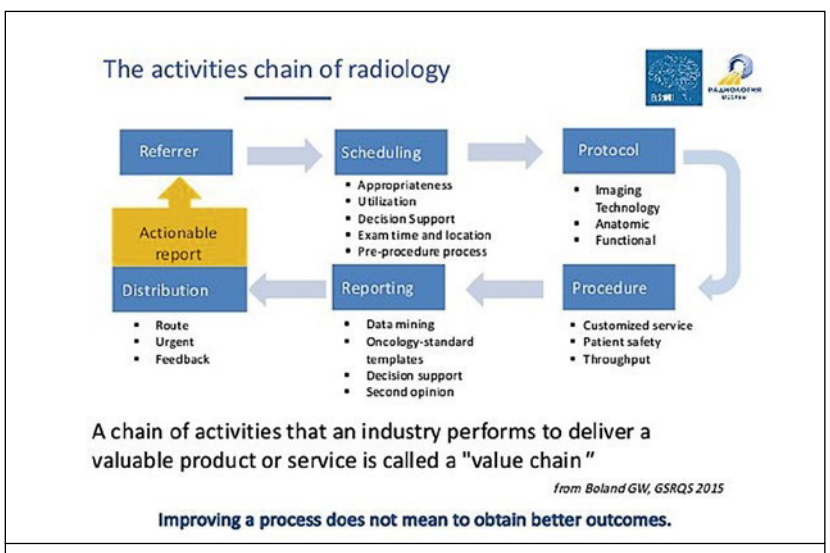
VOL 26 ISSUE 5/17 •Oktober/November 2017

EUROPEAN HOSPITAL

THE EUROPEAN FORUM FOR THOSE IN THE BUSINESS OF MAKING HEALTHCARE WORK

We have impact on value!

The movement to Value-Based Healthcare gives no value to diagnostic processes, including Radiology. ESR aims to establish a more holistic approach to help Europe's single-payer systems shift to a new economic model. John Brosky reports



A chain of activities that an industry performs to deliver a valuable product or service is called a "value chain"

from Boland GW, GSRQS 2015

Improving a process does not mean to obtain better outcomes.

The organisers behind Value-Based Healthcare (VBH) are gaining ground in an effort to transition public and private payers toward value-based reimbursement.

To date, the International Consortium for Health Outcomes Measurement (ICHOM) has published 21 sets of standards covering almost half of what it defines as the global disease burden.

Some European health care groups have experimented with this approach with mixed results, notably the Karolinska University Hospital in Sweden.

VBH started in the United States as a response to ineffective models introduced by payers to manage costs of healthcare services, such as fee-for-service or capitated payment approaches.

Incredibly, VBH does not include diagnostic processes, focusing instead on therapeutic outcomes. Value is defined by treatment without considering the multi-disciplinary evaluation of the patient that in the first instance determines the patient's pathway for care.

'It's still early days,' said Professor Lorenzo Derchi, who is chair of the Value-Based Imaging Working Group of the European Society of Radiology (ESR) and the ESR's First Vice-President. 'Value-Based Healthcare is an economic approach that is interesting, but not the only possible approach. The initiators of this movement come from the Harvard School of Economics, not the medical school,' he told European Hospital during our recent interview. 'It does not consider the whole spectrum of care, a holistic approach to the patient. With this model, radiology is not considered for its role in providing guidance for the therapy, nor for following up the treatment to fine-tune and adapt that treatment.

'Radiology adds impact, more than what is being called value, which is only a calculation of outcome versus cost.

'It's not easy to value the impact of diagnosis,' he pointed out. 'It becomes easier for calculations if the diagnosis is taken for granted. It's not clear if ICHOM did not consider diagnostics, or if they considered it but found it too difficult to measure as a value.'

In September the ESR published a Concept Paper On Value-Based Radiology in the Society's journal, Insights into Imaging, seeking to contribute to the discussion on this critical issue and to move it to the next level by asserting that a correct diagnosis is the first outcome that matters to patients.

European governments are facing difficulties in managing their national health systems, just as the American private payer systems. And the ESR paper points out that short-term cost-cutting solutions, and austerity measures that have been the first reaction, have already reached their limit and are now negatively affecting the quality of healthcare, creating a vicious circle of increased demands on healthcare and a need for greater spending.

'It's like low-cost airline companies,' Derchi compared. 'They work for a while, then low-cost risks becoming a low-value service.'

After publishing the paper, he has taken to the podium at national radiology congresses to increase awareness of this issue, and to start a dialogue that ESR can bring to all involved stakeholders.

'As radiologists we have a long tradition of measuring and assessing our chain of work from the request of the referring physician to the report, to measure each step,' he said. 'Yet VBH sees these as processes and not as outcomes. What we need to do is define that the endpoint of these processes (the final diagnosis) is an outcome. And we need to ask how we can fit this intermediate outcome into the Value-Based Health Care framework.'

Metrics to measure radiologists' impact on patient outcomes become a key step to take the discussion to the next level, to demonstrate whether the diagnosis is correct and actionable, that it is relevant and useful to the episode of care.

'I use the term impact rather than the word value here, because this is the main problem in the ICHOM framework, where value means outcome versus cost,' said Derchi. 'They calculate cost and outcomes starting only at the moment when the patient comes to therapy. The impact of the imaging process, or of the other diagnostic methodologies, such as lab tests, biopsies and even the pathology report, needs to be considered not only as a cost but also as something that's key to the subsequent outcome, affecting what will be done in the treatment process.'

The ESR Concept Paper On Value-Based Radiology sets out five key factors in determining appropriate metrics for what it defines as Value-Based Radiology (VBR).

- Appropriateness of requests
- Attention to radiation protection measures
- Characteristics of the reports, whether they are correct, complete, understandable, structured and properly used
- Relationships between patients and radiology personnel
- Continuous professional education, research and innovation.

VBR creates an opportunity to shift from volume-based calculations to a value-based practice of radiology that puts more emphasis on the relation between quality and outcomes. 'We are doctors in medicine. We are neither photographers, nor operators running machines and pushing buttons. We interpret what is coming from the machines to integrate this information into the clinical picture of the patient to develop the diagnosis. It is our medical knowledge that gives these images significance,' he emphasised.

'If you measure only volume, then time is squeezed, the time for the examination is tight, cutting the time for reading and interpreting and for communicating the report. There is no longer time to discuss the findings with the referring physician, to be sure they are understood, and how they may change the opinion on how to treat.'

'There are two perspectives,' Derchi concluded. 'One is economic, and if we are to be measured, we want to be able to show that we have impact on value. The other is an opportunity to discuss this topic, to create a moment for rethinking how we can achieve acknowledgement of our efforts for the quality in our work.'

Professor Lorenzo Derchi heads Emergency Radiology at San Martino Hospital at University Hospital Genoa in Italy. He also chairs the Value-Based Imaging Working Group of the European Society of Radiology (ESR) and is the ESR's First Vice-President.

www.healthcare-in-europe.com

CONTENTS

New tech secures mobile IT for roving medics

Healthcare goes out and about

New technology being deployed across the NHS in central England is helping to deliver more secure mobile systems for healthcare professionals, Mark Nicholls reports

The partnership between Toshiba and the Birmingham CrossCity Clinical Commissioning Group (CCG) is bringing the work of health and social care organisations closer together.

One of the initiatives planned for the Birmingham area is the introduction of Toshiba Mobile Zero Client (TMZC) to its laptops, which as a result have no hard drive and no local operating system or memory. Instead, they utilise the health system's existing virtual platforms to access and process information.

Ciaron Hoye, Head of Digital for Birmingham and Solihull Clinical Commissioning Groups, explained that, with the CCG moving the local data and applications that healthcare professionals use to the cloud - and giving them access to it through the cloud using virtual platforms - the CCG is breaking down the 'siloed structure' between health and social care organisations to create a more connected digital ecosystem.

This gives practitioners a faster, more holistic view of a patient's history and personal information and is also more secure at a time when health systems have been among organisations vulnerable to cyber attacks over the last couple of years.

'Our patients don't see the boundaries between these organisations,' Hoye pointed out. 'They expect a joined-up service where their personal information follows them to each appointment – allowing seamless healthcare.

'Because the devices are mobile, we're giving our workforce the tools they need to meet the increasing demand for a more flexible healthcare service.

'Patients will see a reduction in time spent in and between appointments, as diagnostic information will be more readily available. Instead of waiting for records to be shared between practices - the information will follow the patient, enabling quicker and better-informed diagnosis.'

With healthcare professionals increasingly working from the field, the CCG believes the TMZC solution will enable them to access needed information wherever they are, and simultaneously record patient information records with up to date statistics when they are being seen.

Mobile equipment such as a laptop, is substantial to meet the flourishing demand for a more flexible healthcare service and support healthcare professionals increasingly working out in the field

Another advantage is that, because no information is stored on the laptops once they are turned off, healthcare providers can share mobile devices and still have access to all the information and applications they need through the virtualised desktop. Additional security features allow the device to remotely be deactivated and reduce the risk of sensitive data being misplaced in the field should it be lost or stolen.

A challenge IT departments face in supporting a mobile workforce is securing the sensitive and personal information across multiple devices and a widening network, which can mean investing in expensive Mobile Device Management solutions (MDM). 'However, because data is virtually stored when using zero client solutions, sophisticated security packages are unnecessary because it can all easily be managed in the cloud," added Hoye.

David Sims is Toshiba's Solutions Sales Specialist. With over 22 years' experience in telecommunications, he specialises in mobility, IOT/M2M and security solutions. Prior to employment at Toshiba, he had held various roles in the telecommunications industry.

Toshiba and the CCG have worked closely to identify a solution that not only helps create a more connected digital ecosystem, but also supports its increasing need for more mobile and flexible working practices. Following a successful user acceptance test, the technology will be rolled out across the CCG area – which covers a million health and social care patients over a large urban environment.

A future development, he said, could be wearable devices used to monitor individuals away from hospitals to collect information about their health.

David Sims, Solutions Sales Specialist with Toshiba, said the company is also helping to explore how Internet of Things (IoT) can transform wellness care in the Birmingham area, and how 'the huge volume of data that devices such as wearables can be utilised for proactive healthcare.'

Ciaron Hoye is Head of Digital for the Birmingham and Solihull Clinical Commissioning Groups, and is also the Digital Workstream lead for the Sustainability and Transformation Plan within the region. Within the industry he was a developer, before moving to the NHS. Having led a number of projects from large scale Virtualisations, to smaller innovations into the use of technology to support healthcare, his current focus is on the use of cognitive computing and personalised healthcare.

Challenges in mobile healthcare

'Last year healthcare was the fifth most targeted industry in cyber-attacks,' Sims pointed out. 'At the same time healthcare staff are increasingly operating from the field, a trend that IT departments must support to ensure sensitive patient and business critical data is kept secure. However, mobile working practices bring with it an increased risk of sensitive data being lost or stolen.'

TMZC safeguards the technology by storing data away from the device, making it only accessible through its existing cloud-based virtual desktop infrastructure solution.

'This removes the threat of malware being stored on devices,' Sims added, 'as well as nullifying concerns about data being compromised should a device be lost or stolen.'

In 2013 over 480,000 TB cases resisted all antibiotics

Facing the front line in the AMR battle

'Nurses have a distinctive and crucial role in the development and implementation of sound health policy,' according to Annette Kennedy, President of the International Council of Nurses, which represents 135 National Nurses Associations and around 17 million nurses worldwide. 'The reason,' she adds, 'is the unique role and relationship nurses play in healthcare provision to patients, carers, families and the community.' Here the nurse/midwife outlines their value in combating antimicrobial resistance (AMR).

One key policy area for the International Council of Nurses (ICN) is antimicrobial resistance (AMR). AMR threatens the effective prevention and treatment of an ever-increasing range of infections caused by bacteria, parasites, viruses and fungi. It is an increasingly serious threat to global public health that requires action across all government sectors and society. (Ref: World Economic Forum. 2013).

Its impact is at multiple levels - individual, systems, economies and trade.

Patients with infections caused by drug-resistant bacteria are generally at increased risk of worse clinical outcomes and death, and consume more healthcare resources than patients infected with the same bacteria that are not resistant.

Today, new resistance mechanisms emerge and spread globally. According to The World Health Organization (WHO), AMR is responsible for 25,000 deaths in Europe annually; 38,000 thousand per year in Thailand; and over 23,000 in the USA. In 2013, over 480,000 tubercular (TB) cases were resistant to all forms of antibiotic treatment.

AMR financial and physical costs

It is estimated that the direct costs of AMR in the USA are up to US$20 billion per year and up to US$35 billion per year for indirect cost. A February 2015 AMR review projected that, by 2050, it would cause over 10 million deaths globally per year and result in a cumulative cost of US$100 trillion, roughly the same as removing the UK economy from global output each year.

Take educational action

As the primary contact with patients, families and communities, nurses can have the greatest effect on public and patient education to improve health literacy. A WHO multi-country survey showed that 64% of those surveyed believed that antibiotics are good for illnesses such as cold and flu; and about one third believed they should stop taking antibiotics when they feel better. As patient advocates, nurses can help patients to understand their diagnosis and make the best decisions about their health.

Their role is also crucial in supporting and strengthening infection prevention and control (IPC) policies and practices; supporting patients' adherence to antimicrobial treatment and correct use of antibiotics; and promoting vaccination. Both health professionals and patients need more education, and better understanding that infections take time to heal, and build up natural resistance.

With other health professionals, nurses' local knowledge can inform decisions regarding antimicrobial therapy, and enhance the multidisciplinary approach to antimicrobial management.

Prevention and control

Nurses also have a role in infection prevention and control, ensuring responsible use of treatments, monitoring and evaluating them, and reporting AMR events.

