technique, pioneered by Professor Lurie's team, called Fast Field-Cycling MRI (FFC-MRI), which can also 'see' extra information, compared to normal MRI. Unlike conventional MRI, FFC-MRI switches rapidly between different magnetic fields - an effect rather like having 100 or more scanners with differing scanning capabilities within the one scanning machine. With the ZF-MRI technology incorporated into an FFC-MRI scanner the researchers will initially modify the FFC-MRI scanner to enable zero-field measurements. The team plans initially to use ZF-MRI to scan small objects, e.g. bottles containing protein gels to mimic normal and diseased tissues, and then, towards the study's end they hope to image patients with neurodegenerative diseases, particularly Alzheimer's and Parkinson's.

The ZF-MRI project team is led by medical physicist Professor David Lurie (centre). Their funded research will last for three years.

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CT angiography - within mere seconds CT facilitates the complete imaging of the arteries - from head to toe if needed. Thus it is possible, quickly and non-invasively (i.e. without the need for arterial puncture in the groin) to rule out or confirm arterial disease in the context of atherosclerosis and to plan treatment - also for out-patients.

Perfusion imaging: The future of CT?

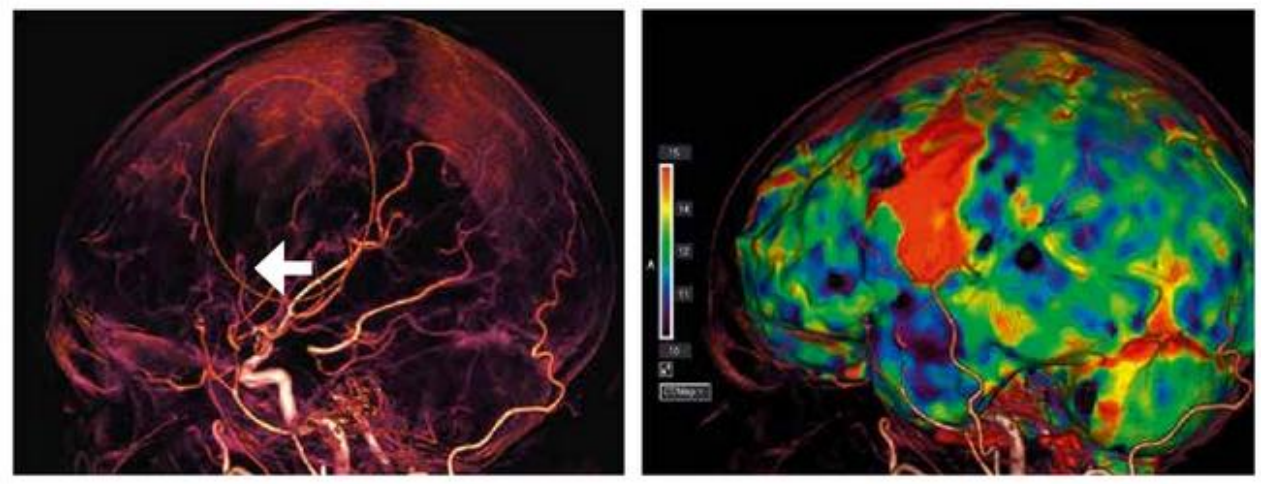
CT scanners now nicely cover morphology. The challenge is moving to CT functional imaging without frying patients

Report: John Brosky

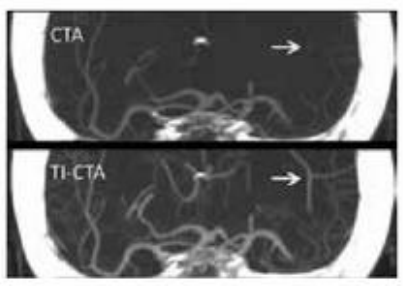
Cardiac scanning was the driving force behind recent developments in computed tomography (CT) that saw the introduction of multi-detector imaging as well as innovations such as dual-source flash scanners and wide 320-slice detectors. The next five years will see the development of a combination of CT angiography (CTA) and CT perfusion as a one-stop shop for cardiologists, according to Professor Mathias Prokop. Radiologists will be able to offer examinations including stress tests capable of predicting the presence of ischaemia equally well as SPECT.

Prof. Prokop and his group at the Radboud University Medical Centre are looking further to a day when CT perfusion can offer functional diagnosis throughout the body, starting with applications in the brain but spreading to oncologic and functional imaging.

The challenge is to create good-quality perfusion scans at an acceptable radiation dose. If perfusion imaging was done using conventional settings for each time point of a perfusion series, then radiation dose would have to be multiplied with the number of scans, and thus be larger than current techniques by a factor of 20-40. Since frying patients is no option, low-dose approaches are being developed that can achieve perfusion imaging at competitive dose, but these approaches so far struggle with reduced image quality. His group sees dose and image quality as the key issues and is working on developing techniques for high-quality perfusion at acceptable dose levels. 'Widespread use of perfusion imaging is not acceptable if we can't bring down the dose,' he said. 'That's the message.'



Left: High-resolution CTA derived from a CT perfusion study. Note occlusion of a side branch of the middle cerebral artery (arrow)
Right: CT perfusion map demonstrates reduced perfusion in affected territory



Comparison of CTA and timing-invariant CTA. Note the lack of collateral vessels on the left side on CTA but good filling on TI-CTA (Courtesy Ewoud Smit)

Iodine map derived from subtraction imaging demonstrates lack of contrast enhancement in a large hyper-dense cysts on the left.

So, now that the Slice Wars have settled, where are we with CT imaging?

Prof Prokop: 'Cardiac imaging used to be the driving force behind new CT developments. Today we can deliver pretty good quality imaging of cardiac morphology in almost all cases, though the technique is not completely fool proof. All the new generation scanners beyond 64-slice are capable of good-quality cardiac work. Cardiac imaging is especially simple with the scanner we use, which is a Toshiba 320-slice unit. In a fraction of patients there's a bit of a problem left with motion correction. 'GE Healthcare recently introduced a software approach to estimate the movement of the coronary arteries and use this information during image reconstruction to counteract this motion and improve sharpness and contour delineation of the coronaries. I expect this technology to spread to the other vendors who are already playing with it. Philips it was the first to publish, but hasn't yet implemented the technique in their clinical software.

'A big issue we have currently with cardiac CTA is that cardiologists tell us it's nice to know the coronary morphology, but that it is more important to know whether a stenosis is functionally relevant. This information is important for deciding whether to treat this stenosis or not. Until very recently we were not very good at answering this question because, while we could see there was a stenosis, we could not say anything about collateral vessels or whether the stenosis caused a malperfusion of the myocardium.'

Is CT really a viable modality to answer this question?

'Assessing the functional significance of a stenosis is a topic that is still under development and will remain so for the next few years, but it will get done. The current technique uses adenosine stress testing and a scan at a time point where there is the biggest difference in perfusion between normal and ischaemic myocardium. The technique has been studied, for example, at John's Hopkins and been tried out in the Core-320 multicentre trial. CT perfusion turns out to predict ischaemia similarly well as SPECT CT, but further optimisation seems warranted. In principle, the technique can be used on any modern scanner but we find it easy on our 320-slice unit because of its ability to perform snapshot imaging even at the high heart rates encountered at stress testing.

'Once the technique has matured, CT will act as a one-stop shop for patients with suspected ischaemia who now undergo a wide variety of tests ranging from bicycle stress testing to ultrasound, SPECT, MR or catheter coronary angiography. The CT workup would start with CTA to see if there are abnormalities. If there is a potentially significant stenosis, then a CT perfusion stress test will show if the stenosis is relevant and needs to be treated.'

In recent investigations you have taken CT perfusion beyond the heart. What potential do you see?

'What's coming next is dynamic perfusion imaging that consists of a series of short scans covering the target area. It can be done with most scanners with decent results, though again there is an advantage in covering an entire target, such as the brain or liver, with a wide detector that gives good signal-to-noise at a relatively low dose.

'These perfusion scans have been successfully used in stroke imaging to discriminate between infarct core and penumbra and to identify proximal vessel occlusions that would warrant intra-arterial stroke treatment. We see increasing indications in oncologic imaging: we'd like to be able to distinguish early between responders and non-responder to biologicals, the expensive but powerful new class of oncologic drugs.

'This would allow for substantial savings if treatment is stopped early and non-responders are put on alternative treatment. This appears feasible because CT perfusion is able to see an early drop in tumour perfusion in responders. Other applications of CT perfusion will include treatment planning for head and neck tumours, lungs, kidneys and tumour differentiation.

'However, the crucial factor for success is to keep radiation dose at bay while providing sufficient image quality. What we are working on now is to make sure that CT perfusion can be done without over-dosing the patient. Currently a CT perfusion of the brain scan will cause an effective radiation dose in the range of 2 or 3 mSv, which does not sound too bad. However, the local dose, for example to the eye lens, is much higher – well above 100 mGy, which is substantial.

'We are trying a couple of approaches, and while we are not there yet, results look promising. We are now acquiring such low dose images during the perfusion series that a single image is almost unusable for diagnosis. The challenge is to understand how we can retrieve relevant information from these ultra-low dose, lousy-looking images.

'One approach, for example, is a 4-D noise filter that can improve the image quality quite dramatically by using not only 2-D or 3-D information but data from the whole acquisition series. We are now already able to look at all the dynamic information: inflow and outflow of contrast via arteries and veins, and areas with delay in perfusion as an indirect sign of obstruction or other abnormalities.

'One of our team members, Ewoud Smit, has shown that a relatively simple technique that we call timing-invariant CTA is able to depict collaterals much better than conventional CTA. He has found that if you do not see collaterals on a timing-invariant CTA the outcome of a stroke patient is invariable bad. Since conventional CTA is a looking at a particular moment in time, collaterals may not yet be enhanced during the time of acquisition. Timing-invariant CTA, on the other hand, uses data from the whole 4-D series and will display vessels impendent of when contrast arrives. The result is that you cannot rely on a conventional CTA if it does not display collaterals – they might be still there but not yet enhanced, while the timing-invariant technique will always show them if they are there at all.'

You've worked in Japan with Toshiba, on phantom models relating to the ViSION Edition scanner. What's the goal?

'We have a Toshiba grant to develop a phantom that allows us to play around with the CT acquisition parameters without having to expose patients to radiation. It allows us to determine how to choose scanning and post-processing parameters to optimise the image quality. We needed models that allowed us to study the influence of each variation we are testing on the accuracy of perfusion measures, noise, spatial resolution, signal-to-noise ratios and, ultimately, visibility of small perfusion abnormalities, such as lacunar infarcts. 'The phantoms need to be organ-specific to replicate the noise that comes from real scanning. The noise in the brain is, of course, different from the chest, for example. We now have a phantom for the brain. We will probably develop such a phantom for the abdomen, and then one for the chest. Toshiba has fully embraced this approach.'

You are updating your best-selling book 'Spiral and Multi-slice Computed Tomography of the Body'. What can we expect to see?

'We hope it will come out at the end of this year. Our goal is to include the very latest information. What will be significant in the new edition is the latest technology, such as perfusion imaging, the new field for development, as well as the related subject of dual-energy and subtraction imaging for contrast-enhanced studies. We are now applying the same techniques we use to extract information from perfusion scans to subtraction imaging, another powerful tool for creating iodine maps at various time points after contrast injection. The resulting high-resolution maps look pretty cool and will probably revolutionise the way we look at contrast-enhanced studies.'

Mathias Prokop trained as a radiologist at Hanover Medical School, Germany and gained a BSc in Physics at Marburg University, Germany. From 1998 he was an Associate Professor of Radiology at the University of Vienna Medical School. He went to the Netherlands in 2002 and became Professor of Radiology at UMC Utrecht in 2004.
In 2009 he was appointed Professor of Radiology at Radboud University Nijmegen as well as Chairman of the Department of Radiology.
Dr Prokop is an expert in body imaging with a special focus on multislice CT and new imaging technologies. Over the past decade he has concentrated on chest screening using CT (cancer, cardiovascular disease, COPD) and has been a major player in the Dutch-Belgian lung cancer screening trial (NELSON).

Interventional radiology

Drawn by qualified training in interventional radiology, around 800 German-speaking specialists headed for Berlin in January to attend the Interventional Radiological Olbert Symposium (IROS) 2013

Report: Dr Jörg Raach

Since the dawn of the 1960s, interventional radiology has been a specialty within radiology that goes far beyond diagnosis; aided by imaging modalities such as CT, MRI and ultrasound, the discipline concentrates on minimally invasive treatment of chronic pain syndrome, vascular and tumorous diseases. 'The advantage of the interventional radiological method is its minimal invasiveness,' explained Thomas J Kröncke MD Priv.-Doz., Congress President of IROS 2013 and Deputy Director of the Clinic for Radiology (Campus Mitte) at Charité University Hospital, Berlin. 'Under local anaesthetic, millimetre-thin catheters are inserted into the blood vessels, or other ductal systems, to gain access to a diseased body area and to carry out the appropriate treatment.' Apart from the success rate of these less invasive procedures without scalpels the shorter recovery time is another strong argument in their favour as shorter hospital stays help to cut costs.