Our continuing education on this topic is critical. We are key to surveillance and monitoring of patients' health as consistent patient carers.

At the 68th World Health Assembly in May 2015, the World Health Assembly endorsed a global action plan to tackle antimicrobial resistance – including antibiotic resistance – the most urgent drug resistance trend. This identified five main objectives:

1. Improve awareness and understanding of AMR
2. Strengthen knowledge through surveillance and research
3. Reduce incidence of infection through sanitation, hygiene and infection prevention
4. Optimise use of antimicrobial agents
5. Develop the economic case for sustainable investment that consider the needs of all countries, and increase investment in new medicines, diagnostic tools, vaccines and other interventions.

Increase health literacy

As nurses have a clear role in meeting these objectives, we must continually advocate for greater health literacy and increased immunisation.

We must keep abreast of AMR trends and also act as role models in our healthcare settings and teams. We need to ensure we ourselves fight the myths on immunisation and are discerning with our colleagues on

Curbing patients who demand A&E attention unnecessarily

Overcrowding rises as winter looms

Report: Moira Mizzi

Overcrowding in healthcare systems has become a worldwide phenomenon with regional influences related to the different healthcare structures in different countries. A recent BBC analysis (February 2017) showed that overcrowding afflicted 9 out of 10 NHS hospitals this winter, with 23 declaring 'black alerts', as other European hospitals face similar 'care crises', especially member states such as Greece, with their ever declining health budgets. (Euronews, January 2017)

The Maltese Islands have not been spared the deluge: overcrowding is among main challenges and priorities to the local health sector.

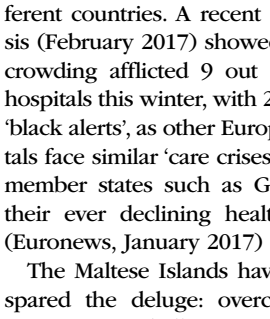
A senior nurse manager of the hospitals maps out the factors she believes are the main culprits for this phenomenon. She claims that, although we have long been aware of the rising age of the population, compounded with the sociocultural shift featuring more working women and smaller nuclear families, not enough has been and is being done to counteract the state of affairs.

As a result of this drastic decline in the availability of support from extended family, mainly due to lifestyle pressures, neglect or debilitating disease, most elderly citizens depend heavily on healthcare systems with acute care wards being blocked by social cases especially since, at present, the hospital administration has no jurisdiction to impose care on family members.

Another factor that greatly influences turnover of patients, especially in accident and emergency (A&E) departments, is inappropriate use of service. Unfortunately, A&E is still inundated with patients suffering minor or chronic ailments, in the hope of gaining a faster transit to necessary investigations and treatment. The senior nurse stresses the importance of educating patients in the correct use of facilities and triaging systems linked with a more efficient set-up between hospital and community networks as a means of counteracting unnecessary pile-ups in a unit where lack of efficiency can easily result in loss of life. Overcrowding, both in A&E and other departments, also results in chaos, decreased efficiency, increased risk of infections and a great challenge to the nurse/patient ratio. Luckily in Malta, this is still at 1:5 and 1:8 during the night. In fact the most recent Eurostat update (January 2017) reported that Malta boasted 'by far the largest increase in nursing professionals... (with) 180 more professionally active nurses per 100,000 inhabitants in 2014 than five years earlier', in contrast to Poland, Ireland and Slovakia which manifested a decline.

The senior nurse believes that a functional set-up between hospital and community networks can also render discharge of patients in the community more efficient, taking into account not only the condition at hand but also their general physical, mental and social well-being. Thus supported, the patient, especially in the elderly bracket, is less prone to be re-admitted, at times in a worse state of health. At the hospital this role is currently being carried out by the Discharge Facilitation Team with Discharge Liaison Nurses, where the latter also cater for intravenous antibiotics at the patient's home, thus avoiding the need of hospital admission. Other measures taken by the hospital in supporting decentralisation of

Continued on page 4



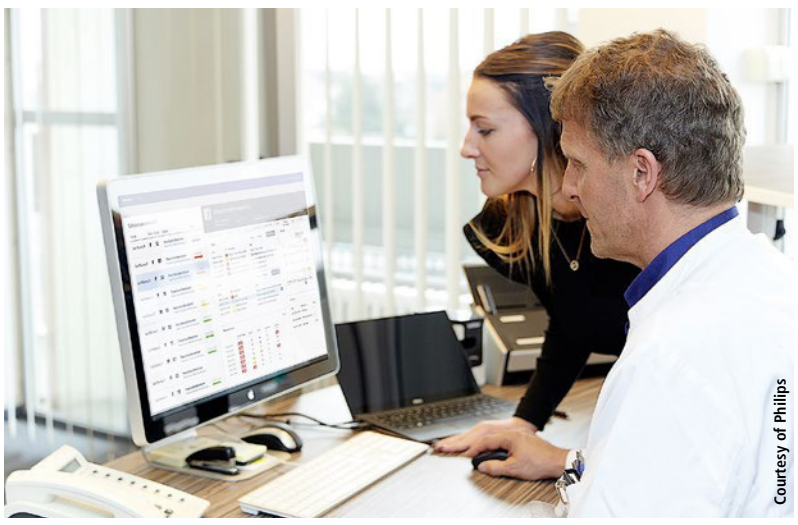
Nurse/midwife **Annette Kennedy MA BNS** gained her bachelor's degree in Nursing at University College Dublin and received diplomas in Management and HR, and a Master's in Public Sector Analysis from Trinity College Dublin, Ireland. From 1999-2004 she was an Executive Board Member for the European Federation of Nurses (EFN) and became its President in 2005 until 2007. From 2013-2017 Kennedy was Vice President of the ICN before becoming the present ICN's President this May. Currently, Kennedy is also Chairperson of the Bray Homeless Forum. She is also a Director on the Citizens Information Service Board. The Education, Research and Resource Centre for the Irish Nurses and Midwives Organisation (INMO) was established by Kennedy, aiming to shift nursing and midwifery into mainstream university life. Last year, the Royal College of Surgeons Ireland awarded her an honorary fellowship in nursing.

medication advice, we speak out when infection control practices are not adhered to and we advocate for our patients on issues of medication side effects. Armed with education and information on antibiotic use and AMR, we will be better able to fight its growth.

Augmenting Philips hospital management solutions

Brazilian cardiologist develops new HIS

The older generation of hospital information systems (HIS) was introduced in Germany around the time the DRG system came into force, with solutions mainly aimed at meeting administrative needs, i.e. handling billing. The clinicians' need for thorough documentation and the provision of a comprehensive overview of a patient came only later – and the administrative features continue to dominate with the systems currently on the market. However, the philosophy behind the new Philips Tasy is very different, the company reports.



Courtesy of Philips

The protocol-supported system can process diagnostic information, guidelines developed by specialist associations and internal hospital directives

The uniqueness of this HIS can be explained through its history. Dr Luiz Arnoldo Haertel, cardiologist at the Hospital Santa Catarina in Blumenau/Brazil – a region with German heritage – is the inventor and protagonist of the system. Can we trust solutions developed in Latin America? 'The work culture in this region is very professional,' assures us Miriam Schnürer, Business Unit Manager EMR/HIS Healthcare.Informatics.Solutions.Services (HISS) at Philips DACH.

Initially, the IT enthusiast developed his HIS to support doctors and nurses at the local hospital. Haertel and team then expanded the system beyond the hospital and developed a complete solution that allows medical practitioners access to medical and socio-demographic aspects of patient cases, patient history and medication.

Tasy is now used by more than 850 healthcare facilities in Latin America.

Support for the billing system was a further requirement because the Brazilian system is particularly complex, with funding organisations stipulating individual billing specifications for service providers. This lack of any standards for billing leads to very challenging requirements for consistent cost tracking, which the HIS must reflect. 'The German DRGs are a lot less complex by comparison,' Schnürer points out.

Very high-tech: the Tasy country of origin

Technology in Brazil is very advanced, even in small and denominational hospitals. Unit dose systems and closed loop medication management are very common. Both the integration of pharmacologists and antibiotic stewardship are very high on the agenda. Keeping track of staff and visitor locations is an advantage when it comes to infection prevention and control and security on the neonatal wards.

The secondary use of clinical data for research and development is common practice. Telemedicine and the involvement of external experts is also common, particularly in rural hospitals where fewer specialist medical fields are represented. The Tasy hospital information system meets the enormous challenges of this environment.

Workload reduction and overview for staff

The advantages of Tasy for German service providers are obvious, Schnürer underlines. Using a hospital information system makes it possible to effectively reduce the workload in medicine and care through documentation. The protocol-supported system can process diagnostic information, guidelines developed by specialist associations and internal hospital directives, and therefore facilitates faster and more precise diagnoses.

Patient information can be visualised in a manageable way. The system makes precise diagnoses and efficient, comprehensive cost tracking a reality, with intelligent data processing. DRG coding and grouping is carried out through the integration of CODIP, DIACOS and SAP systems. The German and European data protection requirements are also taken into consideration.

'From medicine and care to administration and cleaning staff: hospitals using Tasy are paperless and offer all staff the relevant information at the right time, in the right place,' Schnürer confirms.

Comprehensive integration of subsystems

Wherever in most of the systems Tasy has been implemented in Brazil it is the 'master' system that all other subsystems are integrated into via interfaces. In Germany, the comprehensive integration of the Philips solutions is carried out in the spirit of the health continuum, i.e. across all stages of care. 'In Germany we integrate external systems in cooperation with third party providers at the customer's request,' the Philips manager explains.

'Integrating patient data from sources, such as apps and wearables, will also be possible with Tasy. Patient information flows into the hospital seamlessly, and is passed on in the same way to post-hospital care providers upon patient discharge. Tasy is the comprehensive information hub for the entire treatment chain.' EMRAM assessments, i.e. the HIMSS scale measuring the extent to which hospitals have implemented electronic patient information systems, confirm the high level of technology for Tasy. Eight hospitals in Brazil on EMRAM level six work with the system; two are preparing to move to level seven.

Philips acquired Tasy in 2010, after analyses had shown that the system was an ideal fit for the company's product range. Philips counts on standards, especially the developing FHIR standard. Bearing this in mind, why does the company move towards a monolithic system such as Tasy?

'The Service providers currently do not offer FHIR and IHE based and structured "Master HIS" which is requested by some hospitals. Even though Philips fully supports the standardization of HC data, we do not believe that the world is ready for it yet,' Schnürer explains. Philips is currently working on APIs, 'sockets' for external data flow. Tasy offers high performance for external interfaces through a monitoring system which detects abnormalities and errors. Contrary to what is often claimed, the data protection requirements, although they present complex challenges, are not an insurmountable obstacle.

The patient is at the centre

The basic approach for Tasy in Brazil is that 'the patient owns the data'. Data sovereignty on the part of the patient will also play a central role for Tasy in Germany.

Philips first introduced Tasy to the DACH audience at the conhIT 2017. The number one in the Brazilian HIS market is currently being adapted to the requirements of the German hospital IT environment in a co-design project with Düren Hospital. The objective is for hospitals in the DACH region to master the challenges of the future with the help of Tasy.

Miriam Schnürer, Business Unit Manager EMR/HIS at Philips Germany, has been involved with issues in and around the hospital for 23 years. Prior to joining Philips, she held a number of management roles in IT companies. She campaigns to advance hospital IT innovation, find new technologies and opportunities for hospitals and to utilise those benefits for people and healthcare. Further activities include canvassing for infection prevention and control, civil protection, the protection of critical infrastructures and digitisation.

Medical

The treasure trove of healthcare data waitin provide invaluable insights. However, what Empolis Information Management GmbH, a Hospital about medical text mining and the

Thirty years ago Empolis Information Management GmbH began its role in smart data processing and service optimisation. Giving the example of involvement with call centres, Andreas Klüter, CTO of Empolis said, 'We developed software that provides decision trees for call centre staff to help them get straight to the customer's problem and its solution. Our vision is that "no one must ever make wrong decisions again" and our new mission is derived from this vision: "utilise all information to provide the right recommendations".'

'Text mining and linguistics are the tools of our trade, also in healthcare. We developed a solution that retrospectively analyses free text medical reports, using a number of criteria. We do this with the help of mature artificial intelligence technologies, such as deep learning or case-based reasoning.

'Our partner Smart Reporting contributes the clinical process know-how. We fused their know-how and our technology in their prototype module called Smart Radiology.

'Now we can partially structure unstructured data. So far this works with existing reports that we analyse retrospectively. However, we are in the process of developing a prototype that hints at which type of data might be missing, in order to arrive at a complete or guideline-compliant diagnosis of a certain pathology during the process of gathering findings. This might help to achieve a much higher degree of standardisation in findings and clinical reports.'

'Our analysis is based on approximately 150,000 anonymised reports, focusing on the 40,000 brain CTs included in these reports. Our aim was to determine the level of quality of the findings, to figure out whether certain trends are discernible and whether the different hospitals have different referral and requirement patterns for imaging procedures. However, we do not intend to conduct further studies.'