Helping with treatment-resistant hypertension

Around 50% of women and men in Germany aged 65+ years are known to suffer arterial hypertension. High blood pressure (BP) is among the most important risk factors for cardiovascular disease and therefore an essential determinant of the most common causes of death in adults. Therefore, correction of high BP is very important. In most cases this can be achieved via regular administration of one or several drugs. However, if a sufficient lowering of BP is not possible with medication, this is known as treatment-resistant hypertension, now believed to result from faulty signals from the kidneys, which continuously monitor BP and send the respective signals to increase or lower BP to the brain, explained Christian Scheurig-Münkler MD from the Clinic for Radiology Clinic at Charité University Hospital, Berlin, Campus Benjamin Franklin (CBF).

'If this control mechanism is disturbed, interventional radiologists can interrupt the nerves in the kidneys which transmit the faulty signal to the brain via catheter-based renal denervation. Via an incision in the groin of only a few millimetres in size the respective catheter is inserted into the renal vessels. The wall of the vessel is then heated from the inside in several locations, which makes the nerves lose their function without damaging the wall of the vessel. The faulty signal can no longer be transmitted. The treatment takes around 45–60 minutes and is now being offered all over Germany,' said Professor Dierk Vorwerk, Director of the Institute for Diagnostic and Interventional Radiology at Ingolstadt Hospital and Chairman of the German Society of Interventional Radiology.

Above: Schematic image of catheter-based renal denervation, with transmission of the faulty signal to the brain from the renal nerves being interrupted using heat

Right: Professor Josef Tacke at work in Bogenhausen Hospital during a minimally invasive intervention

'The intervention itself is low risk and the effectiveness of the procedure since its introduction in 2008 has been demonstrated in 19 studies involving 683 patients over an observation period of one to 24 months. All studies confirm a significant lowering of systolic and diastolic blood pressure. The maximum reduction in blood pressure ranged from 18mm Hg to 36mmHg (systolic) and 9mmHg to 15m Hg (diastolic),' said Professor Michael Uder, an authority on renal denervation at the University Hospital Erlangen, quoting from the new meta-analysis published by the American Society of Hypertension in 2012. At the same time it does not lead to a decrease in kidney function and has been shown to result in only few and justifiable side effects. However, patients still need to continue to take drugs to lower blood pressure. It will also be necessary to investigate whether this procedure results in a long-term lowering of high BP based on long-term studies with large patient collectives. Larger studies for medical devices prior to their admission to the market are also required (currently, unlike drugs, medical devices are often licensed based on tests involving only 100 patients). Present studies investigate whether, apart from the long-term success of the treatment, there may also be a possible benefit for other diseases such as cardiac insufficiency, cardiac arrhythmia et al.

Ensuring quality of life for diabetics and cost-cutting

Interventional radiology makes it possible to improve diabetic care significantly through early, less invasive interventions. 'With just under six million diabetes patients in Germany the costs of their care are around €6.5 billion annually. Most of those costs are caused by follow-on diseases resulting from diabetes, e.g. coronary heart disease, stroke, diabetic foot and vascular occlusion,' said Professor Petra-Maria Schumm-Draeger, internist, endocrinologist and diabetologist at the University Hospital Munich quoting from a current Robert Koch Institute study. It is these diseases that can be treated particularly effectively through interventional radiology if the intervention is carried out at an early enough stage. This has also been recognised by the International Working Group on the Diabetic Foot (IWGDF), which already includes interventional radiology procedures in its guidelines as first line, standard methods of choice.

A 50% drop in diabetic foot amputations

In the case of diabetic foot syndrome, chronic vascular changes right down to complete arterial occlusion in the legs caused by diabetes, it is possible to prevent or delay amputation through IR procedures. By inflating a tiny balloon in the affected artery (balloon-angioplasty) it is possible to re-open it. This prevents the tissue, which is now again supplied with sufficient blood, from dying, and thus a surgical intervention, including amputation, can often be avoided. In most cases the patient can leave hospital the same day or a day after the procedure. Apart from maintaining quality of life, and possibly the ability to work, this also avoids the enormous costs resulting from an amputation.

Professor Gross-Fengels, from the Department of Interventional Radiology at the Asklepios Hospital Harburg, Hamburg, explained: 'Specialist facilities have been able to lower the rate of amputation by up to 50%. This gives us hope considering that half of all patients die within the first five years of a leg amputation.'

DATES FOR YOUR DIARY

CIRSE 2013 and IROS 2014

14-18 September 2013
Barcelona, Spain
The European Congress for Interventional Radiology CIRSE.

16-18 January 2014
Salzburg, Austria
The Interventional Radiology Olbert Symposium IROS for German-speaking countries.

ForSaTum: Determi obstacles to drug d

Funding is needed, but preclinical imaging research must also gain a high confidence level, with greater efficiency and cost-effectiveness needed in fundamental research into new drugs and imaging procedures

Several obstacles hinder the establishment of new tumour therapies in Germany. Many cancer diagnosis and treatment approaches fail due to high development costs and a lack of clinical efficiency because preclinical procedures are not optimised and there can be no talk of swift clinical implementation.

Founded in 2010, with participation from Aachen and Bochum universities, Philips and some up-and-coming IT companies from North Rhine-Westphalia, the consortium ForSaTum, a German short form that roughly translates Research Satellite for an Accelerated Implementation of New Tumour Treatment Concepts, is striving to remove those obstacles. 'One major problem is that many imaging studies only result in a relatively arguable proof of principle,' explains the consortium's spokesman Professor Fabian Kiessling MD, head of the Experimental Molecular Imaging Department at Aachen University Hospital. 'Mostly the data are neither substantial nor reliable enough to allow us to rely purely on imaging.'

The fact that among some 10,000 new drugs development concepts fewer than ten make it to the clinical testing stage, and more than 80% of these go on to fail. Often, promising clinical treatment approaches are also not pursued by the industry because they were not sufficiently validated beforehand or are deemed too financially risky. The cause is a lack of efficient preclinical units for the standardised longitudinal examination of diagnostics and therapeutic agents in relevant tumour models. 'There is no suitable preclinical platform anywhere in Germany that fulfils requirements for the integration of top medical devices technology, the know-how for the development of pharmaceutical products and comprehensive data management. We have therefore made it our objective to optimise preclinical imaging research to such an extent that, firstly, it has a high confidence level and, secondly, it makes fundamental research and the development of new pharmaceutical products and imaging procedures more efficient and cost-effective,' the professor explains.

Personalised medicine

Imaging diagnostics, and particularly molecular imaging, play a central role in preclinical and clinical research because it increases the validity of preclinical studies and therefore the number of new treatment opportunities. Molecular imaging is the prerequisite for personalised medicine, which is in demand. Prof. Kiessling and the consortium are therefore proud that they have succeeded in implementing an important new development: a fully digital PET-Insert for MRI scanning. The PET scanner was miniaturised to such an extent that it can be integrated into a 3-Tesla MRI within 20 minutes, without any problems, meaning that an MRI scanner can be transformed into an PET/MR scanner at little expense, with the hybrid scanner then also working fully digitally. 'The digitisation of all stages during signal recording and

With a doctorate in internal medicine from the Ruprechts-Karls-University in Heidelberg gained in 2001, **Professor Fabian Kiessling MD** became radiology resident in the oncology department at the German Cancer Research Centre (DKFZ) and at Heidelberg University Hospital. During this period he managed various research groups, such as the Molecular Diagnostics Working Group in the Medical Physics Division of the DKFZ Radiology Department in 2003 and later headed the Helmholtz Junior Group Molecular Diagnostics.
His W3 professorship for Experimental Molecular Imaging was awarded at RWTH Aachen University in 2007 and, in May 2008, he became Chair.
He has been a Member of the Research Board of the European Society for Radiology (ESR) since 2011, and is a founder member of the European Society for Molecular and Functional Imaging in Radiology (ESMOFIR), and the current Secretary of the European Society for Molecular Imaging (ESMI). He has also been a frequent member of programme committees for the congresses of the European Society for Molecular Imaging (ESMI) and the World Molecular Imaging Society (WMIS).

MRI holds a key role in cervical cancer

Modern imaging techniques greatly enhance the treatment selection

Report: Michael Reiter

Staging of cervical cancer is clinically based on a system developed by the International Federation of Gynaecology and Obstetrics (FIGO). The staging is clinical because the majority of cases occur in developing countries where access to MRI is limited, explains gynaecological radiologist Dr Evis Sala. Clinical diagnosis is gained via a smear (pap test), clinical symptoms assessment and examination.

Although MRI has been used for evaluation of disease extent in patients with cervical cancer for the last two decades, it was 2009 before FIGO acknowledged that, where available, CT and particularly MRI could be used to evaluate the extent of disease. According to the Dr Sala this is a key step forward regarding the use of imaging as part of the evaluation of disease extent in cervical cancer. 'Imaging,' he explains, during our interview, 'plays a crucial role in the patient journey. First of all, in young patients who wish to preserve fertility, there is an operation called trachelectomy: the cervix is removed and the tumour along with it, allowing preservation of the uterus. Studies have demonstrated that this method allows affected women to preserve fertility and carry a pregnancy to term.

'Specialist surgeons capable of performing this procedure need the best information available to assess the patient's eligibility. This is where MRI comes in. In almost 100 percent of cases, it is accurate in selecting patients suitable for trachelectomy and in achieving precise planning of that procedure.

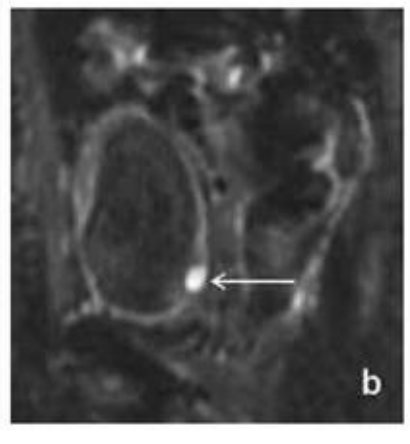
'Apart from fertility-sparing issues, triaging patients with cervical cancer is another purpose which MRI serves very well. If the tumour is small and has not spread into the adjacent parametrium, surgical removal of the uterus and adjacent tissue is performed. In cases where the tumour has spread to neighbouring tissues, radiotherapy is the appropriate option. Clinical staging has proved to be significantly inferior to MRI especially in the early stages of the disease spread to the adjacent tissues (parametrium).'

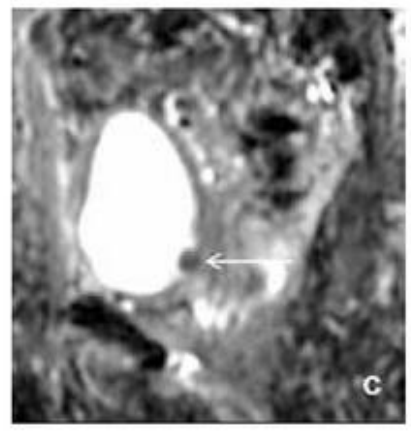
Following medical studies at the University of Tirana Medical School in Tirana, Albania **Dr Evis Sala** gained MPhil and PhD Degrees at the University of Cambridge, UK and took up a radiology residency at Cambridge University Hospitals. She also completed a Research Fellowship at Memorial Sloan-Kettering Cancer Centre, New York, USA, before returning to the University of Cambridge in 2005 as a University Lecturer/Honorary Consultant Radiologist. In July 2012, Dr Sala returned to Memorial Sloan-Kettering Cancer Center, to become Director of Gynaecologic Radiology. Her professional focus is on genitourinary cancer imaging; she has been awarded numerous awards and honours.

'The key added value of MRI is in treatment selection and planning – selecting patients who wish to preserve fertility and triaging patients suitable for surgery vs. chemo and radiotherapy. Radiologists are key members of a disease management team leading to individualised treatment planning and follow-up of patients with cervical cancer.'

Speaking of other applications for MRI, Dr Sala pointed to the evaluation of tumour recurrence. 'MRI can map out recurrence very nicely in the pelvis and the lymph nodes. MRI can be combined with PET/CT if there is a question about distant metastases, for example, in the chest,' she added.

'In general, functional MRI techniques such as perfusion and diffusion MRI provide insights into tumour biology, and quantification of changes following treatment is possible. Dynamic-contrast enhanced MRI reflects tumour perfusion, whereas diffusion-weighted MRI measures water movement, which reflects on tumour cellular density and the integrity of the cellular membranes. MRI parameters, indicative of heterogeneous tumour perfusion and subtle tumour volume change early during chemo-radiotherapy, are independent and better predictors of tumour recurrence and death than clinical prognostic factors. Diffusion-weighted imaging helps predict early response to chemo-radiotherapy in patients with advanced cervical cancer. Therefore, quantitative parameters generated from functional MRI techniques, such as perfusion and diffusion MRI, may serve as prognostic and predictive biomarkers in patients with cervical cancer.'





Future perspectives

One of the major future developments Dr Sala predicts is the use of hybrid imaging for cervical cancer. PET/MR combines local stag-

ined to eradicate development

processing makes for higher temporal and spatial resolution. Therefore, we achieve a significant improvement in image quality; at least first measurement results indicate this. I'm confident that this is a large gain,' he adds, 'even though the final proof is currently still the object of research.'