'While we initially focused on brain CTs to create a knowledge model that allows us to analyse the data, we do plan to cover all anatomies, step by

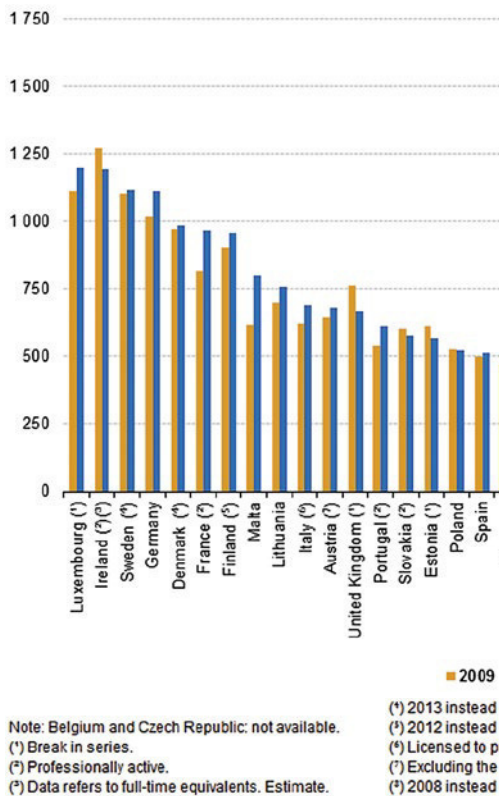
Overcrowding rises as winter looms

Continued from page 3

patient care include the twilight shift that allows certain treatments, such as renal dialysis, to be carried out during the evening, thus reducing the time off work for patients and overwhelming of the unit's resources during the day, evening out-patient sessions, late night radiology services, the Medical Investigations and Treatment Unit (MITU) that caters for patients in need of specialist care on an out-patient basis and a post-op helpline for minor surgery patients.

Specialist nurses, called Practice nurses in Malta, are also providing outreach services in the community. These include services for home-bound patients, such as wound care, clinical nutrition and continence services. These systems must ideally be continuously revised and improved on to become viable and then emulated by other departments to promote further the efficient functioning of the hospital. Whatever measures are taken to curb overcrowding in health systems, none can hold unless a multi-team approach is embraced within and without the healthcare framework. Every healthcare stakeholder, including the patient, must have a say and subsequently take responsibility for his/her contribution to the system.

Likewise, overcrowding cannot be considered as one of the heaviest bucks in a healthcare department, but a matter of national concern where every citizen, be it student, employer, parent or policy maker alike, considers what needs to be done to safeguard our health and the systems that protect it. Only then can the proverbial eggs be distributed more evenly and not crowded in the healthcare basket.



Practicing physicians 2009 and 2014 per 100,000 inhabitants in the EU. The Eurostat update from January 2017 reported that Malta boasted a large increase in nursing professionals in contrast to Poland, Ireland and Slovakia which manifested a decline.

The potential insights are invaluable; we should not waste this source

data mining

g to be explored in German hospitals is immense and could about data security and privacy? Andreas Klüter, CTO of new business entry in healthcare IT, spoke with European need for ethics discussion.

For over 20 years, **Andreas Klüter**, CTO of Empolis Information Management GmbH, has focused on developing systems for intelligent information processing. From 1994 on he was instrumental in realising the "Verbmobil", the worldwide first research prototype for fully automated translation of spoken language at the German Research Centre for Artificial Intelligence. During his tenure as Head of Development at ORBIS, he gathered profound knowledge of healthcare IT. As CTO of Empolis Information Management GmbH Andreas Klüter is in charge of the company's product portfolio and the business division eHealth.

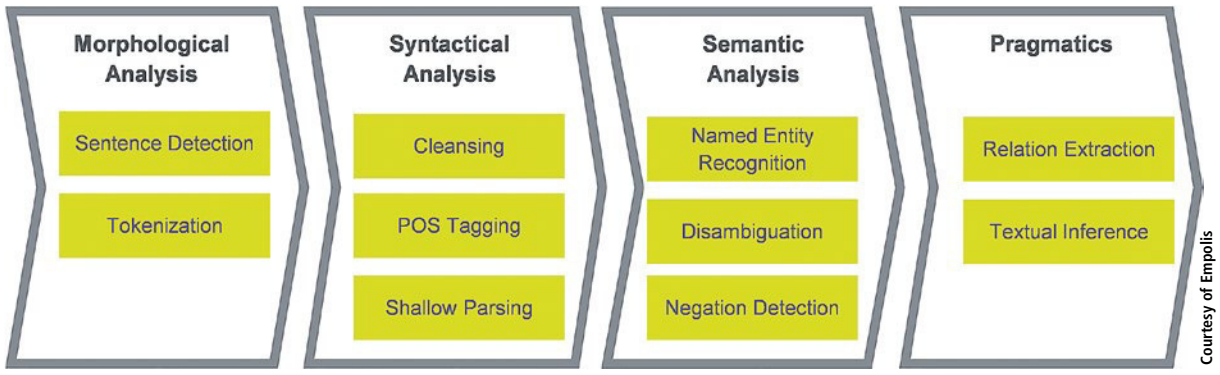
step. In addition we want to analyse the results of other imaging modalities such as MR scans.'

'Data security and privacy are immensely important issues. Therefore only the study principals receive the results and they decide how the data will be used,' he explained. 'We can show trends, but it is not for us to decide whether a trend indicates a problem.'

'We need this debate on artificial intelligence from the very beginning. However: In my opinion the computer cannot do everything better and it won't be able to do everything better, even though it can perform increasingly complex tasks.

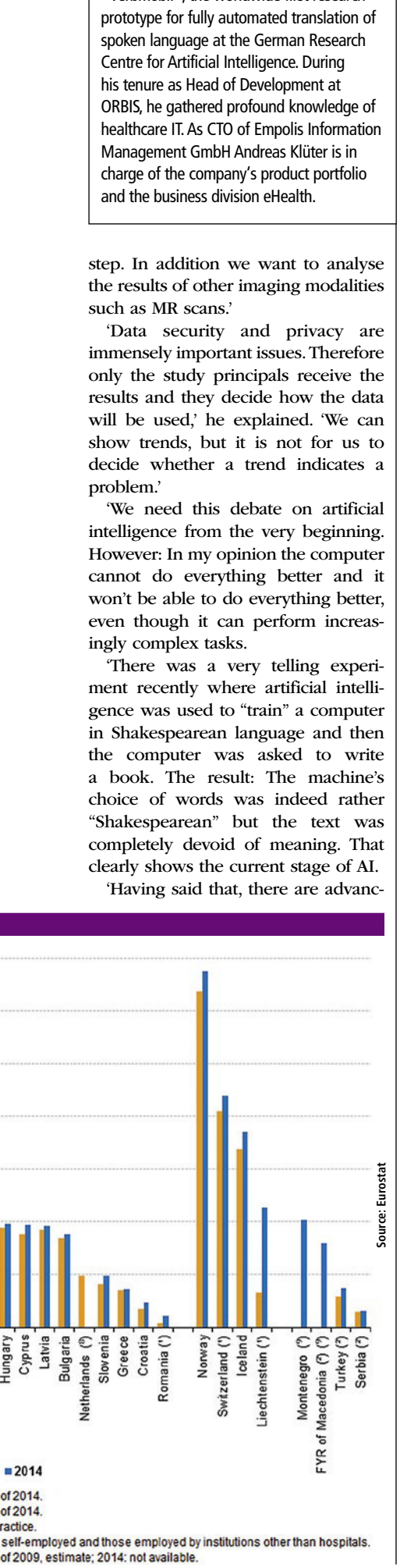
'There was a very telling experiment recently where artificial intelligence was used to "train" a computer in Shakespearean language and then the computer was asked to write a book. The result: The machine's choice of words was indeed rather "Shakespearean" but the text was completely devoid of meaning. That clearly shows the current stage of AI.

'Having said that, there are advances, and we need to discuss how we are going to deal with the new insights and which approach we will choose. It's a long process for a society to agree on a path, but this consensus is necessary and we have to embark on this journey now. To do nothing, I'm sure, is the wrong decision.



Courtesy of Empolis

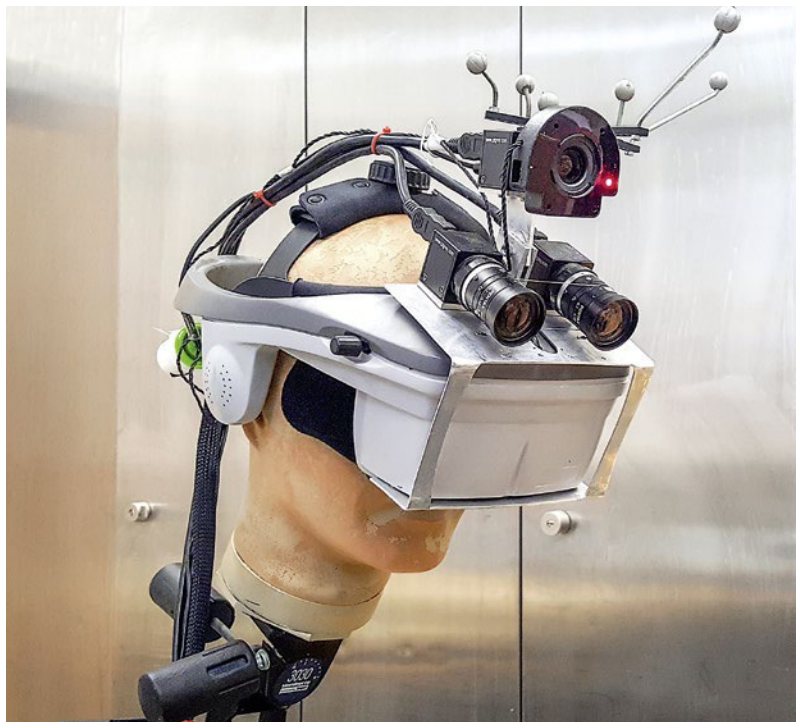
'The archives of German hospitals are full of text and image data waiting to be used, data that might really advance clinical research. The technological obstacles are surmountable today, the potential insights are invaluable. We should not waste this source.'

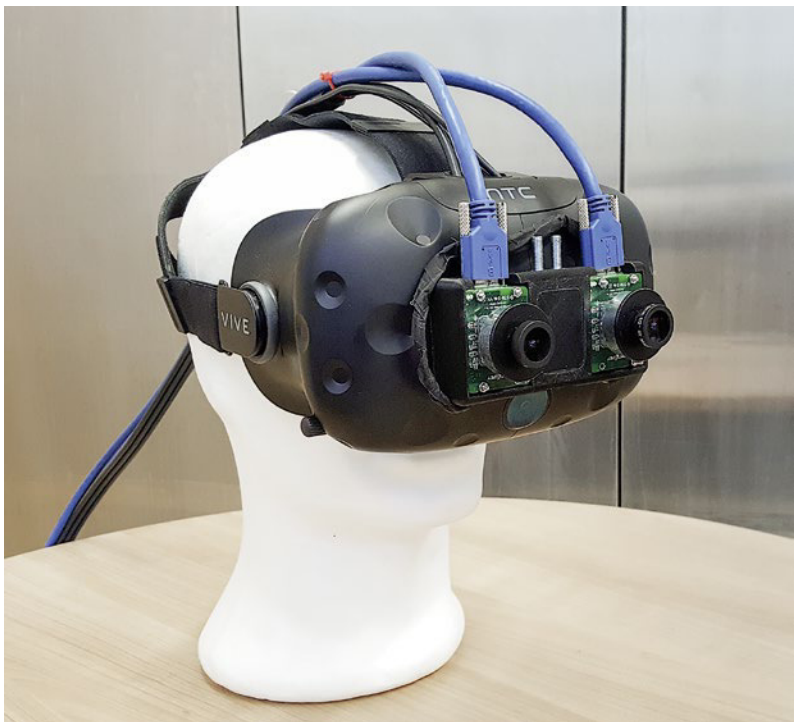


Source: Eurostat

Augmented Reality in the operating theatre

Virtual data merges with a real body





Head-mounted displays used to develop prototypes for medical AR systems. Both head-mounted displays have been developed in Munich – but are not conceived for use in the operating theatre (too many cables, too heavy)

Report: Anja Behringer

Medical Augmented Reality (AR) assistance systems overlay information onto a surgeon's field of view. This technology is complex and expensive. Therefore, the procedure must offer a big advantage compared to conventional treatment and diagnostic methods to qualify for standard use. The objective is a system that shows a surgeon a 3-D image of inside the body plus instruments used during surgery – and not on an additional screen but with a direct view of the patient.

For the system to improve matters it must be easy to use, show relevant information and be easy to integrate into established workflow. Computer scientists merge existing and processed data with camera images of the real environment.

The C-arm, which with the help of AR lowers radiation exposure for patients by factor 40, has proved its value for some years. The challenges that medical technicians still faced three years ago, such as problems with imaging, reliable and precise tracking or issues around data preparation and visualisation have considerably reduced. Real-time imaging and visualisation are now so refined that AR systems can be utilised for an increasing number of applications.

During our interview, Dr Ulrich Eck, Senior Research Scientist for Computer Aided Medical Procedures and Augmented Reality at the Department of Informatics, Technical University of Munich, discussed some future applications.

'Minimally invasive procedures use endoscopes for imaging,' he began. 'The surgeon mainly operates with the help of images transmitted by the endoscope. As the image data is acquired and visualised electronically this type of platform is particularly suitable for the visualisation of additional information, such as pre-operative image data (CT/MRI/PET), or intra-operative image data (US/OCT).

Data glasses for use in the operating theatre

'Planning data can also be visualised for interventions. One particular challenge is the provision of relevant information for the surgeon for every step, at just the right time. The AR system must automatically detect in which phase the current procedure is.'

'The use of data glasses during surgery is an interesting concept, but there are still some unanswered questions, such as issues of ergonomics and sterilisation. The integration of data glasses also changes workflows – similar to the use of navigation systems. Effort and result must have a meaningful ratio, and it's not obvious which interventions are most suitable for this.