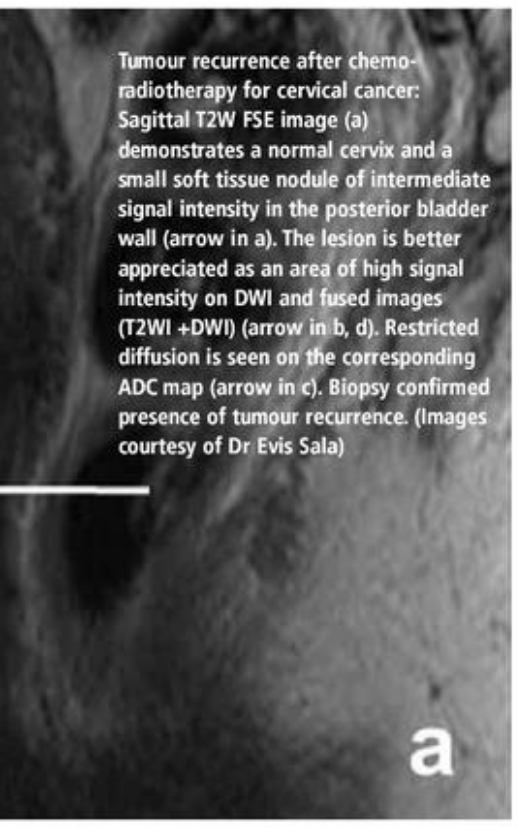
Standardisation benefits

The consortium does not only work around innovative medical devices technology. The more important step for the project as a whole is the development of a specialised animal testing platform that offers pharmacokinetic and toxicological examinations as a service, as well as supporting the testing of new treatment concepts with specific consultancy services. 'When the pharmaceutical industry wants to carry out animal testing the approval procedure takes more than six months. However, by way of a highly standardised animal testing application adapted for the needs of the consortium we can act within just a few weeks. But the time saving, the shortening of the developmental pipeline, is only one aspect. It's also very important that all our examinations are carried out and documented according to standard operating procedures. This ensures the quality of the measurements and makes the costs of the studies easier to calculate,' the professor explains.

The fourth component of preclinical tumour research that connects the project is the development of molecular probes and diagnostics. The initial focus here was on molecular optical and ultrasound probes. Some of these probes are now so reliable that even small differences in the expression of molecular markers can be reliably captured in vivo. Thanks to all these measurements and developments the consortium has succeeded in increasing the trust in imaging in preclinical research.

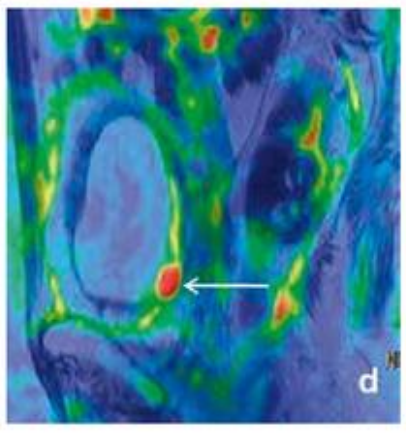
Funding

Prof. Kiessling hopes to have created a platform that facilitates the meaningful testing of drugs, contrast agents, new devices and treatment procedures and which eases the transfer and implementation of these into the hospital. Although the project is part of the interdisciplinary, integrative and inter-faculty (I3) Institute for Technology and Medicine promoted via the excellence initiative and secured from an academic perspective, it is a shame that follow-on funding for this project is currently not yet secured as the three-year term of the EU-NRW Objective 2 Programme Regional Competitive Capabilities and Employment 2007 – 2013 (EFRE) expired at the beginning of 2013. However, further suitable funding currently seems hard to envisage. 'It's very important that the consortium receives further funding,' warns Prof. Kiessling, 'particularly if the industrial partners are to stay on board and if jobs are not to be endangered.'



Tumour recurrence after chemo-radiotherapy for cervical cancer: Sagittal T2W FSE image (a) demonstrates a normal cervix and a small soft tissue nodule of intermediate signal intensity in the posterior bladder wall (arrow in a). The lesion is better appreciated as an area of high signal intensity on DWI and fused images (T2WI +DWI) (arrow in b, d). Restricted diffusion is seen on the corresponding ADC map (arrow in c). Biopsy confirmed presence of tumour recurrence. (Images courtesy of Dr Evis Sala)

ing achieved through the superb soft tissue resolution of MRI with valuable metabolic information from PET. This brings together local staging and evaluation of distant metastases, which is important for therapy planning. Individualisation of patient treatment, assisted by quantitative hybrid imaging is clearly where the future is heading.



Reaching for all corners of the globe

Mindray is quick, flexible, highly international and open to all

Interview: Daniela Zimmermann

'We want to help European customers to improve healthcare quality by providing them with high-quality innovative and cost-effective products and a very good service team and very good professional clinical support team,' David Yin of Mindray confirmed. 'There is competition everywhere, and we are so glad that increasingly European hospitals have accepted us – and also, very importantly, that they are very happy about the product, service and support. This gives us a lot of confidence. We walk very closely with the end-user and customer and medical professionals.

'We also make many very good installations in university hospitals and city-level hospitals in all of Europe. If you had asked about that about five years ago I couldn't speak of the big hospitals; but now I can – in every country. That's very important for us and for the other end-users. They can trust what our product is. A lot of university hospitals do long-term clinical trials of our product. We provide a machine and work on their requirements and import that and send our people there to work closely with the staff doctors.'

Europe differs very much from Asia or America; all the countries are different. How do you cope with the cultural differences?

'The countries have common requirements: reliability, good quality, good features – so, people like a good product. That's the same.

Founded in 1991 in Shenzhen, China, Mindray is now known internationally for its products that cover patient monitoring and life support, in-vitro diagnostics, medical imaging and veterinary. During Daniela Zimmermann's interview with David Yin, General Manager of Mindray Europe, he described the firm's clear strategy for Europe and beyond

Mindray is from China and its products are produced in China, but basically, as a first step, that product consolidates all the information from all the countries. The second step: we use local people. In every country, for each office, our general manager is local and knows the customer really well.'

Each manager in each country reports to the General Manager for Europe, he explains. 'We have six offices in Europe: the Netherlands, France, the United Kingdom, Germany, Italy and Spain. So, all the countries with the offices are our interest, along with others, such as Scandinavian countries.'

All the Scandinavian countries are not even a tenth the size of Germany or France, so, which in Europe is the most interesting for Mindray?

'Germany is the top.'

Where you have to compete against Siemens...

Not really. Our product line is different from Siemens. We have some products with little overlap. Ultrasound has very little overlap. Patient monitors – I think Siemens had this product line ten years ago but sold it to other companies. It's what big companies do; because of their structures and size they can do many things. The electronic part, like us with a patient monitor, is quite a faster moving product. In all industries, the price of electronic products is decreasing.

'Faster reactions and taking the most advantage of electronics technology, a company like us can do it very quickly. This is also important. We are quick and flexible and there's also innovation. How to make it fast is very important to us. When we understand something, we know the market needs, we can just use the new technology. For other big companies, because the product is already there, if they put out something new, that means the old product will discontinue. So, that is a painful decision. For us, everything is new. We are quite flexible, and we move faster.

'Maybe 20 or 30 years later we'll also become bigger. So then, how can we be faster? That is another question, another challenge.'

What are China's strengths? In Germany, for example, Siemens' strength is absolutely high-level engineering. France and Italy are good at design. Does the strength of the Chinese, lie in electronics or engineering?

'I cannot speak generally about the Chinese, but if we talk about Mindray, we have a very strong engineering team: more than 1,600 engineers among our 7,300 employees, so we are a very big engineering team. We also consolidate resources, knowledge, from outside China. We have R&D centres in the USA and Stockholm and we consolidate all requirements. We also work very closely with our local general managers, people who have a long history in the market and the industry and know customers' needs. Therefore, they also contribute a lot. We combine everything together. We also have our own design team and win a lot of global design awards.'

Those prizes have included the internationally recognised 'red dot' design award in 2011 for the firm's HyLED operating light; the 2010 red dot award for the M7 diagnostic ultrasound system; China's iF Design Award in 2009 and, in 2006, the same for its BeneView T8 patient monitor.

So, what's missing for Mindray?

'Two things: Because it has become a global company, you need increasing numbers of local people and talented people to join the company. I think everything is related to people, because people are very important: people from China and people outside China. That is the key to being a great company; you must have a lot of excellent people all together.'

Siemens, for example, has engineers from India, China, France, America, Germany, in a multicultural team. Does Mindray also try to employ French, English or German engineers and, say, postgraduates, when they are new and fresh?

In response to this question, a Mindray representative pointed out that the Shenzhen base has grown considerably. 'You'll find our colleagues from every country, such as India, Germany, Italy and America. It is really an international company – Mindray is open to everyone.'

Peace at last for patients

Silent Scan overcomes the clunk, clunk, clunks

MRI technology has been in use for 30 years, and throughout those decades the high noise level during an examination has stressed many patients – along with being in the confined space of the tube for quite some time.

Today, almost all manufacturers produce tube openings up to 70cm in size and thus help to reduce claustrophobia – also enabling examinations of obese patients. However, noise annoyance has remained – until recently. GE Healthcare has now succeeded in removing that endless clunking sound at its very source.

'With conventional MRI systems noise levels of up to 100 dB are measured for some frequencies, which is on a par with the noise levels during rock concerts. With the Silent Scan MRI, GE has now succeeded in reducing this noise level with new sequencing technology to such an extent that apart from normal background noise resulting from the cooling of the gradients nothing else can be heard,' explains Professor Christoph Herborn, Director of MR Future Concepts at GE Healthcare.

Previous attempts to reduce noise levels during examination were mostly aimed at sealing the gantry with isolation methods instead of eliminating the noise at the source. The results were unsatisfactory. With the Silent Scan technology the T-1 and T-2 weighted examinations are now performed with noise levels comparable to those of a CT exam, i.e. very quietly.

Noise reduction at source

'MRI imaging is complex and consists of multiple parameters that define how the tissue to be examined is stimulated and how this stimulation is scanned by the MRI receiver coils. These parameters include the repetition time, flip angle and so-called echo time (TE). Through modulation of these parameters, but particularly by a significant reduction in the echo time, it has been possible to reduce the noise while the gradient is switched on and off to such an extent that the examination can now be carried out quietly. We have impacted all parameters, but the most dramatic reduction has been in the echo time, which means the sequences, and therefore the examination times, not becoming much longer than with a comparable 'loud' sequence. One example: With a T1-weighted three-dimensional frequency of the head, the examination time with a conventional MRI is around 90 seconds; with the Silent Scan it is extended by 8–10 seconds, using the same parameters and relating to the same image of the examination area,' he explains.

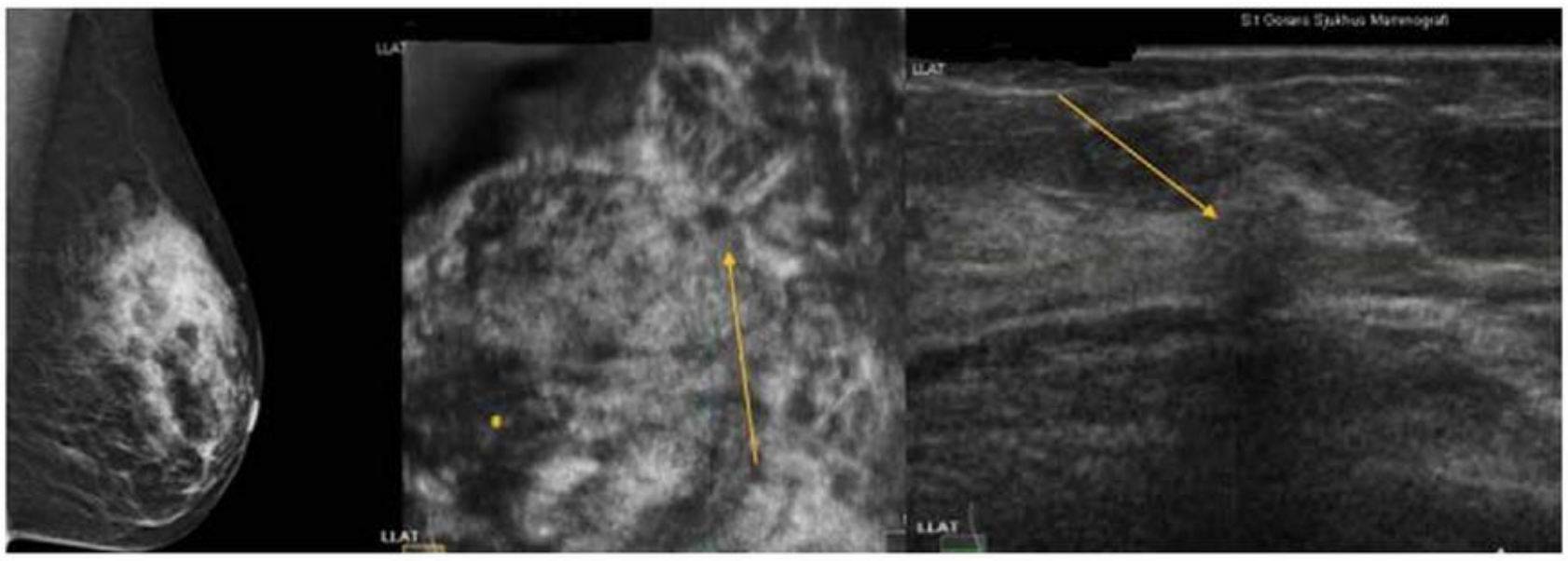
This is a dramatic development indeed, which will significantly improve patient comfort during MRI examinations – in line with the company's philosophy. Moreover, the radiologist is optimistic that further development and expansion of the Silent Scan technology to other examination sequences, such as diffusion, will more than compensate for the current, slight extension of the examination time.

Presented for the first time at the RSNA 2012, GE is currently awaiting FDA 501(k) clearance to introduce Silent Scan technology to hospitals. First study results from the USA underline positive feedback from patients – with the new system they need neither headphones nor any other ear protectors. This significantly eases communication between the doctor or other medical staff and the patient in the MR machine.

Specialist diagnostic radiologist **Professor Christoph U Herborn** MD MBA (healthcare management) joined GE Healthcare in 2011 to direct the company's MR Future Concepts business unit. Following radiology studies at the University Hospital Essen, in 2005 he joined the Clinic for Diagnostic and Interventional Radiology at the University Hospital in Hamburg-Eppendorf, where, from 2007 he undertook business administration, including the commissioning of the new building. Instrumental in the development of radiation-free whole-body MRI, the professor is one of Germany's leading experts, particularly in MRI of the cardiovascular system and gut (virtual colonoscopy).

High volume mammo centres yield high quality research

With 350,000 mammography screenings annually, Unilabs Sweden finds itself on the leading edge for research in mammography and pioneering patient education programmes. *John Brosky reports*



Unsurprisingly, prototypes for every new modality in breast imaging are found at one or another of the 23 mammography centres managed by Unilabs Sweden. In addition, as the centres perform more than 1,500 breast cancer screenings per day, it also is quite expected that research institutions are keen to conduct studies within this network, which covers half the women in Sweden.

What is unusual here is the enthusiasm and passion for this leading edge work among a very busy staff in an efficiently run private company necessarily focused on high patient through-put. Even more surprising is the company's financial support for multiple studies, the largest of which will not be finished for 10 years.

Landmark studies to be reported

The European Congress of Radiology will present a study showing a 57% higher detection rate for cancer with automatic breast ultrasound (ABUS) compared to conventional mammography will be presented. The study of 1,671 asymptomatic women with dense breast tissue was supported by Unilabs and conducted at its centre at Capio Saint Göran Hospital in Stockholm, Sweden.

Preliminary results from the 'Malmö Breast Tomosynthesis Screening Trial', reporting data on 9,000 exams of women with dense breast tissue, is now being prepared for publication. Unilabs joined the Skåne Region to sponsor this three-year study that will ultimately include 15,000 women.

'This work is a big part of our daily routine in practice,' explained Karin Leifland MD PhD, Head of Mammography for Unilabs Sweden.

One year ago, the Unilabs centre at Lund University joined the Karma study being conducted by the Karolinska Institute to identify risk factors for breast cancer among 70,000 women. Each patient who agrees to participate completes a lifestyle questionnaire, allows an assessment of her breast tissue density and undergoes a blood work up for genetic information.

According to the lead investigator, Karolinska Professor Per Hall, 'The Karma study is now recruiting almost a thousand women a week, which is a stunning figure. Without Unilabs Skåne's cooperation this could never have been possible.'

The goal of the Karma study is to create the world's best-characterised breast cancer cohort by following the patients to see who develops breast cancer over 10 years and then determine why.

There are three MRI studies underway at Unilabs centres. One follows women with a hereditary risk of breast cancer, which compares the results of conventional mammograms with ultrasound examinations and finally an MRI exam. A second MR study funded by Unilabs is for a doctoral thesis on vacuum biopsy. The third is for pre-operative diagnosed breast cancer that randomises patients with one group undergoing an MR exam to see if more cancer is detected than in the mammograms and ultrasound.

It helps that Swedish women are the nicest mammography patients in the world, Dr Leifland points out. 'When we ask them to take a biopsy for tissue samples, they say, "OK". They are really interested in participating in various studies because they know even if it may not benefit them, it may benefit their sisters.'

Pioneering Preferential RF Ablation studies

In collaboration with Capio St Göran Hospital and the Karolinska Institute, Unilabs is validating the efficacy of Preferential Radio Frequency Ablation (PRFA) in a study with three patient cohorts.

In this procedure a well-defined, solitary tumour of less than two centimetres is targeted using ultrasound so that a thin electrode can be inserted. PRFA technology induces an enzymatic destruction of the tumour by heating it for 10 minutes between 70 and 90 degrees Celsius. Surrounding fibrous and fatty tissues are left unharmed.

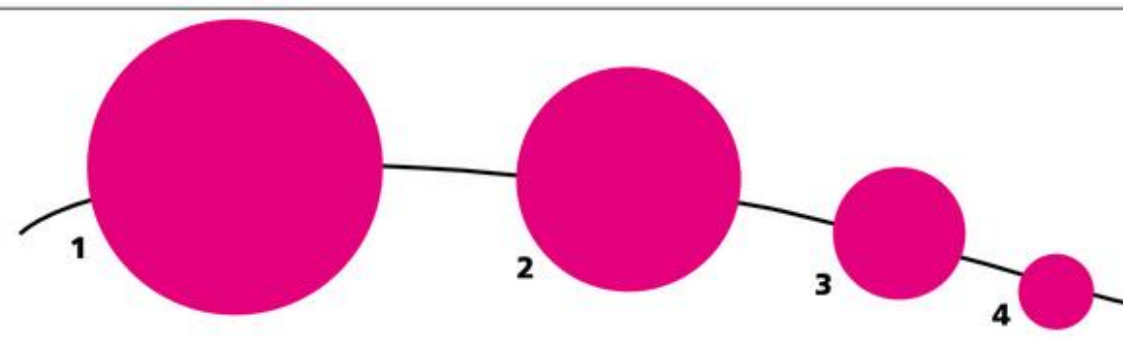
Mammography expert Karen Leifland MD PhD is head of the Unilabs SA Mammography Department at Capio St. Göran'S Hospital in Stockholm. Sweden

The first patient group are women already on the operating table. Immediately following the ablation, the tumour is surgically removed for a study of the heat-induced effects.

A second cohort of patients in this group is asked to wait three weeks before the tumour is removed surgically. The third group are much older women who cannot undergo surgery. After treatment they are followed with imaging exams to determine if the tumour has been destroyed or if the cancer returns.

'We have completed this procedure on 55 women, six of whom are in the third group, and not one has any cancer left,' said Dr Leifland. The experimental approach without surgery could never be applied to younger women, she explained. But the older patient cohort allows the group to validate the effectiveness so that with enough evidence it may someday be performed on younger women.

'If we can do this – identify women with a tumour, ask them to come back in a week, heat it up for 10 minutes and know that it is gone – that,' she declared, 'will already be a fantastic outcome.'



CROSSING CULTURAL BARRIERS TO SAVE LIVES

Immigrant children can play a key role

Unilabs also supports patient education to help the Swedish health ministry meet an ambitious goal of regularly screening 80% of women for breast cancer.

'We are at 94% participation in some areas but only at 47% in others,' explained Karin Leifland, who heads the Mammography group for Unilabs Sweden. The target group for a new campaign at Unilabs' centres is women who have immigrated to Sweden from Africa and Arab-speaking countries and who do not share the same cultural motivation to participate in screenings as Swedish women.

Where Swedish women have an incidence of breast cancer 30-40% higher than the immigrant population, an immigrant woman in Sweden is 30-40% more likely to die of breast cancer because the condition is not detected until in an advanced state. The first challenge, says Dr Leifland, is the high rate of illiteracy among the large populations of these women in urban areas.

The Unilabs Sweden team revised its invitations to come for a screening so that a seven-year-old child, who often is asked to read the letter, can tell his or her mother why she should go for a screening.

Once the woman does come for a screening she is given a key ring holding four rubber balls ranging from 24 millimetres in diameter to just 3mm. The staff explains that the largest ball is the average size of a tumour that the woman will be able to feel when palpating her breast. The next is the average size of what a doctor would feel and the third is what can be seen in a mammogram. The smallest, she is told, is the size of a tumour the Unilabs radiologists will be able to see if the woman comes for follow up visits, when they can consult her prior exams.

'Yes, it works!' Dr Leifland said, explaining it is effective with a woman who thinks that having visited once, she does not need to return the next year.

Proton therapy

Dresden will treat patients in 2014

Report: Brigitte Dinkloh

Whilst the first cancer patients are due to be treated with proton therapy in Dresden, Germany, in spring 2014, this autumn physicians and scientists will begin to work with this internationally unique research and development platform for innovative technologies in radiotherapy.

Over several days in February, the centre piece of the unit – the proton accelerator and treatment facility consisting of a gantry and nozzle – was transported in a heavy duty convoy from Belgium to the river Elbe, and then installed at the new site on the Dresden University Hospital campus.

Called OncoRay, the scientific institution is a joint enterprise organised between Carl Gustav Carus University Hospital and the medical faculty of the University of Technology, and the Helmholtz-Centre Dresden-Rossendorf (HZDR), is aiming to develop a new dimension in gentle radiotherapy: over the coming years the use of protons in cancer treatment will be further advanced with a close focus on the patient and away from commercial constraints.

The dimension of this high-tech installation from world proton therapy facilities market leader, Ion Beam Applications S.A. (IBA) of Belgium, sets benchmarks. The gantry alone, a steel construction that, once assembled, measures 13m x 11m and is rotatable by 370 degrees, weighs 110 tons. The focused proton beam travels across this steel colossus for the last few metres of its journey to the patient.

Installed at the same time at the Dresden site, the proton accelerator accelerates the particles to around two thirds of the speed of light – about 180,000km per second. To ensure the proton beam reaches the patient with the highest precision on its 50m journey from the cyclotron via the beam line and gantry, more than fifty quadrupole and dipole magnets guide it, each weighing several tons.

Set to an accuracy of a thousandth of a millimetre, the magnets ensure the correct shape and direction of the beam.

Alongside the proton acceleration facility, which is based on electromagnetic fields, the scientists at HZDR and OncoRay will test a new technology: Utilising high-energy laser beams to bring the particles up to the necessary speed, the objective is to drastically reduce the costs of the construction and maintenance of these treatment facilities in the future. This is a prerequisite to ensure all patients needing this gentle therapy will indeed be able to benefit from it. The coexistence of a conventional and a laser-based proton accelerator will be unique worldwide – the Dresden competency centre is becoming established as a reference- and crystallisation point for further research in this field.

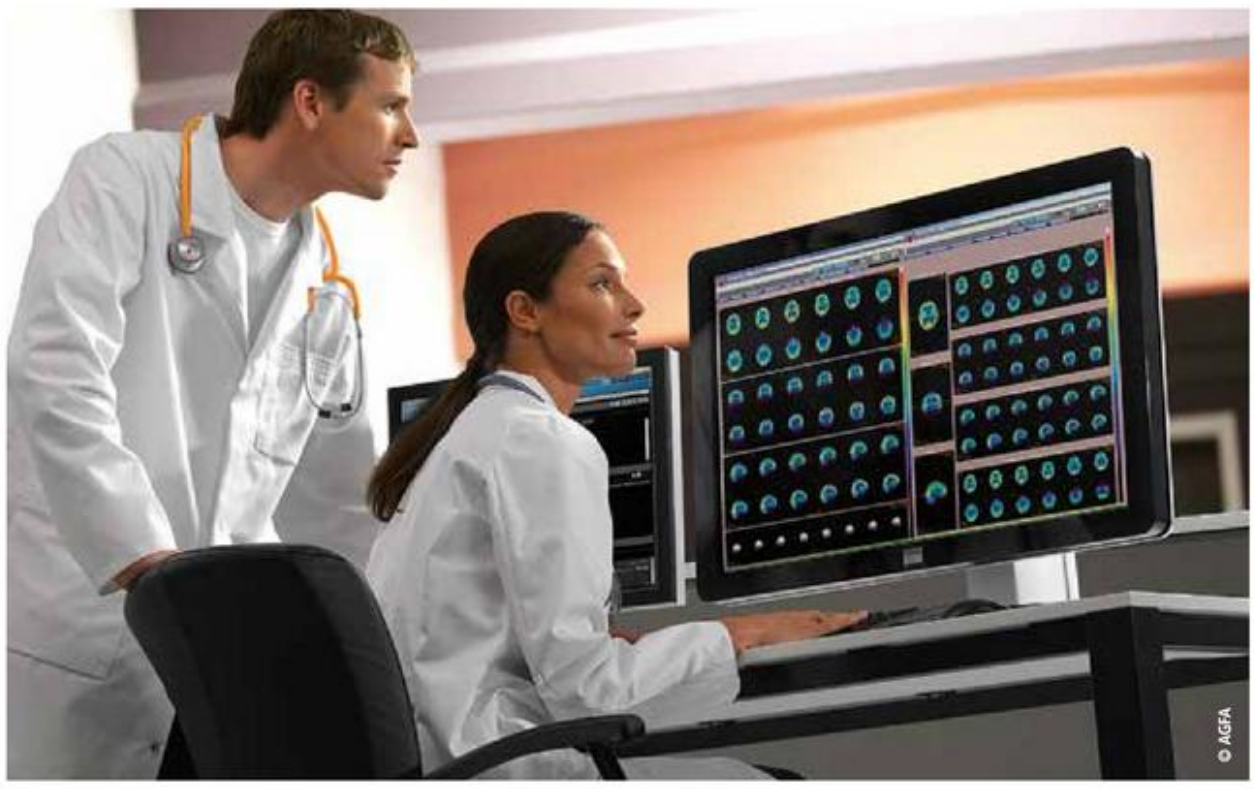
OncoRay's Scientific Coordinator Stefan Pieck, with at Carl Gustav Carus University Hospital Board Director Professor Michael Albrecht, and OncoRay spokesman Professor Michael Baumann, with the first gantry component fitted in the proton therapy facility

Looking into the lower area of the cyclotron, one can see which way the protons travel during acceleration in the four copper tubes

Imaging Clinical Information System

No image left behind

By creating a single interface with the patient medical record, Agfa HealthCare's ICIS can bring any type of image and linked meta-data into a patient's record to be viewed and retrieved



Interview: John Brosky

Integrated diagnosis, where multi-disciplinary teams focus on a single patient's care, can be an effective model for diagnosing illness and monitoring treatment. But it only works if every team member can access the same images at the right moment.