'In summary, there are currently no data glasses/HMD for use in the operating theatre which, along with technical criteria, such as screen resolution and contrast, system latency, precision and quality of visualisation, also meet the requirements for ergonomics (light, removable, comfortable, no cables) and operating theatre specific requirements (sterilisable, reusable, robust, cost efficient). The development of an HMD suitable for the operating theatre needs close cooperation between manufacturers of data glasses, researchers in augmented reality and medical experts. The first studies in this area are currently being carried out.'

Asked for which application we can expect the early implementation in the operating theatre at a reasonable cost, Eck spoke of medical devices manufacturers who 'now have the first devices in their range which integrate the concept of the camera-augmented C-arm (CamC) developed in our department, into their products'.

X-ray images projected onto the patient's body

'CamC is intended to help surgeons work faster, with more precision and with reduced radiation exposure for patients and staff.

'In future, we can expect augmented reality enhancements of products for specific types of application, such as in neuro-surgery.

The idea of projecting a patient's X-ray images onto their body during surgery makes sense even to lay people. Eck explains the complexity: 'An X-ray image projects a 3-D space (the body) onto a 2-D plane. When an X-ray image is projected onto the body the spatial correlation between image content- and visualisation is no longer accurate, because it results in the impression that the information is located on the user's skin. Only when the projector projects from the perspective of the X-ray source and the user views the patient from this direction is all the information of an X-ray image visualised correctly. This is the idea that our CamC-system is based on, albeit with a screen and not a projector.'

Detailed 3-D reconstruction of the respective body region (static or dynamic) is an essential prerequisite for the correct projection of X-ray images onto the body. Only then can the image be projected without distortion.

'In simple cases,' Eck concludes, 'projection of an X-ray image onto a body part, such as a flat hand, offers added value as the spatial correlation between the surface of the hand and the image corresponds well enough. We believe that, in most other cases, this type of projection does not deliver any noteworthy advantage.'

In 2012, **Ulrich Eck PhD** began his Computer and Information Science studies at the University of South Australia. After gaining his PhD in 2016, for his thesis 'Precise Co-Location of Haptic Devices in Visuo-Haptic Augmented Reality', he became a Senior Research Scientist at the Technical University of Munich. He manages research in the NARVIS laboratory at the Chair for Computer Aided Medical Procedures. His research interests include medical augmented reality, medical simulation, haptic simulators, computer vision and human/computer interaction.

Gaining a uniform, homogeneous and shadowless illumination

Adaptable universal

Lighting up during diagnostics, minor surgery and other needs in A&E, intensive care, the recovery room, and more, the Soled 15 has universal value. ACEM, its maker, reports that the model provides excellent light intensity, IR-free light beam, colour temperature (CCT) of 4.500°K, colour rendering index (CRI) of 95, low power consumption and long life.

'The high technological level combined with the use of high-powered LEDs allow Soled15 to have a very linear yield and a negligible performance decay for its entire life duration,' the firm adds.

'Thanks to the high efficiency achieved, Soled15 has a light intensity of 65.000 Lux (85.000 Lux with 'Boost' function) and a low power consumption (16W).

The round shape also makes it handy and functional both in use and move, the firm adds.

The I-Sense touch panel controls all lamp functions from on/off to light intensity adjustment, parts selection (SEL), boosted brightness and, Acem adds, 'the new SEL function allows the selection of single parts of the light beam and the activation of the desired LEDs in a sequential way according to the requirements and needs.'

The brightness boost brings maximum light intensity in case of a wide light field; this approximate 20% increase deactivates automatically after five minutes.

* Acem is an Italian specialist in the design and manufacture of medical devices, surgical lamps for medical use, surgeries and operating rooms, etc.

The company's flagship is LED (Light Emitting Diode) technology used to produce its lamps.

*Acem products will be on display at MEDICA 2017, being held in Dusseldorf, from 13-16 November. Hall 10 Stand E 31.

The Soled15 has a light intensity of 65.000 Lux (85.000 Lux with 'Boost' function)

Virtual fracture clinic boosts patient care

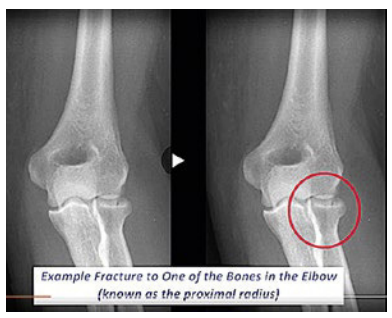
A fracture clinic model being pioneered by a UK hospital is improving patient care and delivering significant cost savings for the NHS, Mark Nicholls reports

The Virtual Fracture Clinic (VFC) established by the Brighton and Sussex University Hospitals NHS Trust sees patients with broken bones or soft tissue injury supported through video links and self-management methods, rather than make additional journeys to hospital for face-to-face appointments with orthopaedic consultants.

The trust says the initiative also makes better use of consultant time by allowing specialists to focus more on their own areas of expertise.

The clinic was originally set up after orthopaedic consultant James Gibb became concerned that the existing model of care – where patients attending emergency departments with fractures were assessed and then booked in for a further appointment with an on-call orthopaedic consultant - was inefficient.

However, that meant they did not necessarily see the best person for their specific injury – a spinal specialist may be seeing someone with a broken toe, for example. 'It was a bit of a lottery,' said Lucy Cassidy, the trust's VFC project lead. 'Now, when a patient attends A&E, instead of being put on a list to see someone face to face, they are referred for a virtual consultation.



The VFC has 27 rehab videos hosted on Youtube, helping patients to self-manage injuries

'This consultation involves an orthopaedic consultant looking through each case, and depending on the type of injury, the patient is placed on a self-management pathway and supported with rehab videos online. Or if they had an injury that needed to be seen, they would be booked into an appointment with the right specialist and receive the appropriate management.'

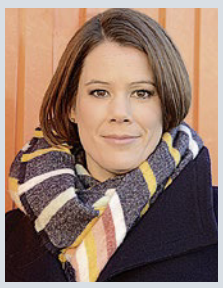
Patients have access to a rehab adviser within 72 hours of their injury, saving them having to come in to hospital with a generic fracture clinic consultant before being referred on.

The model is based on a virtual clinic in Glasgow, but has been taken a significant step further in Brighton by adding the physiotherapy component.

'Our service is now more streamlined and we find a large percentage of our patients can be self-managed, where they do not even need to come in for an appointment, ' Cassidy added. 'We decided to design with a physiotherapy-led service because we found patients were not being given much information to self-manage injuries.'

The VFC has 27 rehab videos hosted on YouTube, presenting patients with six weeks' worth of rehab across various injuries. Giving patients the correct information at the outset of their treatment journey is helping to reduce long-term problems.

Brighton has 4,500 adult general fracture clinic cases and 3,000 wrist and hand injury patients a year with plans to expand to paediatric cases next year.



Lucy Cassidy is an advanced practice physiotherapist and leader of the Brighton and Sussex NHS Trust's Virtual Fracture Clinic project.

With the virtual appointment half the price of a £150 (170 euro) face-to-face appointment, there are significant cost savings for the NHS from the project, for which Microsoft supplies software and part-funds the initiative. 'It also means that our hospital consultants can be redeployed to maximise their skills,' Cassidy pointed out.

The hospital has been collecting data to help manage referrals and ultimately to measure outcomes by coding every injury

Within the trust, this has meant additional ward rounds for neck or femur fracture patients, while other hospitals have held additional clinics or helped increase theatre capacity. 'We are basically using the workforce to maximise their skills set rather than using them in a generic fracture clinic way.'

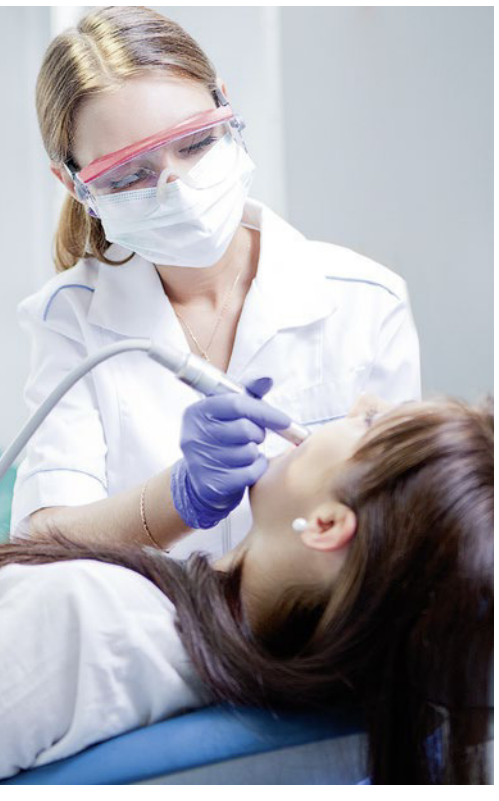
While there are clear staff resource benefits, putting figures on internal savings is more difficult, but it does mean less imaging, fewer registrars using clinics, reception staff time saved, and patient journeys down with carbon footprint reduced.

Current figures show that 57% of patients referred to the VFCs are discharged or placed on SOS appointments - where they are on self-management but can regain contact for support - after first referral from A&E, compared to a previous discharge rate of approximately 40% in the traditional model.

The initiative has reduced outpatient appointments by 57%, saving the NHS more than £750,000 (€850,000), with 2,000 fewer patients having to visit the hospital a year.

Mrs Cassidy said patient satisfaction is up and, since January, the hospital has been collecting data to help manage referrals and ultimately to measure outcomes by coding every injury, to enable clinicians to look at the functional outcome for each injury and assess patient progress.

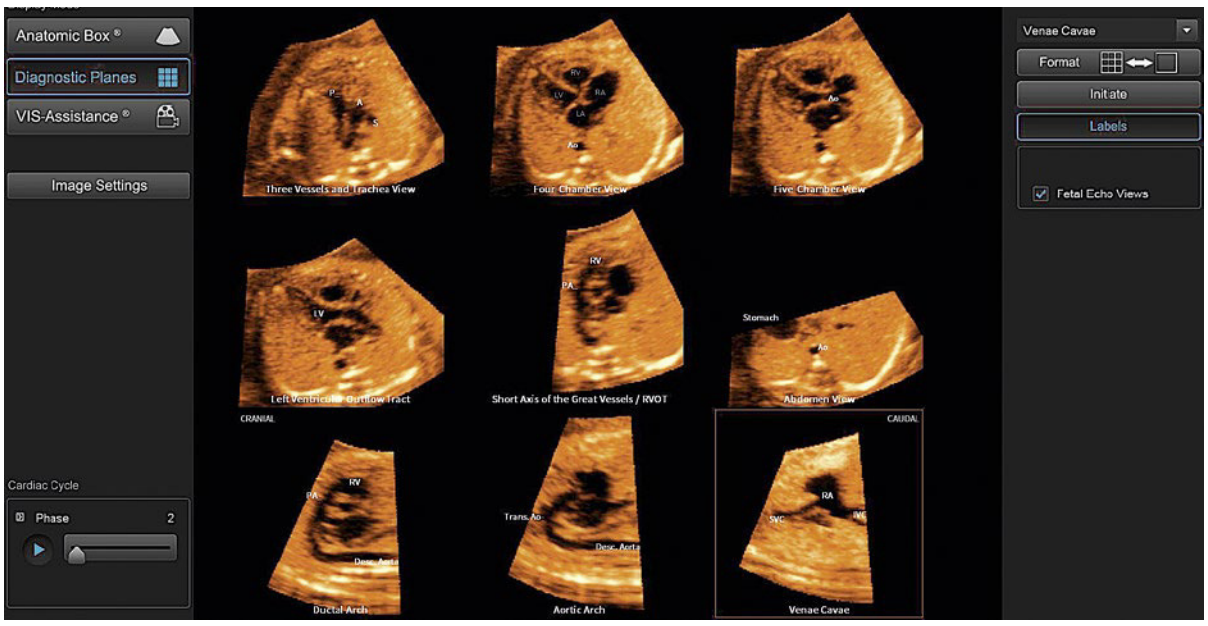
lighting



Method able to detect congenital heart disease with 98% sensitivity, 93% specificity

Fetal Intelligent Navigation Echocardiography

The FINE method which allows automation in fetal echocardiography demonstrates an accuracy of 95% in the detection of congenital heart disease and is integrated as 5D Heart technology into a commercially available ultrasound platform (Samsung Healthcare), Daniela Zimmermann reports



The system automatically displays nine standard fetal echocardiography views simultaneously in a single template

Roberto Romero carries an impressive number of distinguished titles. He is known as an innovator in medical sciences; an inventor of breakthrough technologies; Professor at several academic institutions; head of research at the prestigious Perinatology Research Branch of NICHD/NIH in the United States, and Editor-in-Chief for Obstetrics at the American Journal of Obstetrics & Gynecology.

Trainer-in-Chief might appear to be a role beneath the dignity of such an accomplished physician. Yet, all this year, Professor Romero has been on the road leading one training session after another with fellow Obstetricians.

Using ultrasound simulation software, he demonstrates how to apply a novel method (Fetal Intelligent Navigation Echocardiography or FINE) to obtain standard fetal echocardiography views after acquiring cardiac volume datasets.

FINE is Romero's baby, a technique and a technology he developed with Lami Yeo, Professor of Obstetrics and Gynaecology at Wayne State University School of Medicine in Detroit, Michigan, to improve accuracy in the prenatal detection of congenital heart disease (CHD).

Progressively advancing tools in the prenatal screening and detection of congenital heart disease

Since first describing the method in 2013, Romero and Yeo have progressively advanced the tools they created from bench-to-bedside on the long path through clinical proof. They have demonstrated feasibility in the clinical setting and have since demonstrated abnormal fetal cardiac anatomy and hemodynamic flow in cases of CHD by applying FINE combined with colour or power Doppler ultrasound.