Using the patient medical record as the vehicle, and embedding a universal viewer called XERO inside that record, Agfa HealthCare's innovative Imaging Clinical Information System (ICIS) for the first time enables access. With sometimes surprising results.

During our interview, the President of Agfa HealthCare, Luc Thijs, explained ICIS and shared lessons learned from installations at reference centres in North America, Spain, Belgium, Russia and the United Kingdom.

This new Imaging Clinical Information System sounds as if your engineers named it. What is that and what does it do?

Luc Thijs: 'One of the biggest problems in healthcare today is bringing imaging information out of individual departments and into the mainline care process. We are solving this problem through the integration of images into electronic health record. It does not simply store images, which many others can do, but provides tools that capture meta-data and clinical information linked to those images – which very few can do. Departments outside of radiology or cardiology can now have a workflow to bring these medically relevant images into the patient record and share them with care givers.'

Are there really so many images relevant to clinicians?

'Point of care images are captured in many departments. In surgery there may be a C-arm taking X-ray images; there may be an endoscope capturing images; there may be ultrasound images. They do not make it to the patient record. Pathology is creating a lot of images, typically through a microscope. These biopsy samples and slides are stored, but the images? Where are they? There are medically relevant images in systems and devices stored in departments all over the hospital. We go into departments where we've never been before – into pneumonology, where we need to connect with endoscopes; into obstetrics and gynaecology, where there are a great deal of images being generated that have nothing to do with radiology.

Radiologists have been sharing images for years. Why is there a problem for other departments?

'Other departments don't always have the tools used in radiology, such as workflow, orders and accession numbers. With the Imaging Clinical Information System (ICIS) services platform we create an order and an accession number, capture meta data about that image and ensure the data and images themselves make it to the patient record. This becomes very important because healthcare systems not only need to store this data, they also want to retrieve it. For example, to review all images for a specific organ that has been treated in a certain way. The meta-data makes this possible.

The Cleveland Clinic is your flagship installation for ICIS. What have they learned there now that they are using the system?

'On top of all the clinical advantages discussed before, some things we've found out have little to do with the care process. Sometimes there are patients who come into the hospital who may already have a pressure wound. Having images of the patient on admission provides proof that they did not receive these wounds while being treated at your hospital. It can be a form of protection against a false charge that a patient got worse in your hospital. Is it part of a clinical care process? No. Does it save cost? Probably.

'Another example has to do with documentation. Depending on a country's reimbursement system, in certain cases if you can prove by means of an image that you performed an epidural to anaesthetise the patient, then you can receive reimbursement. Today no one does this; hospitals miss a reimbursement they earned. It is easy to take this image, and with ICIS it is easily registered, and potentially it generates revenue for the hospital.'

Finally clinicians will see everything, but do they need all this?

The time that **Luc Thijs** spent in Agfa HealthCare's Imaging Division helps to explain his passion for the firm's new ICIS system. He joined Agfa-Gevaert in 1990 and held several management roles, including Vice President of Growth Markets at Agfa HealthCare, which required him to manage the company's largest geographical area, covering Latin America, Africa and the Middle East, Asia-Pacific, Russia and the CIS states. In April 2011 he was appointed President of Agfa HealthCare and became a member of the Executive Committee of the Agfa Group.

'It always depends on the physician. In the case of integrated diagnostics, or tumour boards, a radiologist's diagnosis of a CT can benefit from a review of pathology images. This is also true in endoscopy. We'll see a trend of greater integration of diagnostics and a multi-disciplinary treatment of patients.

'What we find is that people in these departments are very excited to learn the images they create can now find their way into the patient file. And, referring physicians who send a patient to surgery, for example, can now follow this patient through images taken from the operation, through radiology images and perhaps, if there is a biopsy, he will also be able to look at pathology images together with the pathologist's report. Today this is simply not possible.

'ICIS is not just exciting for Agfa HealthCare but for hospitals. It can´t be done in a week. Hospitals want to move step-by-step because they do not know themselves, and are surprised to find how many sources of relevant images they do not find in the patient's medical record.'

Italian patients control their own diagnostic images and data

Carestream's new patient portal, MyVue, recently successfully completed its practice run in Europe at Italy's Delta Hospital in Lagosanto. European Hospital editor Brigitte Dinkloh asked Dr Giorgio Benea, Director of the hospital's Department of Diagnostic and Interventional Radiology, about staff and patients' reactions to the system

MyVue is the first portal to allow secure transmission of sensitive patient data in line with privacy regulations. After examination a patient does not need to return to hospital, but instead can await results and images at home.

Dr Giorgio Benea, radiologist at the Delta Hospital, explained that since MyVue was installed in early September last year, 455 patients have been involved and he has received direct patient feedback about the portal via a telephone survey, to which each patient is requested to respond about 20 days after admission. 'More than ninety percent of patients are very satisfied with MyVue and the reactions of doctors involved with the patient portal have also been extremely positive,' he confirmed.

Following medical and radiology studies in Ferrara, Italy, **Professor Giorgio Benea** MD worked as a registrar at the S. Anna Hospital, later heading its whole body CT and vascular and interventional radiology departments. Since 1995, he has directed the Department for Clinical, Radiological and Interventional Radiology for the Azienda USL Ferrara hospitals Argenta-Portomaggiore, Comacchio, Copparo, and Lagosanto.
A professor at the Medical and Surgical Faculty, University of Ferrara, Dr Benea is also an Italian Society of Medical Radiology (SIRM) for IT delegate.

Security encryption

'Patients who take part in the patient portal can not only view their images and read the results in any location with internet access, but also store them on their own computers and share them with whoever they wish – their physicians and specialists as well as family and friends – the data is owned by the patients,' he explained. The only important prerequisite is the safe transmission of the data to its owners without access by third parties. Carestream ensures this through its security encryption.

To use MyVue the patient is initially sent an e-mail with a temporary password that enables log-on to the portal. S/he then adds a personal password, which is only valid when combined with their personal e-mail address. If the patient wants to share his/her data with someone, s/he first sends the guest an invitation by e-mail. The guest can then log on to the system by activating a link and then view the chosen data. The owner of the images determines the length of time as well as the amount of data that s/he wants to make accessible to the guest.

Accessibility

The key benefit: Access to MyVue is possible via any browser and any type of device, be it iPad, laptop or PC. Thus the concept of a patient who can control his or her data anywhere in the world has become a reality.

The new portal not only helps to avoid repeat examinations but also provides an even bigger savings potential because neither CD nor DVD burning is necessary or hard copy printing. 'As the patient is in charge of the transmission of his images the workflow becomes more structured and effective and there's

IHE-Europe takes on the world in Istanbul

The movement for interoperability among health information devices and systems has spread across Europe reaching Turkey, which will be host to the European IHE Connectathon in Istanbul this April

Report: John Brosky

Launched 13 years ago with the first 'connectivity marathon' in France, Integrating the Healthcare Enterprise (IHE) has steadily gathered more nations and vendors in its drive across Europe to finally reach the eastern edge of the continent – Turkey.

The ambitions of the Brussels-based association IHE-Europe do not stop there. Delegations from the Middle East are expected at the 2013 event, aptly reinforcing the theme 'Connecting Where The Continents Meet.'

Reaching even further, IHE International is organising the first-ever World Summit for HIT interoperability to be held in parallel with the five-day Connectathon testing event in Istanbul. Over two days the summit offers three concurrent tracks aimed at specific levels of interest in IHE deployments from strategic planning for hospital executives to how-to sessions for IT engineers responsible for an implementation.

For the third year in a row the testing event, called Projectathon, will run concurrent to Connectathon to enable validation of cross-border patient data exchanges for the large-scale project, Smart Open Services for European Patients (epSOS). The IHE-based system came on-line in April 2012 and today counts 24 participating nations.

Both testing events are powered by IHE-Services, which was spun out of IHE-Europe to offer customised testing sessions and demonstrations for vendors and regional health networks.

Making available the suite of tools and simulators on the Gazelle platform that is the heart of this annual 'plug-fest' for HIT engineers is expected to accelerate the momentum toward interoperability.

The core testing activity among 300 software engineers at Connectathon shows how far IHE has grown beyond its roots in radiology to include technical frameworks and integration profiles for nine healthcare domains, including the laboratory, pharmacy and even ophthalmology.

Radiology continues to make up almost half of the tests performed at Connectathon. This year validation to the IHE Mammography integration profile will be a highlight in this large domain.

For the past two years the testing of cross-enterprise document sharing, which facilitates management of electronic health records, accounts for the greatest number of tests at Connectathon. Cross-enterprise Document Workflow (XDW) will be the hot area for testing activity this year.

less strain on staff and budgetary capacities in the imaging departments,' Dr Benea pointed out.

Although the professor cannot yet put the exact savings potential into figures, he is certain that the acquisition costs of hard- and software will have been amortised within a very short period.

The pros and cons of tablet-computers in radiology

Although not yet suitable for primary readings, tablet technology does offer potential for second opinions, sharing information with patients and clinicians, and seeking expert support, according to radiologist Dr Erik Ranschaert from the Jeroen Bosch Hospital, Den Bosch, The Netherlands

Radiologist **Dr Erik Ranschaert** is a staff member at the Jeroen Bosch Hospital, in Den Bosch, The Netherlands and member of the ECR ICT and e-Health subcommittee. When promoting teleradiology during a Special Focus Session at ECR 2012, he presented the findings of a survey conducted with the support of the European Society of Radiology, bringing fresh insight into the professionals' reactions towards teleradiology in Europe.

Report: Mark Nicholls

The ECR 2013 session 'Tablet computers in radiology – friend or foe?' will give speakers the opportunity to present the drawbacks and advantages of using this mobile technology in radiology. Among them, Dr Erik Ranschaert will appraise the use of tablet computers in mobile teleradiology and include aspects of the iPad in this area, looking at the evolution of mobile imaging, reasons behind tablet popularity – especially among medical professionals – and cover technical aspects, such as display, bandwidth, safety/ security and software/apps.

Dr Ranschaert emphasised: 'The main issue is that tablets are not suitable for primary readings. Although the screen quality is excellent, there are too many limiting factors: no standard DICOM calibration, limited screen size for complex examination, touch-screen only, no multitasking, limited functions of viewing software, usually no access to RIS work list and scrolling remains difficult.'

With the iPad remaining a consumer device rather than one designed for protecting sensitive patient data, issues of security and safety are also a concern, he warned, adding that hospitals need to adapt their safety policies to prevent data breaches and tablets remain vulnerable to loss or theft and patient information should never be stored on the device itself.

However, he recognises that tablet computers do have a role in radiology in general and particularly in mobile teleradiology, bringing better communication with clinicians, communication with patients and online expert consultations, but he warns they are not comparable to diagnostic screens and have no FDA approval for primary diagnosis. 'For preliminary readings, emergency readings and clinical review, iPads can be very useful to radiologists,' he believes. 'They might also improve communication between medical professionals – for instant consultation – or even between medicals and patients and facilitate expert consultations and second opinions.'

Another, very different kind of tablet in medicine: During ECR this year there will be an appraisal of the use of these flat, light, information technology tools in mobile teleradiology, and will include aspects of the iPad in this area

In terms of taking teleradiology forward they offer quicker communication and availability, emergency interpretations, though mostly for 'intra-institutional' rather than 'external' purposes.

Tablet advantages: More flexibility, less expense

He pointed out that new applications are emerging, including RadSnap, a free mobile app for cloud-based radiology that enables professional consultations for difficult cases sent via iPhone or iPad. 'This helps referring physicians and radiologists in areas of the world where they cannot afford expensive PACS software,' he pointed out.

For the radiologist, the tablet is convenient, versatile and offers enhanced flexibility both inside and outside the department, while patients can use tablets to view their own images in the hospital PACS or to seek a second opinion or specialist advice, and doctors can use tablets to explain the radiological findings.

Advantages to the hospital are that tablets are cheaper, and by facilitating quicker access to the images for both radiologists and clinicians, they help improve patient care.

Online commercial services are available where patients can upload their images for second opinions from an iPad, he said, helping them manage their own health process.

Dr Ranschaert suggests the next step for tablet computers in radiology/teleradiology is the increased power and speed of tablets, increased bandwidth for mobile viewing (greater availability of 4G network, higher bandwidths) increased resolution and even smaller pixels, automated calibration, HTML5 viewers for multi-platform compatibility and integration of IS and access to priors via PACS, cloud storage and server-side processing capabilities for image manipulation and 3-D volume rendering.

When it comes to radiology – is the tablet computer a friend or foe?

'Certainly a friend, if used correctly,' Dr Ranschaert qualified.

During the SF19 session 'Tablet-computers in radiology: friend or foe?' (11 March, 4-5.30 p.m.) other speakers will present a technical overview of tablet-computers, examine the device's radiological features and discuss reading DICOM images on the tablet.

Success for Totoku´s LED

Japanese vendor Totoku reports that more than 3,000 units of its new i2 series displays were delivered in the second half of 2012, with 'very positive user feedback'. Although a rather high-priced model, Totoku sold the largest quantity of the greyscale display MS53i2. 'With its extremely high resolution of 15 MP the monitor is optimised for use in mammogram diagnosis,' the manufacturer explains.

This is the first model with the new LED backlighting. The successor of the CCFL technology is based on semiconductors and known from a variety of consumer products. 'The benefits are both ecological as well as of a financial and qualitative nature,' according to Marcel Herrmann, Marketing Manager at Totoku Medical displays. 'Compared to CCFL monitors, LED displays, save up to 20% electricity and have about a 30% longer life span, affecting the user's budget positively. Furthermore, the CO2 emissions decrease due to reduced energy production. Specifically, the MS55i2 display will use 15% less power than its predecessor. At the same time it almost doubles the lifetime and disposal is also much more environmentally friendly because LEDs do not contain critical elements, such as mercury.'

Because the CCFL is mounted horizontally behind the display, the LED provides a significantly higher number of light sources, which can be controlled individually, resulting in much better uniformity, the firm adds. 'The contrast ratio also increases by a quarter to 1200:1. As usual, the new models also have a five-year warranty on the backlight,' says Marcel Herrmann.

The MS55i2 also supports Independent Subpixel Driving (ISD), raising the resolution by three, thus increasing detail and image quality.

All new i2 models offer the new display port interface, enabling connection not only with DVI signals or video cards but also the latest Display Port cards from various vendors, e.g. Matrox, ATI and NVIDIA. Display Port now offers true 10-bit greyscales on a colour display and true 11-bit for greyscale products.

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JiveX Mobile

Images and clinical data are on the move

Entering the world of apps with JiveX Mobile, Visus reports that it is offering image and clinical data based on HTML 5 and adds, 'The solution runs on all mobile platforms and integrates seamlessly with HIS systems designed for mobile devices.'

While the mobile PACS viewer is currently receiving the final touches, Visus developers are confident that the solution will be well received and will prove a success, since products that give clinicians more flexibility and facilitate communication in every-day clinical work are highly sought after. Both tablet PCs and smartphones are excellently suited as a mobile desk if – and only if – the required data are quickly available, consistent throughout the hospital network and comply with the strict data privacy rules in healthcare. 'A major challenge was the development of a platform-independent system that is compatible with all current operating systems,' explained Guido Bötticher, Vice President for Sales at Visus. 'Therefore we decided to use HTML 5 for the JiveX mobile viewer: it's a programming language that all infrastructures understand well. To meet the data privacy requirements the image data are not stored locally on the device but on a web server. Working with a central data pool moreover ensures that the users access identical and up-to-date data anytime and from anywhere.'

The real-life success of a mobile viewer depends on the handling of different kinds of image and clinical data such as ECG or ultrasound images, the company points out. 'Drawing on the Visus PACS II strategy with JiveX Integrated Imaging, the mobile version masters this challenge easily. For the Visus team it was particularly important that the mobile solution goes far beyond radiology and, with its tight links to the HIS, prepares the ground for mobile electronic patient records. The open and flexible platform design allowed the creation of a HIS provider-independent solution whose architecture accommodates even highly specialised medical software systems.'

Guido Bötticher: 'We wanted to create a mobile desk that offers pretty much the same benefits as a stationary desk: the user can access as many data as possible from one system.

'Therefore,' he added, 'we were eager to link our solution with other systems. The mobile version of JiveX – like all our products – is based on an open architecture that integrates easily, flexibly and neutrally in existing hospital and provider structures.'

DATES FOR YOUR DIARY

31 May 2013
Berlin, Germany
4th Annual Scientific Symposium: Ultrahigh Field Magnetic Resonance

13-15 June 2013
Marbella, Spain
ESSR - Annual Scientific Meeting 2013 European Society of Musculoskeletal Radiology

20-21 June 2013
Milan, Italy
ESER - Annual Scientific Meeting 2013 European Society of Emergency Radiology

27-29 June 2013
Dubrovnik, Croatia
OIC 2013 - Oncologic Imaging Course

19-22 September 2013
Frankfurt a.M., Germany
ESNR - 37th Annual Meeting of the European Society of Neuroradiology

11-12 October 2013
Rome, Italy
EUSOBI 2013 - Annual Scientific Meeting of the European Society of Breast Imaging

24-26 October 2013
London, UK
ESCR 2013 Annual Scientific Meeting

Fi ultra-light gital detector

l extremity X-rays

The Pixium Portable 2430 EZ, a new WiFi ultra-light flat-panel detector, provides unlimited flexibility thanks to its multi-share, auto-detection and image storage capacity, reports manufacturer Thales. The image and diagnosis quality, with very low dose based on cesium iodide X-ray detection technology, is outstanding, the firm adds. 'The versatility and autonomy of this portable and robust detector make it ideal for paediatric imaging and, for extremity X-rays, it's the optimal complement to the larger-format 3543 EZ launched last year.'

The device can be used in a new radiography room or on a mobile cart and, Thales points out, it could prove a good solution for a retrofit. 'It can be multi-shared in various configurations: several detectors in one room, or with one detector shared by several rooms. It offers total freedom due to automatic attachment by infrared and an auto-detection feature.'

The new device complements the Thales range of detectors that cover most radiological applications, which the firm adds, '...serve as benchmarks for the majority of equipment manufacturers throughout the world.'

Fujifilm's continuing glo

New business ventures, new systems – and those include 3-D mammography

Since the Japanese firm Fujifilm, which had held a premier position worldwide for brilliant, high-resolution photographs and films, was transformed into Fujifilm Holdings Corporation, a multinational concern with almost 82,000 employees worldwide, the firm has evolved to cover a large range of technologies, ensuring the expansion of the existing business as well as formation of new business areas, such as the production of medical devices, highly functional materials and further high-tech applications.

With three core business sectors, imaging solutions, information solutions and document solutions, the corporation has achieved a constant worldwide turnover of more than €20 billion annually over the last three years. With above average R&D investments of 7-8% of group turnover, the company aims for leadership in technology in many business areas, as well as for diversification into new sectors. Over the past few years, Fujifilm has indeed demonstrated its ability to change impressively.

Medical systems

Fujifilm is a pioneer in digital diagnostics and is expanding into prevention and treatment areas. The current diverse product range within the medical systems sector offers imaging systems for diagnostics, image archiving and communication systems (PACS), imaging plate systems, digital radiography, flat panel detectors, digital mammography, dry imager, X-ray systems, X-ray film, endoscopy systems and ultrasound. The erstwhile classic revenue driver X-ray film is becoming less and less important as the trend towards digitisation is irreversible and driven particularly by cost-conscious healthcare systems that need to achieve optimum cost savings, explains Jan Döhring, who is Marketing Co-ordinator of Medical Systems Europe.

Branching into digital radiography and IT, the firm's business model has also changed from consumer goods to a more project-based business. 'Essentially, we don't need salespeople as such, but rather consultants and specialists who are aware of customers' medical equipment, are familiar with the highly complex technology and able to install and maintain it. Success can no longer be measured immediately but develops over time. This adjustment is the turning point that the company currently has to master,' he explains. However, Fuji set the course for this development at an early stage: it had one of the first web-based archiving systems as a PACS and, with a complete line-up of panel sizes, Fuji is among the leaders in digital radiography worldwide. 'This is one of Fuji's core strategies: Wherever we were market leaders in CR; we also want to be in DR. Detectors development is progressing accordingly.'

Europe's north-south divide

In Europe, Fujifilm has the largest turnover and biggest market share in the large national economies of Germany, France, Great Britain, Italy and Spain and lately also Russia. From a technology and regulatory aspect, there is now homogenisation across Europe, but there continue to be big differences regarding radiation exposure and price. The highest prices can be gained in Scandinavia, although the country's required standards are also the highest, particularly regarding radiation protection.

'The further south you go, the bigger the price divide, although the standards required are also no longer so high. Things are more difficult in Denmark, Germany, Austria and Switzerland where high standards are required whilst prices are low,' explains Jörg Müller, DR Product Manager for Medical Systems Europe. 'However, with our systems developed for the global market, the flexibility is so high that we can generally meet these different requirements.'

Jan Döhring, European Marketing Coordinator for the Medical Systems Division at Fujifilm

Jörg Müller, DR Product Manager of Medical Systems Europe at Fujifilm

On the other hand, the European market is now in the lead in many areas, particularly in mammography. This increases opportunities for Europeans to impact on new technological developments that happen in Japan regarding the modalities and, in America, for the IT sector.

This is a positive side effect of the increasing share of Europe in the overall medical turnover of Fujifilm worldwide.

New for mammo: FDR Amulet Innovality

At the ECR in Vienna, Fujifilm is presenting FDR Amulet Innovality, the third generation of the proven, fully-integrated mammography system, an X-ray machine connected to a detector.

From the start, Fujifilm took the lead when it came to dose output and readout speed and was therefore predestined for screening. Over the last few years ergonomics and workflow have been further improved with the Amulet F and Amulet S systems. With the FDR Amulet Innovality the company is introducing a completely newly developed detector, which is also based on amorphous selenium (a-Se) but has a completely different structure compared to all other detectors available. 'We have a honeycomb structure that facilitates different readout procedures. This gives us variable resolution and allows us to read mammograms more efficiently for the normal range, the 3-D range and now also for tomosynthesis,' Jörg Müller points out.

The key is totally new geometry for the 24x30cm detector. Radiation absorption is improved significantly by the new geometry and effectiveness is increased by 20% compared to the previous model, the firm reports. The detector's structure was also optimised so that noise was reduced and the signal was much clearer, further optimising the dose and display of details. 'Our new detector currently has the highest detail display and the largest modulation transfer frequency available

The new FDR Amulet Innovality supports all known volumentric methods within one device with increased sharpness, reduced dose and improved patient comfort

bal presence

Nayhmeh Eskyhi, resident in Maria Hilf's Interventional and Diagnostic Radiology Department

Christoph Müller-Leisse, Director of the Interventional and Diagnostic Radiology Department at Maria Hilf

Dr Mechthild Schulze-Hagen, collaborating gynaecology and obstetrics specialist

on the market. This means that the finest details can be sharply displayed without being affected by noise, and users can adapt an examination flexibly to each individual patient,' he explains with enthusiasm.

In addition to the new system's tomosynthesis performance the first studies in 3-D mammography in various countries have shown an up to 40% reduction in false positive results with a dose requirement comparable to that of 2-D mammography. Obviously this also cuts down the number of unnecessary biopsies, lowering patient worries.

'FDR Amulet Innovality is currently the most sensitive system available and has 20% lower dose requirement for 2-D images,' Jörg Müller confirms, 'and ten percent lower dose requirement for the tomosynthesis application compared to the previous systems.'

Fuji's 3-D mammography in practice

Maria Hilf GmbH operates two hospitals – Maria Hilf and St. Franziskus – in Mönchengladbach, north-west Germany. The healthcare company's history dates back to the 1850s, when two Catholic nuns arrived in the city from the Netherlands to care for orphans and sick people. During 150 years, the hospital grew to become an organisation in the maximum care category, partly owned by the community and highly renowned for its commitment to high quality of care and holistic orientation towards patients. Advanced technology, such as Amulet 3-D, helps support this mission. European Hospital reporters asked the hospital's leading physicians about their hospitals and experiences when working with Fuji's 3-D mammography system.

'With its 800 patient beds, Maria Hilf ranks among the major care providers in the region,' explained Professor Christoph Müller-Leisse MD. 'We support rather rare disciplines, such as pulmonology and thoracic surgery, and have dedicated centres for continence and neurourology. Our radio-oncology department is outstanding in North Rhine-Westphalia. We have a large neurology department, with a service offering that includes, e.g., thrombus extractions. For cases such as acute strokes we cooperate with specialists in the field. We have general surgery, emergency surgery, and trauma departments.

'In addition, we carry out a large number of interventions, many of them image guided with the support of CT. Quite a number of cases are referred to us from a visceral practice with which we collaborate. Percutaneous interventions are part of our portfolio. Interventional radiology is a focus of Maria Hilf.'

What about working with the 3-D mammography equipment?

'Based on her work with the Amulet 3D from Fuji, Dr Mechthild Schulze-Hagen and I are currently carrying out an ROC – Receiver Operating Characteristic – analysis comparing 3-D to 2-D … something that hasn't been done yet. ROCs are diagnostic confidence rankings associated with the diagnostic categories of BI-RADS – the Breast Imaging-Reporting and Data System devised by the American College of Radiology. In this context, this new approach will compare 2-D and 3-D mammography regarding, for example, scar detection, which is not part of the ACR approach, as well as micro-calcifications.