From work presented in September 2017 at the World Congress of the International Society of Ultrasound in Obstetrics and Gynaecology (ISUOG) in Vienna, Romero and Yeo, in a case-control study, have now demonstrated a sensitivity of 98 percent and a specificity of 93 percent for the FINE method, with an overall accuracy of 95 percent.

'In twenty minutes you are all going to know how to do this,' Romero told colleagues at a training session held during the World Congress.

The essential first step is acquiring a spatiotemporal image correlation (STIC) volume, which is a four-dimensional volume dataset of the fetal heart. Next, the operator utilises Anatomical Box to mark seven anatomical structures of the fetal heart. Once marking is completed, the system automatically displays nine standard fetal echocardiography views simultaneously in a single template, which include the four chamber, five chamber, left ventricular outflow tract, short-axis view of great vessels/right ventricular outflow tract, three vessels and trachea, abdomen/stomach, ductal arch, aortic arch, and superior/inferior vena cava.

Professor Roberto Romero MD, D.Med. Sci. heads the Perinatology Research Branch, Program for Perinatal Research and Obstetrics, Division of Intramural Research, Eunice Kennedy Shriver National Institute of Child Health and Human Development, National Institutes of Health, Bethesda, Maryland and Detroit, Michigan. He is also a Professor of Molecular Obstetrics and Genetics, Wayne State University (Detroit, Michigan), Editor-in-Chief for Obstetrics at the American Journal of Obstetrics & Gynecology, and an author of over 1000 peer-reviewed publications and several books.

Since its original invention, the FINE software has been integrated into the WS80A premium ultrasound system from Samsung Medison, and is known as 5D Heart technology.

The display of echocardiography views also uniquely includes automatic labelling of anatomical structures and the naming of each cardiac view.

'For many years we've been acquiring 2-D images of the heart and doing it poorly. We could not always detect the abnormalities in the heart,' Romero explained. 'It is difficult. Babies can be in different positions, they move around. To acquire the 2-D planes, the movements required by the operator can be minor, subtle, with the transducer tilted, moving forward and backward,' he explained to the training session participants.

Approximately 60-80% of all congenital heart anomalies go undiagnosed before birth, and they affect nearly one percent of births per year in the USA alone, according to the U.S. Centers for Disease Control and Prevention.

'Sonographers learn to do these exams by trial and error, with lots of patience and on many women. There is a long and time-consuming learning curve – and it's inconvenient for patients,' he said.

Once the sonographer manually acquires the 2-D images, interpretation and diagnosis are equally difficult, he said, adding: 'You need a lot of brain power to figure this out.'

Difficult? Not true

'In developing Fetal Intelligent Navigation Echocardiography, our first objective was to obtain a sonographic volume dataset of the fetal heart. We were told this was too difficult and that this cannot be obtained in the clinical setting. This is not true. We have prospectively demonstrated that obtaining these STIC volumes can be done, and in 96 percent of cases, the quality is appropriate for examination using FINE.'

'Then we were told this cannot be done outside a research centre. And this is not true. Everyone can obtain a STIC volume. In fact, we have published several papers on teaching others how to acquire these volume datasets,' Romero confirmed.

Next, the training session turns to operator-independent navigation and exploration of the anatomy surrounding each of the nine cardiac views, using the Virtual Intelligent Sonographer Assistance (VIS-Assistance) feature to identify abnormalities.

The FINE method simplifies fetal heart examination by substantially decreasing the number of steps required to obtain echocardiography views. It also streamlines workflow, and reduces operator dependency.

In discussing the most recent research study of the FINE method presented at the World Congress in Vienna, Romero stated: 'There are several clinical implications regarding the FINE method. It may be used to assess foetuses with normal hearts and a broad spectrum of CHD with a high degree of accuracy. It can be considered both a cardiac screening and diagnostic tool in the clinical setting.

'Since STIC volume datasets, diagnostic planes, and VIS-Assistance video clips can be transmitted by telemedicine for expert consultation, this also expands the outreach of fetal cardiac imaging, which could favourably impact the current sensitivity of CHD.'

Finally, he noted, FINE can be used for educational and training.

New transducer delivers best resolution in first trimester exams

Ultrasound is indispensable in prenatal exams

'In prenatal diagnostics, particularly in the first trimester, ultrasound continues to be the modality of choice when looking for malformations,' says Professor Markus Hoopmann, deputy director of prenatal medicine and gynaecological ultrasound at the Women's Health Clinic in Tübingen University Hospital. This case for ultrasound is significant because today fetal DNA that circulates in the maternal blood, can be screened for trisomy 21, or Down's syndrome. 'When this blood test was introduced, many experts predicted the demise of prenatal screening, particularly in the first trimester.' He strongly rejects a swansong.

The trisomy 21 blood test offers 99 percent sensitivity. A success rate, Hoopmann concedes, ultrasound first trimester screening will never achieve. Nevertheless, he adds, 'many people forget that the cell-free fetal DNA test is a screening test, not a diagnostic test. For a full diagnostic work-up representative fetal cells are needed that can only be obtained by punction.'

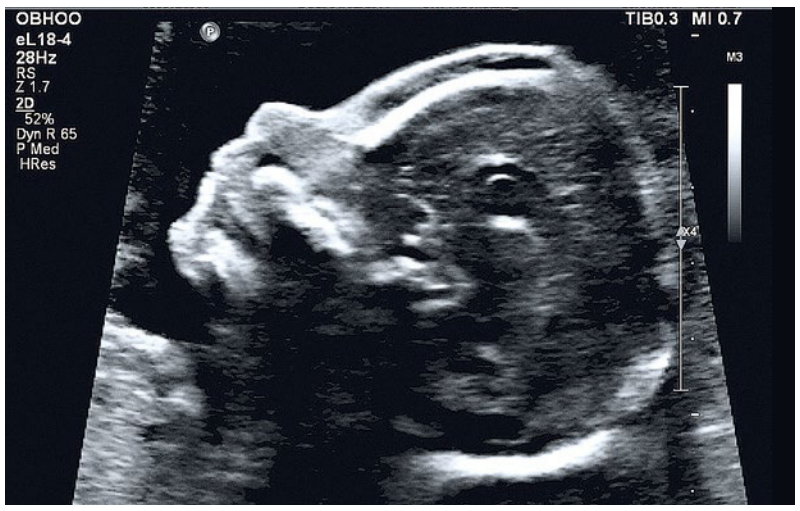
However, an even more important misconception is the widely held view that trisomy 21 screening equals prenatal diagnostics. 'Chromosomal anomalies account for a mere 10 percent of all malformations – and of those 10 percent only half are trisomy 21,' he explains. Far more frequent are structural anomalies, such as congenital malformations of the heart, anenzephaly or holoprosencephaly. '50 percent are clearly visible in ultrasound during the first trimester. Today, even spina bifida can be detected much better due to specific changes in the posterior fossa: Modern ultrasound systems offer increasing resolution which means that more and more anatomical detail is visible.'

Another alleged or real innovation in ultrasound that he is not keen on, especially in prenatal diagnostics, is artificial intelligence, inter alia in automated nuchal translucency measurement: 'Automated measuring processes by no means replace quality assurance.' The positioning of the measuring points to measure fluid in the neck at 11-13 weeks pregnancy is not crucial but correct setting of the planes on the ultrasound system. 'Deviating only a few degrees can significantly compromise your results. The sagittal plane has to be set manually,' Hoopmann explains, In prenatal ultrasound diagnostics, 'at no point is a human body, from the little finger to the mitral valve, examined more thoroughly and in its entirety as in the first trimester.

'No machine can handle this complexity. But maybe I'm just not as utopia-inclined as other people.'

3-D ultrasound is another issue where Hoopmann's feet are firmly on the ground: 'So far all endeavours to establish 3-D prenatal ultrasound

Continued on page 10



Hypoplastic nasal bone in pregnancy week 16

Since 2006, gynaecologist/obstetrician **Markus Hoopmann MD** has focused on specialised obstetrics and perinatal medicine and chaired the working group Ultrasound Diagnostics in Gynaecology/ Obstetrics (ARGUS). In 2009, he became deputy director of prenatal medicine and gynaecological ultrasound at the Women's Health Clinic, University Hospital Tübingen, Germany. This April he was appointed extraordinary professor at Eberhard Karl University Tübingen.

1.5 seconds to auto-detect four standard planes and auto-calculate six clinically relevant measurements

Fetal CNS screening advances

Smart Planes, created by Mindray Medical, applies machine learning to automatically display the essential central nervous system scanning planes for the detection of fetal brain disorders and malformations. John Brosky reports

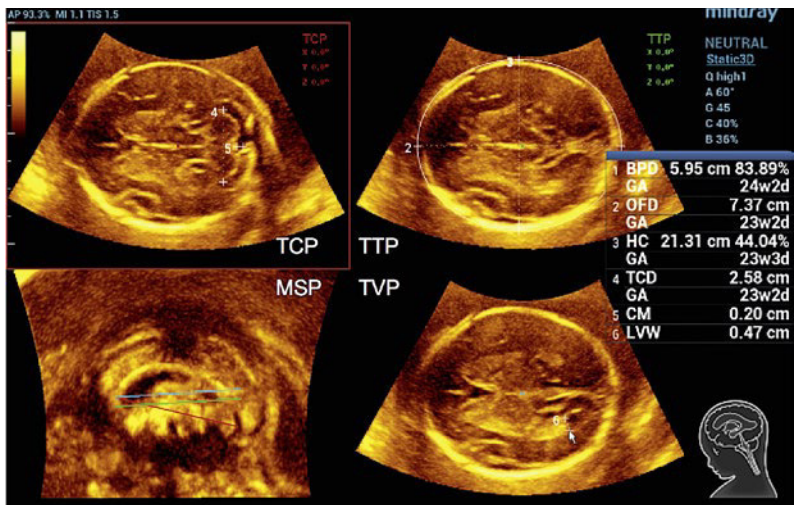
Ultrasound screening a foetus for central nervous system (CNS) disorders presents significant challenges, which explains why malformations are often missed.

The unborn child is often moving or in a poor position for performing the examination. For the sonographer, the examination is physically demanding and time consuming. Diagnosis is often based upon the three axial plane views that provide a view of anatomic landmarks and important measures of this morphology.

While the trans-cerebellar plane (TCP), trans-thalamic plane (TTP), and trans-ventricular plane (TVP) are considered critical for a clinical assessment, not all CNS anomalies are evident from these axial planes. Multiple studies have shown the three mid-sagittal plane (MSP) acquisitions are critical for the diagnosis of disorders, providing a unique view of intracranial structures, such as the corpus callosum and an axial view of the cerebellar vermis.

Yet, MSP views are particularly difficult to obtain using 2-D ultrasound. One study showed that in only 35 percent of exams is the acquisition of MSP successful.

According to Giuseppe Rizzo MD, from the Department of Obstetrics and Gynaecology at the University of Rome Tor Vergata, CNS anomalies are frequently missed because successful acquisition requires a premium ultrasound platform operated by a physician who is not only experienced in the demanding protocols but also up-to-date with the research that can help inform the diagnosis. 'Even with a great machine, these planes are not easy to obtain manually, and then if the physician is not aware of the latest findings, the right diagnosis can still be missed,' he explains.



Rizzo recently completed a clinical trial with a premium ultrasound platform that he said is a breakthrough for fetal CNS screening by offering an alternative to the demanding manual manipulations.

Mindray's Resona 7 system, equipped with the Smart Planes intelligence, brings computer-assisted detection to streamline and accelerate a thorough screening of the fetal brain.

Using a 3-D volume acquisition of the entire fetal brain, in mere seconds Smart Planes technology automatically reconstructs the standard CNS scanning planes of MSP, TCP, TTP and TVP, which even experienced physicians would take minutes to identify and acquire reliably.

Smart Planes also immediately calculates the range of anatomical measurements for biparietal diameter (BPD), occipitofrontal diameter (OFD), head circumference (HC), transcerebellar diameter (TCD), cisterna magna (CM) and lateral ventricles (LVW)

Auto-detection by Smart Planes of the four standard planes, as well as the auto-calculation of the six clinically relevant measurements, is completed with both precision and speed in less than 1.5 seconds.

Multiple studies have shown three mid-sagittal plane (MSP) acquisitions are critical in diagnosis of disorders, providing a unique view of intracranial structures, such as the corpus callosum and an axial view of the cerebellar vermis

The optimal standard plane for each view is detected based on machine learning techniques for pattern recognition that applied a training dataset of over 5,000 images of standard planes in fetal CNS.

Learning-based detection is an innovative procedure in medical image analysis; it simulates the human visual recognition process by selecting features from the training dataset to construct algorithms that are refined progressively by further learning to generate the final detection model. 'This,' Rizzo points out, 'is not yet artificial intelligence, but it's a step in that direction.'

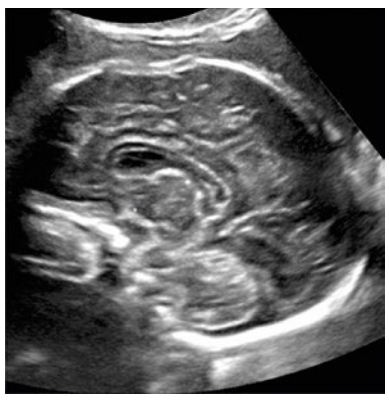
The speed of detection and display of relevant planes for CNS screening are accelerated by the unique zone acquisition architecture on board the Resona 7 platform. Unlike conventional beam-forming signal processing this transforms ultrasound to channel databased processing, transmitting and receiving a relatively smaller number of large zones.