'Each year, I read about 12,000 mammographies with a screening background. In addition, we have worked on 500 patient cases from a curative, non-screening background, using Fuji's Amulet 3-D since May 2012, and we detected 11 carcinomas. We analysed this non-screening group of patients, and have been able to demonstrate that there are a number of significant benefits of 3-D over 2-D. Carcinomas that form along lactation ducts are an illustration in point. These carcinomas manifest themselves through calcifications that are hard to discern in 2-D. Calcifications formed alongside ducts are relevant indicators for malignity.

Are there additional benefits from Amulet 3-D mammography?

Dr Schulze-Hagen: 'The technology helps reduce false positive, but also false negative diagnoses. I'll explain on the basis of oil cysts: these cysts, which have no pathogenic relevance, lead to calcifications over the long term. In 2-D there is sometimes no way of telling apart emerging oil cysts from carcinomas that form in scarred regions. In 3-D, physicians can differentiate cysts on the surface from carcinomas that are growing into surrounding tissue. And for breasts that have had surgery, 3-D also has significant advantages; in these cases, duct structures may be interwoven and highly complex, producing unclear results in ultrasound. MRI may be an option; but 3-D mammography can help resolve suspected recurrences conveniently.

How does this mammography compare with tomosynthesis?

Dr Nayhmeh Eskyhi: 'In 3-D mammography, the summation effect of 2-D images is resolved in 3-D, which makes dense tissue more transparent. 3-D serves for routine initial image acquisition. For subsequent diagnostic steps, or in follow-ups tomosynthesis is used for precise measurements. We should keep in mind that tomosynthesis comes with an exposure which is significantly higher compared with the dose from Amulet 3-D.'

ECR at a glance

The European Congress of Radiology organisers want to strengthen interactivity with the audience, so is offering many chances for direct communication between attendees and the speakers as well as even longer discussions

The second innovation in 2013 is that 'multidisciplinary' activity will be even more in focus than in former congresses.

Here we present a brief overview relating to sessions that provide much in this way, particularly the three in the **Managing patients with cancer** group, which emphasize the increasing importance of multidisciplinary cooperation in cancer diagnosis and treatment. Sharing their expertise, radiologists, surgeons, hepatologists and oncologists lead the sessions, selecting colorectal liver metastases, hepatocellular and cholangiocarcinoma as central themes:

Thursday, 7 March, 16:00–17:30, Entrance Level, Room E2
MS 3: Colorectal liver metastases
Session Objectives:
1. To learn about the prognostic factors of colorectal liver metastases.
2. To become familiar with the most common therapeutic strategies.
3. To understand the role of the multidisciplinary team in patients with colorectal liver metastases.

Friday, 8 March, 08:30–10:00, Entrance Level, Room F1
MS 4: Hepatocellular carcinoma
Session Objectives:
1. To learn the current management of HCC as laid out in scientific guidelines.
2. To identify those areas of uncertainty, where multidisciplinary teams are needed most.
3. To understand the basis of personalised care for HCC patients and the need for multidisciplinary teams.

Saturday, 9 March, 16:00–17:30, Entrance Level, Room E2
MS 11: Cholangiocarcinoma
Session Objectives:
1. To learn about state-of-the-art diagnosis of cholangiocarcinoma.
2. To understand the value of surgical and systemic strategies in therapy.
3. To appreciate image-guided interventional treatment.

Last year the mini-courses 'The Beauty of Basic Knowledge' were successfully introduced. Their number has doubled in 2013.

These events will cover themes in the field of head-and-neck radiology as well as musculoskeletal radiology.

Thursday, 7 March, 12:30–13:30, first Level
MC 25A: Musculoskeletal Imaging: Trauma. Room P
MC 24A: Head and Neck: A taste of the oral cavity and salivary glands. Room N/O

Friday, 8 March, 12:30–13:30, first Level
MC 25B Musculoskeletal Imaging: Degenerative disorders. Room P
MC 24B Head and Neck: Main pipelines of the neck: pharynx and larynx. Room Q

Saturday, 9 March, 16:00–17:30, First Level
MC 25C: Musculoskeletal Imaging: Inflammatory/infectious disorders
MC 24C: Head and Neck: Main pipelines of the neck: pharynx and larynx. Room N/O

Sunday, 10 March, 12:30–13:30, first Level
MC 25D: Musculoskeletal Imaging: Neoplastic/nonneoplastic lesions. Room P
MC 24D: Head and Neck: The suprahyoid neck: anatomy and diagnostic algorithm of the neck mass. Room Q

Monday, 11 March, 12:30–13:30, first Level
MC 25E: Musculoskeletal Imaging: Metabolic/endocrine disease. Room
MC 24 E: Head and Neck: Temporal bone: so beautiful, yet so complicated. Room N/O

Also worth mentioning is the Foundation course 'Neuroimaging'. According to its theme 'All you need to know about neuroimaging in 18 easy lessons', this will answer most questions:

Friday, 8 March, 08:30–10:00, Entrance Level, Room E2
08:30 – 10:00 The orbit, the petrous bone and the sella.
10:30 – 12:00 Paediatric
14:00 – 15:30 Trauma and vascularity
16:00 – 17:30 Infection and inflammation

Saturday, 9 March, 16:00–17:30, Entrance Level, Room E2
08:30 – 10:00 Metabolic and neurodegenerative disorders
10:30 – 12:00 Tumours and phacomatosis

The scientific highlights of ECR at least will be the categorical courses, 'Never without Arteries', 'Urogenital Imaging' and 'Oncologic Imaging', all providing participants with the latest results and innovative techniques in the related areas.

The importance and exciting potential of cardiac imaging might be seen separately. One of the last sessions at ECR 2013, but surely one the highlights is the following:

Monday,11 March, 14:00 – 15:30, Lower Level, Room D1
SS 1803 Cardiac imaging: Into the future

allenges ion

ing, but lab professionals point out that aspects of teaching, training, research, development and innovation also need a funding stream.

Under the new model of reimbursement, Dr Thomas fears the possible disconnection in pathology service provision between primary and secondary care may be an issue where financial stringencies result in poorer quality care and the risk of duplication as patients move across the two divisions. 'It remains unclear,' he said, 'how the new commissioning landscape will impact on the costing and reimbursement of pathology investigations. 'There may also be a possible lack of resources for innovative developments as the business of pathology becomes more focused on financial profit for shareholders and partner organisations.'

Dr Thomas said hospital managers must be persuaded to perceive pathology –which accounts for up to 70% of diagnoses made – as bringing a cost benefit to the overall process of patient care, rather than 'an expensive extra' and with the move to outcome measures it should be possible 'to demonstrate the impact that pathology has on the patient pathway.'

Part of the change will see pathology labs challenged to be more innovative: for some, Dr Thomas pointed out, this will be about reconfiguring services into more effective units where larger bulk provision may provide cost benefits; whilst for others it will be about the introduction of new procedures to diagnose and monitor disease and its response to therapies.

While key areas of innovation remain in genetics and genomics, especially with the cost of whole genome sequencing falling to affordable levels, Dr Thomas said there are other innovation areas in the ways services provision can be delivered, such as outreach opportunities or biomarker developments. He added: 'The impact of phenotypic expression influenced by environment must not be overlooked and hence the use of innovative proteomic biomarkers must remain an important focus of innovation.' He cited the use of BNP and Calprotectin as examples of biomarkers that can impact on both quality and cost in the patient pathway, but it remained largely for pathology to demonstrate the cost benefits of such biomarkers. Much of the traditional assay and technological development is now within the province of commercial diagnostics companies; however, he said there is evidence that innovation is still happening in the NHS.

Dr Mike Thomas is Clinical Director of Inflammation and Infection Services and Head of Clinical Biochemistry for the Royal Free London NHS Foundation Trust and President of the Association for Clinical Biochemistry

ology

South African born **Dr Liron Pantanowitz**, a pathologist at the University of Pittsburgh Medical Center in McKeesport, Pennsylvania, has written more than 200 publications on all aspects of pathology. He presented his ideas on digital pathology and how it can shape medical diagnosis and treatment as keynote speaker at the Cambridge Healthtech Institute conference held in San Francisco in February this year.

nite amounts of time. The pixel shows more information than the eye, and the computer can pull the whole picture together.

POC testing technology

Julian Baines, Group CEO of EKF Diagnostics Holdings plc, considers the present role of point-of-care tests and their potential value to health services

By its very nature, Point of Care Testing (POCT) technology does not strictly sit within the hospital sector. Rather, the rationale behind POCT is to keep the patient out of the hospital system and within the primary care setting. This is because lying at the heart of the concept of POCT is the principle that medical tests are convenient and immediate to the patient. Consequently, in countries that have fully embraced POCT, patients can visit a general practitioner (GP) or a nurse to provide a tiny blood sample and undertake a test for haemoglobin levels, lipids, glycated haemoglobin (HbA1c), CRP, to name but a few, and receive a lab-accurate result before leaving the surgery.

By putting resources into POCT, governments can free up funds and resources that can then be invested in other critical hospital services. Therefore, rather than resist the inevitable drift towards POCT, hospitals should embrace technology that is focused on providing a better patient experience and reduces the total cost of basic patient care by enabling clinical decisions to be made at the earliest opportunity.

Currently, the barriers to the wider use of POCT are not so much technological, providing products are designed and manufactured with quality and ease of use at the forefront to rapidly deliver accurate results, but those of politics and acceptance.

Using the United Kingdom as an example, the National Health Service (NHS) is a political hot potato and any change is deemed to be negative or, in the case of the current government, an attempt to privatise. This is an extreme point of view because POCT has the potential to save the NHS vast sums of money through earlier diagnosis and treatment, or even the reduction of unnecessary treatment. However, when the former Minister of Health, Andrew Lansley, tried to tweak the system to allow more POCT he was criticised. The UK has a highly structured and complex central laboratory system and making changes will not be easy due to the highly politicised nature of the NHS. It is a similar story in France, although there is a move there to radically reduce the number of central laboratories that might, in turn, make the French health authorities more open to the POCT concept.

Julian Baines has extensive experience and understanding of the global diagnostics and POCT market stems from his decade as Group CEO of British Biocell International (BBI), where he was responsible for selling the business to Alere Inc in 2008. He is still a BBI Board Member, as a non-executive director. In December 2009 he was appointed CEO of EKF Diagnostics Holdings plc and completed the acquisitions of Quotient Diagnostics, Argutus Medical and Stanbio Laboratory. EKF Diagnostics, he points out, is now one of the world's fastest growing diagnostic businesses.

Not surprisingly, there are varying degrees of POCT acceptance between countries and continents. In countries such as the USA and Germany, where health insurance pays for treatment, POCT is embraced because of the cost efficiencies it offers. In emerging markets the opportunity is even greater, as they do not have a pre-established dependence on central laboratory testing and therefore are often early adopters of diagnostic innovation that improves patient care. Without doubt, emerging markets are catching up with the western world regarding patient care, and the effective use of POCT is a key contributor to this.

Another key driver stimulating the growth in POCT uptake in emerging markets, such as Asia, is an increasing per capita GDP with subsequent escalation in incidence of western diseases, for instance diabetes. This has been evidenced by growing demand in these regions for our

Diabetes detection and management: Then Quo-Lab POCT analyser measures glycated haemoglobin (HbA1c)

Quo-Test and Quo-Lab analysers for easy and reliable measurement of glycated haemoglobin (HbA1c), which is used to detect and manage diabetes.

The on-going world economic downturn should further influence the greater adoption of POCT within countries not currently widely using such technology. This is because POCT offers excellent patient care and monitoring at a significantly lower cost to traditional laboratory and hospital based care. In times of austerity POCT offers an avenue for reducing the financial burden on health services.

That said, POCT is not without limitations. No GP would use POCT exclusively where a second opinion from hospital consultants and experienced biomedical scientists are critical, for example in oncology or HIV. However, POCT can play a key role in identifying early onset of conditions, such as diabetes and anaemia, which can then be investigated by further testing at a central laboratory.

DNA s tackles

'This is a dramatic demonstration that medi the future – it is a technology of the here a

Researchers have used genome sequencing to control an MRSA outbreak in a British hospital, and scientists from the University of Cambridge, the Wellcome Trust Sanger Institute and Cambridge University Hospitals believe the breakthrough could impact significantly on the way hospitals tackle the commonly termed 'superbug' threat in the future.

The team used advanced DNA sequencing technologies to confirm the presence of an on-going outbreak of methicillin-resistant Staphylococcus aureus (MRSA) in real time in a Special Care Baby Unit. By cracking the bacterium's genetic code, they were able to end the outbreak at the Rosie Hospital in Cambridge – and devise a new weapon in the continuing MRSA problem.

Identifying the carrier

Hospital staff became concerned after MRSA was detected in 12 babies during routine screening, but current tests could not tell if this represented a single on-going outbreak within the unit or whether these were unrelated cases.

The research team stepped in and, by comparing MRSA isolates from those 12 patients using DNA sequencing technology, they showed the pathogens were all closely related and part of the same outbreak.