The result is Mindray's exclusive Advanced Acoustic Acquisition that can extract more information from each acquisition, ten times faster than conventional line-by-line beam-forming methods.

'This system simplifies fetal biometry acquisition and reduces scan time,' Rizzo confirms. With Smart Planes, examination times are significantly shorter and workflow efficiencies greatly improved. Smart Planes precision and reliability also demonstrated a reduction in inter-observer variability, which increased diagnostic confidence, he added.

'You can analyse the images off-line, without the patient in the room. We can also send the images to a colleague for an expert consultation.'

The Resona 7 with Smart Planes has also proved to be an excellent platform for education with the on board library of images, which, he observed, is a great advantage for on-going, live case training.



Smart Planes immediately calculates the range of anatomical measurements for biparietal diameter (BPD), occipitofrontal diameter (OFD), head circumference (HC), transcerebellar diameter (TCD), cisterna magna (CM) and lateral ventricles (LVW)

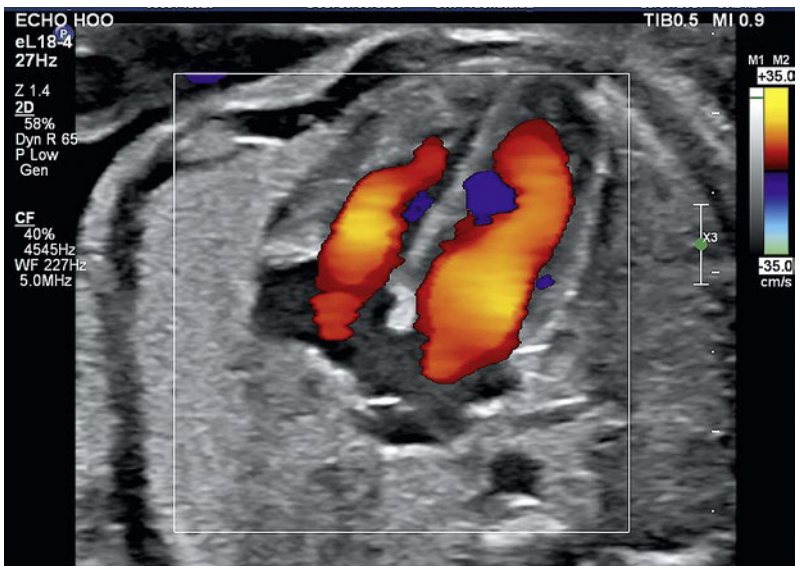
Giuseppe Rizzo, MD, completed his medical residency in Obstetrics & Gynaecology at University of Cattolica S. Cuore, in Rome, and today is a Professor in the Obstetrics & Gynaecology department at the University of Rome Tor Vergata, Italy, He has received many awards and honours, published various research articles in scientific journals and is a reviewer and editorial contributor for various scientific journals.

Fetal Intelligent Navigation Echocardiography

Continued from page 8

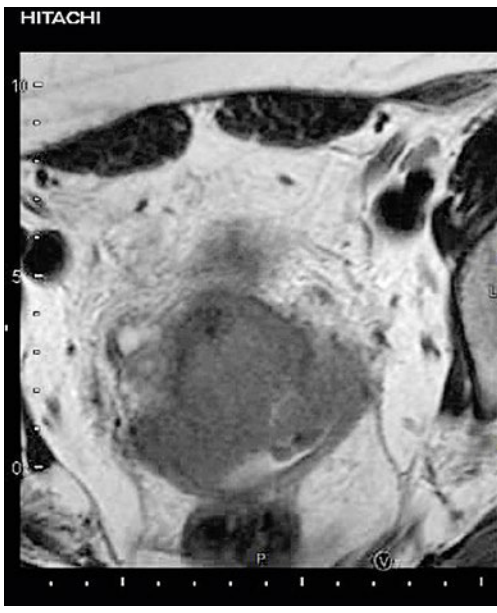
as a superior method have failed.' He does about 95 percent of his diagnoses on 2-D images. Nevertheless, he says, 3-D can be helpful in certain cases, for example in the evaluation of cerebellar vermis. For a few weeks now, Hoopmann has been using an innovative transducer, the eL18-4 by Philips, which does offer the desired results. 'This transducer delivers best resolution in first trimester exams with abdominal access,' he reports.

Older linear probes tend to lack penetration. Albeit, the new transducer also has its limitations: as soon as a foetus is larger than 8 cm it becomes difficult to generate a whole-body image. Thus, this particular probe can play out its strengths during the first trimester when the foetus is still small.



Non-suspicious four-chamber view with colour Doppler showing ventricular filling in pregnancy week 20

Fusion i



Fusion imaging techniques are being trialled to help advance the diagnosis of cervical cancer and endometrial cancer.

A team from a French hospital is using a Hitachi fusion imaging protocol – a combination of magnetic resonance imaging (MRI) with real-time high-resolution ultrasound (US) – to help evaluate locoregional extension of cervical cancer and endometrial cancer, which is regarded as a key step in patient management.

Work carried out by senior personnel in the Clinical Research Centre at the Hôpital Intercommunal de Créteil, Paris Est University, saw patients undergo a 1.5-T MRI protocol, an ultrasound exam and MRI and ultrasound fusion imaging examination. The results of the imaging fusion were then compared with US and MRI results alone.

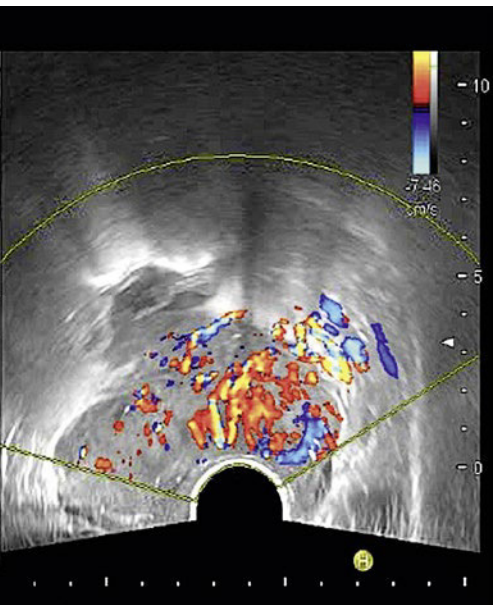
The reference diagnosis was based on the anatomopathological results for the women who had surgery, or the result of the multidisciplinary tumour board meeting for patients without surgery. The team compared the performances of each technique for the diagnosis and extension, such as parametrial, vaginal and bladder involvement.

Findings indicated that fusion imaging could be used as a complementary technique for MRI especially in complex situations for cervical cancer, such as questionable parametrial or vesical infiltrations when adding with the MRI results.

The study showed: 'While MRI remains the reference in extension

Advancing cervical and endometrial cancer diagnosis

maging could improve detection



Hitachi's Fusion imaging combining MRI and Real-time Virtual Sonography (RVS) showing a cervix lesion with color Doppler

diagnosis, real-time fusion imaging could improve in such difficult cases the patient care's management.'

Claire Theodore, from the Hôpital Intercommunal de Créteil, said the aim is to improve diagnosis through fusion imaging. 'Looking at the extension of the disease is very important to determine the stage of the disease and will improve different care managements – whether surgery, or concomitant radiotherapy and chemotherapy – and it will also help to advise more complex surgery if the disease is more spread.'

From the results, the team developed a fusion imaging protocol for cervical cancer including axial T-2 MRI sequence to evaluate the parametrium.

The technique, she explained, is user-friendly and patient friendly and involves using the MRI sequences to focus on specific areas and then use the ultrasound on the same plain as a second view on a different axis.

'The aim is to improve diagnostic performance because there is some discrepancy in MRI for extension of the disease, and it can be more difficult to assess, so fusion imaging can provide more information by adding ultrasound information and in real time we can compare the two exams and have more information.'

Figures show that cervical cancer is responsible for more than 266,000 deaths annually, with 528,000 new cases reported worldwide in 2012. In France – where the trial is being conducted – 3028 new cases and 1102 deaths were reported in 2012.

The American Cancer Society says 12,820 new cases of invasive cervical cancer were diagnosed in the USA in 2016, and more than 4,200 women died from cervical cancer in that year.

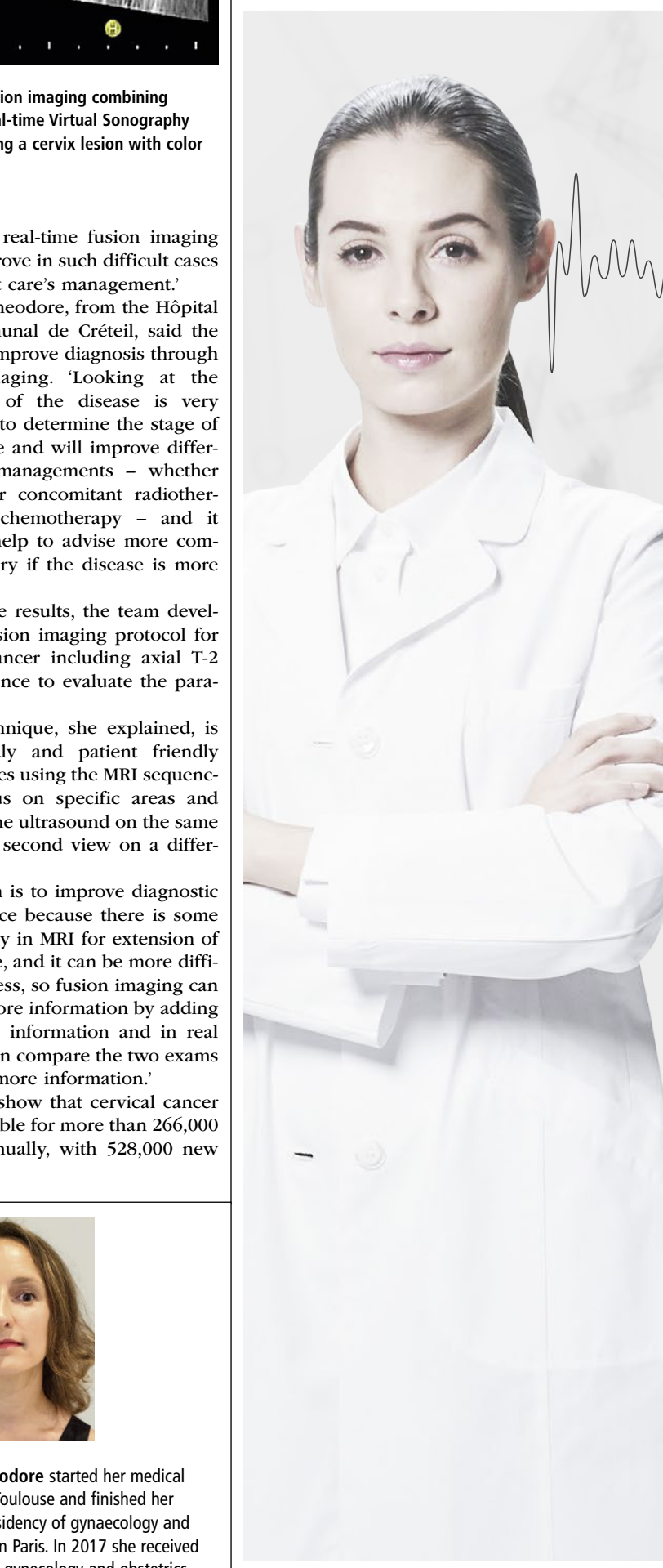
Fusion imaging is generally conducted after biopsy, as Claire Theodore stressed the importance of conducting biopsy at the earliest opportunity, with imaging performed for all patients who have a suspicion of cervical or endometrial cancer.

However, she also stressed that fusion imaging is still at an early stage, with further studies needed to assess its full potential and added that it was purely a diagnostic model.

The first study about cervical cancer recognised that ultrasound was very accurate for malignant diagnosis and MRI was the more efficient for the parametrial and bladder infiltration, whereas fusion imaging was accurate also for vaginal and bladder infiltration.

The team emphasise that fusion imaging should not be considered as an additional examination… 'but as a complementary technique easily performed when ultrasound and MRI are not efficient enough.

'Fusion imaging is a combination of ultrasound and MR data that can enhance and improve the diagnosis in some difficult cases.'

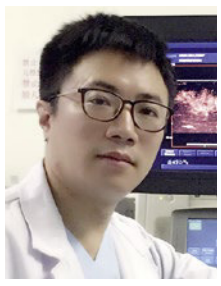


Claire Theodore started her medical studies in Toulouse and finished her medical residency of gynaecology and obstetrics in Paris. In 2017 she received her M.D. in gynecology and obstetrics after completing her master 2 research degree focusing on the use of MRI and ultrasound fusion imaging for cervical cancer.

Expanding innovative clinical applications

Advancing contrast enhanced ultrasound

Professor Dirk-André Clevert is the Section Chief of the Interdisciplinary Ultrasound-Centre at the University of Munich-Grosshadern Campus, Germany.



Dr Jun Luo is the head of the Ultrasound Department at the Sichuan Provincial People's Hospital in Chengdu, Sichuan, China.

Professor Fabio Piscaglia heads the Centre for Ultrasound of Internal Medicine at the University of Bologna, Italy.

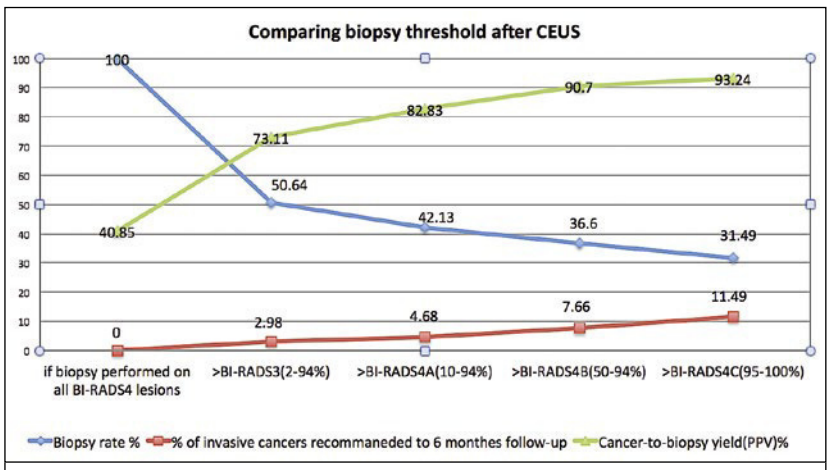
The ability to demonstrate blood perfusion as well as organ function using contrast agent-enhanced ultrasound is quickly finding innovative uses in clinical practice.

Contrast-enhanced ultrasound (CEUS) has advanced rapidly since its first introduction. Today it is widely used as a primary imaging technique for a number of indications and pathologies. At a symposium organised by Bracco Imaging during the European Congress for Radiology 2017, the session chairman, Professor Jean-Michel Correas from the Necker University Hospital in Paris, France, introduced three practicing clinicians who demonstrated new applications for CEUS.

In 2016, an ultrasound arm of the Liver Imaging Reporting and Data System (LI-RADS) set forth criteria aimed at harmonising the interpretation of findings obtained at CEUS with those of traditional CT and MR criteria for hepatocellular carcinoma (HCC) lesions.

According to Professor Fabio Piscaglia of the Medical and Surgical Sciences group at Italy's Bologna University, while CEUS should not replace CT or MRI, the ability to integrate imaging modalities can be very useful for best patient management. He cited a situation in which neither CT nor MRI is conclusive as to whether detected nodules are benign or malignant. Here, CEUS proved invaluable in targeting specific nodules to select those that should undergo biopsy.

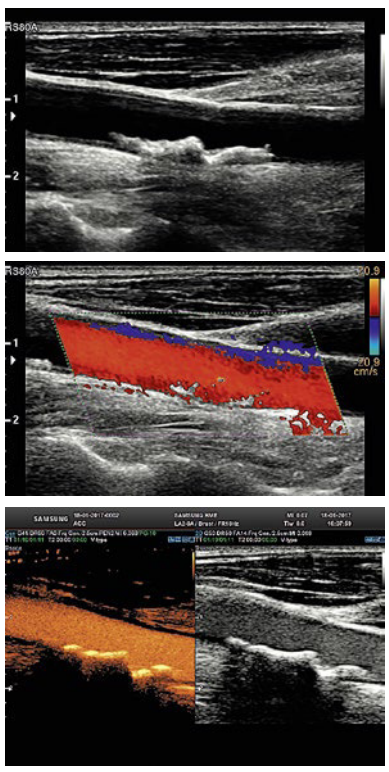
The CEUS LI-RADS working group of the American College of Radiology adopted a conservative approach with stringent criteria to preserve an extremely high positive predictive value for the diagnosis of HCC and assure confidence that staging with ultrasound examinations can be trusted.



Detected lesions are rated using the same scale applied to CT and MRI findings. Lesions classed as LR-2 to LR-3 have a low probability of being HCC, the probability of HCC is higher for LR-4 lesions and for those characterised as LR-5 there is a certainty of malignancy that virtually eliminates the risk of misdiagnosis.

Piscaglia presented results from a University of Bologna study where, across 300 nodules, a positive predictive value for LR-5 was found to be more than 99 percent for HCC.

According to Piscaglia, inclusion of the LI-RADS classification of lesions in radiology reports can help to establish a definitive diagnosis of HCC and avoid the risk of a misdiagnosis with cholangiocellular carcinomas (CCC). The standardisation of criteria also aids in communicating clear information to the referring hepatologist, not only to recommend biopsies, but also to assure optimal patient management



CEUS provides more information to help treatment because it shows the full extent of a stenosis without artefacts

in cases where the malignant lesion cannot be biopsied. The rating scale also helps in monitoring the progression of a specific lesion over time, even without a tumour size change.

Supported and endorsed by ACR and European professional societies, LI-RADS is a dynamic document, Piscaglia said, continually expanding through refinements as new findings accrue and in response to clinicians' feedback.

Applying the exceptional vascular imaging properties of CEUS to the carotid artery, Professor Dirk-André Clevert, Section Chief of the Interdisciplinary Ultrasound-Centre at the University of Munich-Grosshadern Campus, demonstrated how these exams can aid in assessing a stroke risk and determining the best patient treatment regimen.

An unstable carotid artery plaque causes approximately 25-50% of all strokes and about 80% of all strokes are ischemic, he said. 'With reconstructed images from CT and MRI we can see the complete carotid artery and stenosis of the arteries. Yet, do we know the extent of the stenosis? And we need to think about the correct treatment for the patient, in light of the extent of the occlusion. A reliable ultrasound exam becomes essential in these unclear cases where a decision needs to be taken for stenting, for surgery, or for no treatment in the case of an occlusion.'

Following a preliminary scan using grey-scale B-mode, the next step for the radiologist is to turn on colour Doppler to assess the blood flow, Clevert explained. Yet Doppler ultrasound has some limitations and does not always provide full diagnostic differentiation of critical stenosis from complete occlusion. In a further step CEUS can provide more information to aid with the treatment of the patient with an ability to show the complete extent of the stenosis without artefacts.

CEUS can also help assess stroke risk based on the contrast uptake inside the plaque, and thereby provide more conclusive information on the vulnerability (risk of rupture) of the plaque.

Combined with the high temporal and spatial resolution of ultrasound, contrast enhanced ultrasound (CEUS) is well placed to study vascular diseases and improve the visualisation of pathologies, he concluded.

At the Sichuan Provincial People's Hospital, Chengdu, China, Dr Jun Luo has been exploring the usefulness of applying CEUS to the characterisation and BI-RADS classification of focal breast lesions. A particular feature of Asian women, he explained, is that they have relatively small and dense breasts, which can complicate interpretation of traditional mammography images. As a result, sonography is usually considered the primary clinical work-up tool in China.

Japanese studies have similarly shown the effectiveness for ultrasound over mammography for Asian woman to detect early cancers, and a USA study demonstrated that findings with ultrasound are comparable to mammography. However, a limitation is a higher false positive rate using ultrasound with a resulting over-diagnosis rate ranging from five to as high as 50%.

Due to this tendency for over-diagnosis, Luo stated provocatively, 'BI-RADS is still not yet good enough.'

The key point in Luo's analysis is that neither ultrasound nor mammography includes dynamic perfusion information that can be fundamental in the diagnosis of breast lesions. Additionally, without perfusion information, neither modality can assess the risk of malignant transformation of a benign lesion. The addition of perfusion information aids in clarifying whether suspicious masses are malignant, cysts or benign lesions.

The potential with CEUS, he proposed, is to create predictive models that would maximise the reduction of false positives and minimise misdiagnosis of invasive breast cancers. Citing the results of a single-centre study that applied predictive models, the use of CEUS reduced the biopsy rate by up to 50% with only 2.98% missed invasive breast cancers that were detected only at the six month follow-up. The results have led to the start of a multicentre study in China to validate the findings.

'BI-RADS can be improved by using contrast because it gives information on microvasculature, which is very important in differentiating benign breast nodules from malignant lesions,' Luo said. 'Contrast ultrasound may also predict the risk of malignant transformation among benign lesions if microvascular proliferation is observed, just as occurs in examinations of the liver.'

How microbubbles cross the blood-brain barrier

A transducer halts abdominal bleeding

Stopping abdominal wall bleeding with contrast-enhanced ultrasound was just one of the exciting developments in CEUS presented at the Bubble Conference 2017 in Chicago

When you cut your finger you apply pressure to the wound until the bleeding stops. Professor Dirk-André Clevert from the Institute for Clinical Radiology at the Ludwig Maximilian University Hospital, Munich, Germany, remembered this simple remedy when seeking a non-invasive method to stop abdominal wall bleeding. In a first step, the radiologist precisely locates the bleeding site with the help of fusion imaging, i.e. computed tomography and contrast-enhanced ultrasound (CEUS). Then, using the transducer, he applies pressure to the damaged vessel. Intermittent contrast medium injections enable him to check whether the bleeding continues. 'In most cases, it stops within 30 minutes,' Clevert underlines, adding,

'The procedure was born out of necessity.

The fact that vessels involved in abdominal wall bleedings tend to be very small, turning endovascular therapy into quite a challenge, and that access via the groin can be difficult in older and obese patients triggered the search for a new method to manage the bleeding. Clevert had used a similar pressure approach with false aneurysm in the groin post catheterisation. While the bleeding can indeed be stopped by applying constant pressure on the lesion, 'the aneurysm procedure is more difficult since the groin vessel is much larger. The abdominal wall with its weaker perfusion presents itself for this technique.'

Penetration, however, is the limiting factor: 'The closer the bleeding is to the surface the easier it is to stop. Deeper than five or six centimetres, it becomes rather difficult.' Also, obviously if the bleeding is located behind a bone, the pressure technique won't work either. 'With soft tissue, it's a very helpful procedure,' Clevert reports.

Since substantial physical strength is required the radiologist recommends upright standing during pressure application rather than sitting down: 'Ideally, the patient couch is lowered so the transducer can be placed on the relevant site with arms outstretched.'

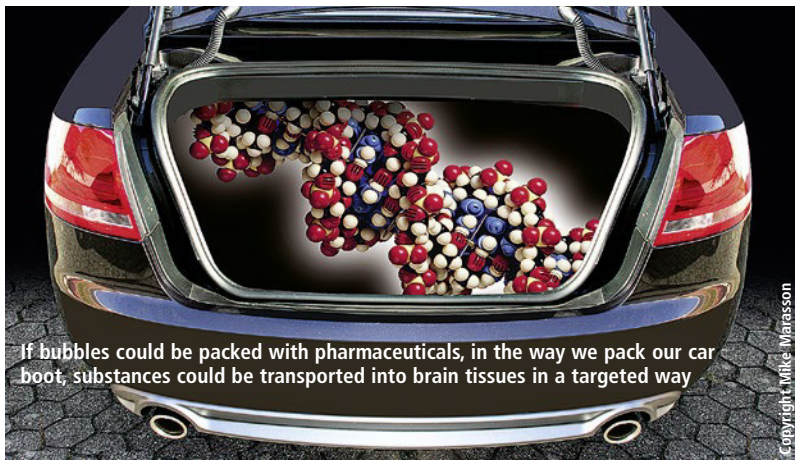
Professor Clevert presented this technique at the recent Bubble Conference 2017 in Chicago, the largest annual event in North America dedicated to new developments in contrast-enhanced ultrasound. The 'bubble' refers to gas-filled microbubbles used for contrast in CEUS.

While the system has shown its value as a non-invasive, cost-efficient and radiation-free diagnostic imaging procedure, more recently CEUS has also revealed its treatment potential. In addition to Clevert's new method to manage abdominal wall bleeding, a procedure was presented at the conference to briefly open the blood-brain barrier using contrast-enhanced ultrasound.

The oscillation of the microbubbles widens vessels just long enough to allow the bubbles to cross the blood-brain barrier. 'If we manage to pack these bubbles with pharmaceuticals, the way we pack the trunk of our car, we can transport substances into the brain tissues in a targeted fashion,' Clevert explains. In addition, the bubbles can be loaded with specific markers that inter alia dock onto VGF-2 receptors that are expressed during tumour angiogenesis – thus a high level of VGF-2 receptors is often associated with tumour growth.

Myocardial imaging

Myocardial imaging was another exciting feature at the conference. CEUS detects an infarction very early and enables a more precise prognosis of the extent of the cardiac event than catheterisation. Wall motion disorders and myocardial perfusion can be visualised better with 60 frames per second during a dynamic study, new algorithms and different transmission and reception settings may well increase this number to 6,000 frames per second to significantly enhance image resolution. 'The researchers in Chicago,' Clevert confirmed, 'demonstrated that bubbles can handle the stress created by such high frame rates.'



If bubbles could be packed with pharmaceuticals, in the way we pack our car boot, substances could be transported into brain tissues in a targeted way

Copyright Mike Marasson

IR: Merging information from different imaging systems leads to better patient care

Ultrasound implementation is going universal

Used in combination or exclusively for 90% of IR procedures in everyday clinical practice

'Ultrasound imaging is an attractive non-ionising medical imaging tool. It's safe, free of side effects and offers an unmatched real-time imaging capability,' interventional radiologist Professor Giancarlo Bizzarri underlines during our EH interview.