The ward was deep cleaned, but when another MRSA positive infant was detected after an MRSA-free gap of two months, the team used advanced DNA sequencing to show in real time that this strain was

Digita

The scandal shocked the German healthcare sector in 2012 – and investigations continue. Physicians had apparently tampered with patient data and manipulated candidate shortlists for organ transplants. Criminal manipulation of laboratory results appears to have played a key role in the cases – it was alleged that results were wilfully re-attributed, pushing less needy patients up the list for a new organ.

For Professor Joachim Thiery, President of the DGKL (German Society for Clinical Chemistry) and head of the Institute of Laboratory Medicine, Clinical Chemistry and Molecular Diagnostics (ILM) at the Leipzig University Hospital, the route to be taken is obvious: At the 2012 annual DGKL congress he called for high-tech protection of digital lab results.

Background

There used to be strict separation between electronic medical records

equencing s MRSA outbreak

ical genomics is no longer a technology of nd now' Report: Mark Nicholls

also part of the outbreak, despite the lack of apparent links between this case and previous patients. The finding presented the possibility that a member of staff was carrying the MRSA strain.

Tests on 154 members of staff showed that one person was also carrying MRSA, which may have been the source for at least some babies in the unit. The healthcare worker was treated to eradicate the MRSA presence and thus remove the risk of further spread.

Essential distinguishing between the strains

This is believed to be the first time rapid genetic testing has been used to track and stop an outbreak, but the technique could soon become a regular way of stopping MRSA.

Professor Sharon Peacock from the University of Cambridge, said that current bacterial typing techniques lacked sufficient discrimination to distinguish between strains of MRSA that are most often isolated in hospitals. 'In the event that two patients are either carrying or infected with a strain such as EMRSA-15 – the most common clone in the UK – it isn't possible to distinguish with any confidence whether there has been a transmission event from one patient to another, or whether both patients acquired their MRSA through independent acquisition events. So, a driver for evaluating whole genome sequencing of MRSA was to see whether this provided enough discrimination to tell apart strains of the same lineage.'

Professor Sharon Peacock is Professor of Clinical Microbiology in the Department of Medicine at the University of Cambridge and an honorary consultant with Cambridge University Hospitals NHS Trust and for the Health Protection Agency. Her research focuses on the role of sequencing technologies in diagnostic microbiology and public health.

This was achieved by undertaking whole genome sequencing using a rapid high throughput bench-top sequencer, but the investigations took a decisive turn and became a real-time prospective study as the outbreak unfolded at the Rosie Hospital.

'What we also wanted to achieve was to start the process of translating the technology from being a research tool where timing does not matter, to a real-time clinical tool – so we were using machines that could be used in the future in clinical practice,' she explained, adding that the next step is to devise simple-to-use automated interpretation tools that will enable hospitals to analyse complicated sequence data.

'Our study indicates the considerable potential of sequencing for the rapid identification of MRSA outbreaks. If we have a robust system of this type available for routine use in the future,' Prof. Peacock pointed out, 'we could use it to investigate putative outbreaks at their outset and, if confirmed, put in place infection control measures that bring them to a rapid close.'

The team is also building a database of MRSA genomes with 2,000 already collected from across the UK, which will provide an essential genetic framework with which to compare and interpret MRSA genomes in the future.

Cleaning remains essential

The researchers are currently studying all MRSA carriers and infected patients over the next year from a number of East of England hospitals and the community to understand transmission events with the aim of improving infection control management.

'In the future, sequencing will be used for infection control surveillance and outbreak investigation because it adds considerable value to the existing methods of infection control, and could act as an early warning system,' Prof. Peacock predicted. She also stressed that conventional methods of combating MRSA, such as hand-washing, hospital cleaning and care of intravenous lines, remain essential for the on-going prevention of MRSA bloodstream infections, but the introduction of technology to crack the MRSA genetic code will add an extra weapon in the fight against the pathogen.

Sir Mark Walport, Director of the Wellcome Trust, said: 'This is a dramatic demonstration that medical genomics is no longer a technology of the future – it is a technology of the here and now. By collaborating with NHS doctors, geneticists have shown that sequencing can have extremely important applications in healthcare today, halting an outbreak of a potentially deadly disease.'

The Genspeed MRSA Test System by Greiner Bio-One is a comparatively inexpensive solution that is already available on the market.

MRSA outbreaks cost a fortune

A new test gives reliable results in just 75 minutes, speeding up combat actions

Since Methicillin-resistant *Staphylococcus aureus* (MRSA) has developed resistance to antibiotic treatments, infections have become a dreaded occurrence in hospitals worldwide. According to one report*, an MRSA infection results in additional costs of €1,600 euros a day and hospital stays can be extended by seven days, pushing total costs to between €5,000-10,000.

Developed by Greiner Bio-One with Amplex Diagnostics (Germany), the *Genspeed* MRSA Test is a DNA-based in-vitro diagnostic tool for qualitative detection of MRSA from human nasal and throat swabs. The system's main advantage is speed combined with reliable results, the manufacturer reports. 'The result is available only 75 minutes after sampling. In addition to low-throughput applications, Genspeed MRSA can also be used in facilities that analyse large numbers of tests. In this case, Genspeed MRSA serves as a fast and reliable tool for night and weekend shifts, when only part of the staff is present.'

The system consists of the Test Kit, a PCR cycler, the Genspeed Reader and the software, which is pre-installed on a laptop.

'In addition to speed, the test system also scores points for its high sensitivity, allowing the complete detection of the main mechanisms of resistance as well as the new resistance gene *mec*C (previously called $mecA_{LGA251}$),' the maker reports. 'Analyses of individual samples are possible at any time. Three controls (for DNA amplification, hybridisation, as well as a negative control) on the Test Chip offer greater reliability.

'Due to its compactness and relatively ease of use, there are no costs for maintenance and support. Particular emphasis was placed on simple and functional design of the software. The individual analytical steps are well structured and intuitive. Pre-filled and ready-to-use supply of the reagents reduces the number of process steps to a minimum,' and, the firm adds: 'The system can be quickly adapted to different diagnostic applications without much effort.'

* HTA Report 100, DIMDI, medical efficacy and cost-effectiveness of preventive and control measures against MRSA infections in hospital

Electronic signatures are a necessity against fraud

al Lab results

(EMRs) or hospital information systems (HIS) used in wards and information management practiced in labs, Professor Thiery pointed out. Significant advances have evolved regarding the technology, and '...we are now close to achieving widespread penetration with EMRs in the hospital sector,' he said, adding, 'This progress comes with major challenges to – and potentials for – laboratory medicine.'

Among those challenges is integrating data from physicians and nurses as well as lab results at a very early stage, and in making that data pool readily available to anybody involved in a case.

If patient data is available at the time when lab tests are ordered, lab physicians can base their analysis on the patient's history and therefore provide a more precise and targeted evaluation. 'Lab information systems (LIS) and HIS solutions now communicate with one another very well' he said.

DGKL President Joachim Thiery insisting that electronic signatures are necessary to combat any tampering with lab results (Photograph: MR)

Protecting results from manipulation

'Now, what we learn from those fraudulent cases is that we can no longer simply and conveniently proceed by feeding values derived from a lab analysis directly into some HIS or EMR. The identity and authenticity of this type of data are at risk of manipulation.' Thus, he adds, lab results – whether abnormal or normal – need to be turned into fixed electronic objects, or documents '... and they require a format, such as PDF, and an electronic signature of top safety level to be attached to them'.

The lab information typically includes reference values and recommendations in an accompanying letter. At the University Hospital Leipzig, lab results are turned into documents and automatically sent into the respective patient's EMR.

Use electronic signatures

When mere values, or figures, are fed into systems, they are beyond the control of the lab physician. The professor's final message: 'We learned the hard way that this definitely must stop. Electronic signatures are readily available, and they've been shown to work properly in everyday routine. Let's start using them – now.'

The Berlin Diagnostica Forum

Scepticism increases among German in vitro diagnostics firms

The 2013 turnover expected by German in vitro diagnostics producers are significantly lower compared to last year, according to a survey of members carried out by the German Diagnostics Industry Association (VDGH) presented in January at the Diagnostica Forum in Berlin. Whilst more than half of those surveyed expected improvements in 2012 only about a third forecast this for 2013.

Report: Bettina Döbereiner

Carried out in December 2012, the survey showed only 35.4% of members believe their economic situation will improve. At first glance this may look optimistic, says Dr Martin Walger, Managing Director of the German Diagnostics Industry Association. It is in fact thought provoking, considering that 56% of members expected a positive development for their company when surveyed the previous year. The number of those expecting stagnation accordingly rose to more than half. However, only 10% of those surveyed are predicting deterioration of their situation, and this figure is only marginally higher than the prognosis for 2012.

There are unlikely to be any effects on investment planning and expenditure on research and development, based on the information provided by the 48 in-vitro diagnostics companies surveyed by the association in December 2012 – to the contrary, the previous year's values are even being exceeded – only the dynamics regarding the size of the workforce are expected to slow down. With around 10%, slightly more companies declared their intention to reduce their workforce than did so the previous year. Vice versa, at around 50%, slightly fewer companies announced that they would increase their workforce.

Asked about the greatest obstacles against development, almost half of all companies cited high cost pressure in the German market. In second place was consolidation and concentration on the customer side, followed by the reimbursement levels set out in the German statutory health insurers' fee schedules, which companies consider to be too low.

Member companies also complained about cuts to reimbursements for medical laboratory services and about the drawn-out procedures for innovations before they receive approval and acceptance in terms of the range of services covered by the Germany statutory health insurers.

Test approvals are too slow

This last point in particular was criticised by Dr Karl-Heinz Büscher, Member of the VDGH Board and Head of the Central Lab Marketing Automation Department at Siemens Healthcare Diagnostics, who said, 'The acceptance of new laboratory tests into statutory medical care in Germany takes far too long and has almost come to a standstill in the last few years.' Since 2009, he added, out of thirteen suggested laboratory innovations, only one test has been approved for acceptance into the fee schedules that determine the level of reimbursement for medical costs by the statutory health insurers in Germany – nine other tests are still under discussion.

This situation, he said, is unacceptable in the long run, and he called for the introduction of faster assessment procedures for innovations in the future.

Top: Karl-Heinz Büscher (right) and Manfred Partsch. Below, from left: Ulrich Orlowski, Joachim Thiery, Martin Walger

The German diagnostics industry has positive expectations regarding the planned new legislation on the early detection of colon and cervical cancer, which has already been negotiated in the Federal Parliament. This new law envisages an official invitation to screening examinations sent by health insurers to all their members. However, the so-called Law on the Early Diagnosis and Register of Cancer (KFRG) will not come into force for another three years to allow for an implementation period, as Dr Ulrich Orlowski of the Federal Ministry of Health explained at the forum. Therefore, diagnostics industry representatives do not expect a related boom in business much before 2016. More than 50% of companies surveyed also considered personalised medicine to be a very promising area, although currently more than half of those surveyed are convinced that personalised medicine does not have any relevance for their companies.

Having discussed the outlook for 2013, the forum considered the 2012 business year. Based on the first three quarters sales statistics, the German market showed negative growth in in-vitro diagnostics of 1.5%. 'We have a twofold picture here,' explained Dr Martin Walger. Laboratory diagnostics had an upward trend of just under 3%, but there was an almost 8% decrease for the fast tests sector. He believes the reason for this decrease to be the large drop in tests for self-monitoring of blood glucose. 'The health insurers have stopped reimbursing self-tests for blood glucose monitoring for Type 2 diabetics who are not insulin dependent,' he said, and the budget for the test strips generally has been tightened a lot by the health insurers and the Association of Statutory Health Insurers.

Market crash effects

With this negative balance, Germany is in line with the European trend, as a look at growth in Europe is also sobering, Dr Walger said. Only three of the larger European markets (Belgium, Switzerland and Great Britain) still show positive growth based on preliminary sales statistics – in 2011, however, all eight larger European markets still showed positive growth. 'The crash in the Southern European markets, which already loomed in 2011, is dramatic,' he said. Greece is in first place with a minus of 10.7%, followed by Portugal with a minus of 9%. Italy, which in 2011 still had a turnover of €1.7 billion, putting it in third place behind Germany and France within the European market, has a negative growth of 3.6% based on preliminary figures. The EU-wide growth rate of almost 1% seen in 2011 is unlikely to have been achieved in 2012, Dr Walger pointed out.

Professor Joachim Thiery MD, President of the German Joint Association for Clinical Chemistry and Laboratory Medicine and Director of the Institute for Laboratory Medicine, Clinical Chemistry and Molecular Diagnostics (ILM) at the Leipzig University Hospital, looked at the future of diagnostic procedures. The automation and networking of analytical processes, in the shape of highly standardised methods, has almost been achieved in Germany. Around 80% of diagnostics is now being performed by so-called high-throughput platforms, which have continued to revolutionise laboratory diagnostics worldwide since the 1950s. But, the professor said, 'We are going through a saturation phase regarding automation.' Instead, new approaches, such as metabolism and protein analysis will become much more important in the future.

Re-agent-free instruments, such as mass spectrometry, are increasingly used in the context of multi-parameter analysis, Prof. Thiery said, and sees this sector's future in the development of systems medicine laboratory diagnostics that takes into account the increasing density of information and which further develops laboratory-focused bioinformatics. Even if, he added, medical demand is not quite keeping up with existing technological developments, such as seen in metabolic and protein analysis, sooner or later it will become an important growth area for diagnostics companies. ■

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