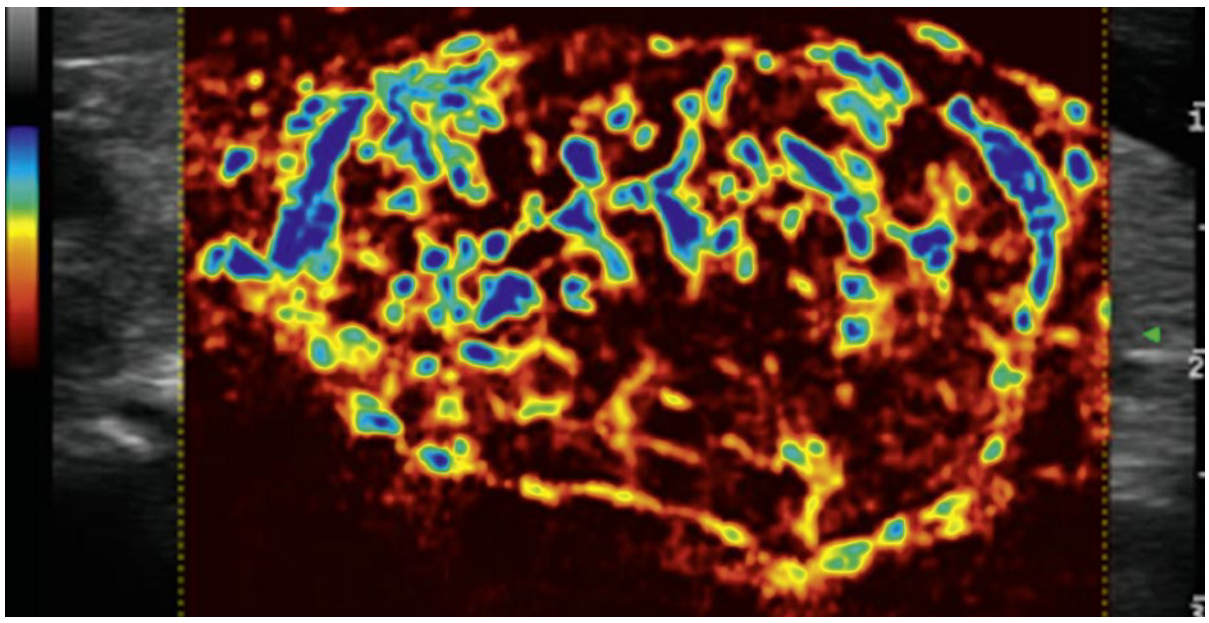
'In the last decade, technological improvements, such as colour-Doppler, contrast enhanced ultrasound, harmonic imaging, and elastography have increased the power of ultrasound,' radiologist Giancarlo Bizzarri points out. 'As a matter of fact, many medical specialists, other than radiologists, now make regular use of ultrasound in their daily practice. Thanks to its flexibility, medical ultrasound has been successfully introduced in emergency departments. 'But, we have to remember that diagnostic ultrasound is just one side of the coin.

'The real-time nature of ultrasound paved the way for its use in guiding interventional procedures. For example, in our department at Regina Apostolorum Hospital, although the number of diagnostic ultrasound examinations has been reducing over time, 90% of all interventional procedures are now performed with the exclusive or combined use of ultrasound.'

Easy to use systems

'The increasing demand for productivity by hospitals, diagnostic centres and private studies has driven the simplification of ultrasound systems.

'The widespread use of ultrasound has caused industries to focus their attention on the design, ergonomics and ease of use of the instrument. Diagnostic confidence increased, allowing the operator to focus on the patient, rather than on using the tool itself, which must have a user interface that is as simple and intuitive as possible. In addition, the introduction of purely digital scanners makes it possible to produce easy-to-use, self-adjusting equipments such as EasyMode technology.



New algorithms for advanced haemodynamic analysis such as microV allow the detection of low-velocity blood flow and micro-vascularisation

Promising new tools

'Diagnostic ultrasound is a varied and complex field, and some tools are more effective than others at providing high-tech answers to the following radiological requirements:

Non-invasive measurement of tissue elasticity using strain elastography or shear wave techniques can be promising for the characterisation of thyroid, breast, musculoskeletal, prostate and hepatic lesions.

The introduction of new algorithms to colour Doppler for advanced haemodynamic analysis enables detection of low-velocity blood flow and microvascularisation, for example in the presence of thyroid lesions, breast cancer, or in the early diagnosis of degenerative rheumatic diseases.

Contrast-enhanced ultrasound with high sensitivity, deep penetration, great resolution, and tissue-specific contrast media will be suitable for a wide range of clinical applications.

Real-time image fusion techniques allow ultrasound to be spatially co-registered with multiple volumetric image diagnostic modalities, such as MRI, CT, PET, and scintiscan, to create a virtual environment that maximises anatomic localisation and lesion characterisation and reduce the radiation dose and costs.

Benefits from multimodal real-time ultrasound combined with MRI/PET/CT

'We can combine the top performance and exclusive solutions of ultrasound systems with the specific information offered by MRI, PET and CT. Specifically developed for interventional imaging, fusion imaging technology provides additional clarity and precision when ultrasound-guided interventional procedures are required.

'Interventional settings require dedicated features and solutions that allow the accurate management of any kind of clinical problem. In a radiology department we have access to different kind of imaging techniques, such as MRI, CT, PET, fluoroscopy, nuclear medicine imaging, and so on. For the best patient care it's often not enough to use just one of these techniques separately. Image fusion such Virtual Navigator merges the real-time capabilities of ultrasound such as Doppler, CEUS, and elastography with functional information from other systems.

'Merging the information from different modalities, fusion imaging technology can also provide a real-time, accurate, low-cost, and radiation-free solution in research and teaching.'

3-D use increases in IR – what about 2-D imaging?

'The cognitive localisation of lesions with real-time ultrasound while making use of a secondary 2-D technology represents a significant challenge in every day clinical practice.

'Recently, an advanced technique was developed that makes it possible to precisely locate lesions, or other anatomical landmarks on real-time ultrasound via co-registration of the probe position with a 2-D secondary modality.

'In our experience, the use of these Body Map technology with scintiscan imaging has resulted in a high level of accuracy, with very

Professor Giancarlo Bizzarri is the Head of the Interventional and Diagnostic Radiology Department at Regina Apostolorum Hospital – Albano Laziale (Rome, Italy)

easy matching and precise real-time tracking. These new 2-D mapping techniques may provide tremendous support in the accurate diagnosis and proper planning of surgery and interventional procedures such as core biopsies and FNA procedures.'

'Because BodyMap 2-D navigation, 3-D Fusion Imaging, and Virtual Biopsy techniques can increase the diagnostic confidence of the operator, in different parts of the body, there are countless possible applications.

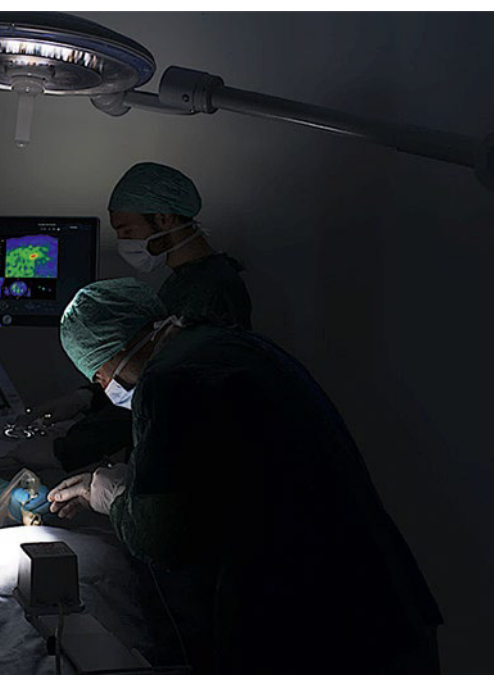
'Simplified and automatic fusion technologies and customised protocols will reduce the learning curve for the operator, and will help to make all these techniques more widespread.

New developments and future impact

'The main efforts in medical imaging are now directed towards prevention, diagnosis, selection of optimal (personalised) therapy (local/systemic), guidance of local treatments, assessment of therapy results (local/systemic) and disease follow-up. All these objectives require information to be not only archived and communicated, but also co-registered and processed by fusion and virtual reality software algorithms.

'In the near future, these new technologies will be integrated into all imaging and diagnostic modalities, PACS, Oncology Information Systems, and HIS, going beyond the simple radiological environment and spreading throughout all diagnostic and therapeutic fields.'

Real-time image fusion techniques allow ultrasound to be spatially co-registered with multiple volumetric image diagnostic modalities, such as those from MRI, CT, PET, and even with 2-D Dicom images.



Supporting the next generation of doctors

Fujifilm SonoSite maintains its strong focus on supporting medical training and education, and recently supplied instruments for a series of ultrasound workshops at the Doctors Academy International Medical Summer School.

Doctors Academy is one of the world's largest providers of independent medical education. Ultrasound workshops prove very popular among delegates, since the opportunity to gain hands-on experience in this area is necessary to fully understand the basics of the technique. Professor Stuart Enoch, a surgeon by training and now the CEO of Doctors Academy, explained: 'We focus on responding to the academic needs of medical students and junior doctors by delivering specialised knowledge advancement and skills courses that are not available via traditional routes.

'Medical students and junior doctors are seldom given the chance to perform and interpret ultrasound scans during their education or training. The workshop covers the fundamental principles of ultrasound, including the interpretation of core organs and choosing the most appropriate probes to use in different situations. Our tutors focus on a series of real-life scenarios, and discuss whether MRI, CT or ultrasound is the most appropriate investigative technique. This is followed by a demonstration and a practical session, enabling delegates to perform ultrasound scans for themselves, which explains the popularity of the workshop.'

ESMO highlights imaging's role in CRC liver metastases

From detection to treatment response

Imaging is increasingly useful in detecting colorectal cancer (CRC) liver metastases and evaluating how these lesions respond to treatment. Dr Daniele Regge reviewed all the latest advances during last September's Madrid meeting of the European Society of Medical Oncology (ESMO), Mélisande Rouger reports

A large majority of colorectal cancer (CRC) induced metastases will develop only in the liver, an organ that has long challenged radiologists.

'77% of all CRC metastatic patients have liver-only metastases and complete surgical removal of these lesions is the only treatment option that provides the best opportunity for long-term survival in 30% of patients,' said Daniele Regge, associate professor at Turin University and director of the radiology unit at the Candiolo Cancer Institute, Italy.

However not all patients are candidates for surgery, at least not as an initial therapy. To select candidates appropriately, doctors rely on imaging techniques, he explained. 'Imaging is the first stop to select which patients may benefit from surgery from those needing chemotherapy.'

Contrast-enhanced CT (CECT) is usually performed as a first test to detect and characterise metastases. But MRI is increasingly used as a complementary examination for those lesions that remain uncertain, or simply to pick up more lesions.

Many studies have compared diagnostic accuracy of MRI and CECT to detect liver metastases. One randomised study that specifically compared the value of hepatocyte-specific gadoxetic acid enhanced MRI and CECT (Thomas D Vreugdenburg et al., International Journal of Colorectal Disease 2016) offered interesting results on both modalities' reliability.

Although the authors did not notice any major difference in picking up lesions, using CECT or MRI altered surgical planning in significantly distinctive proportions. 'If you had a diagnostic pipeline with MRI, the change in surgical planning would be 20%,' Regge explained. 'But if you used CT, change would be observed in almost 50% of patients. These results prove that liver MRI is better at fulfilling the ultimate role of imaging to identify suitable patients for surgery – despite being expensive.'

In particular, the combination of diffusion-weighted MRI (DWMRI) and gadoxetic acid agents boosts sensitivity up to 95%. Radiologists may also use hepatospecific agents, for instance Gd-BOPTA and Gd-EOB-DTPA, to help them characterise lesions.

'Using agents provides increased lesion conspicuity on T-1-weighted images, because metastatic lesions maintain their native dark signal while the liver becomes much more enhanced,' Regge added.

Another study focusing on PET/CT (Eur J Nucl Med Mol Imaging 2015 Jan) showed that the incidence of extra hepatic disease detected only by PET was 32%. PET also led to change in patient management in 24% of cases. 'There is no solid evidence yet showing that PET should be used in tumour response, but probably it should be indicated in patients with a high risk of extra hepatic disease, for example BRAF+, or in patients with unclear resectable liver metastases,' Regge said.

For patients with unresectable metastases who will undergo conversion therapy, imaging will also help detect potential remaining lesions or their reduction after chemotherapy, and help decide whether subsequent surgery can be performed, or not.

Regge strongly recommends performing MRI in these patients because CT will not reveal some of the chemo-induced changes. 'On CT, post-therapy metastases often have reduced contrast in respect of the liver and ill defined borders. This is the consequence of tumour size shrinking to sub-centimetre diameters and drug-induced steatosis, which modifies the imaging aspect of the liver parenchyma,' he explained.

Additionally, intraoperative ultrasound (IOUS) or contrast-enhanced IOUS may be performed before surgery. Regge went on sharing results that highlight MRI's added value in detecting and characterising CRC liver metastases.

A study published in Annual Surgical Oncology in 2012 concluded that MRI was more sensitive than FDG PET/CT, after analysing 39 articles conducted in 1989 patients and 3854 liver metastases.

Research also showed that gadoxetic-acid enhanced MRI had an overall sensitivity of 97% compared to 72% for MDCT in the detection of metastases smaller than 1cm in fatty liver. Last but not least, DWMRI and CEMRI picked up previously unspotted metastases on CT and detected the largest disappearing lesion on CT.

Disappearing liver metastases (DLM) are an important issue to consider in treated patients, Regge explained. Seven to 37% of patients who have undergone neoadjuvant therapy for CRC have one or more DLM; and, in 35 to 80% of DLM's resected areas, viable tumour cells are found.

'It's not time to wait and see for DLM in CRC cancer. Complete radiological response correlates poorly with a complete pathological response. Recurrence after conservative management of liver metastases is observed in 33 to 74% of the cases. So it is advisable to resect or ablate the area of the DLM, considering the high microscopic residual disease rates at these sites.'

Here again, evidence of MRI's role piles up. A paper (Use of imaging to predict complete response of CRC liver metastases after chemotherapy, MRI vs. CT. Min Jung et al, Radiology 2017) recently showed that positive predictive value of MRI for absence of tumour was almost 80% compared to 35% for CT.

Imaging can also help detect DLM during surgery. IOUS enabled detection of 39% of all 67% detected DLM during laparotomy, compared to 6% by macroscopic liver examination.

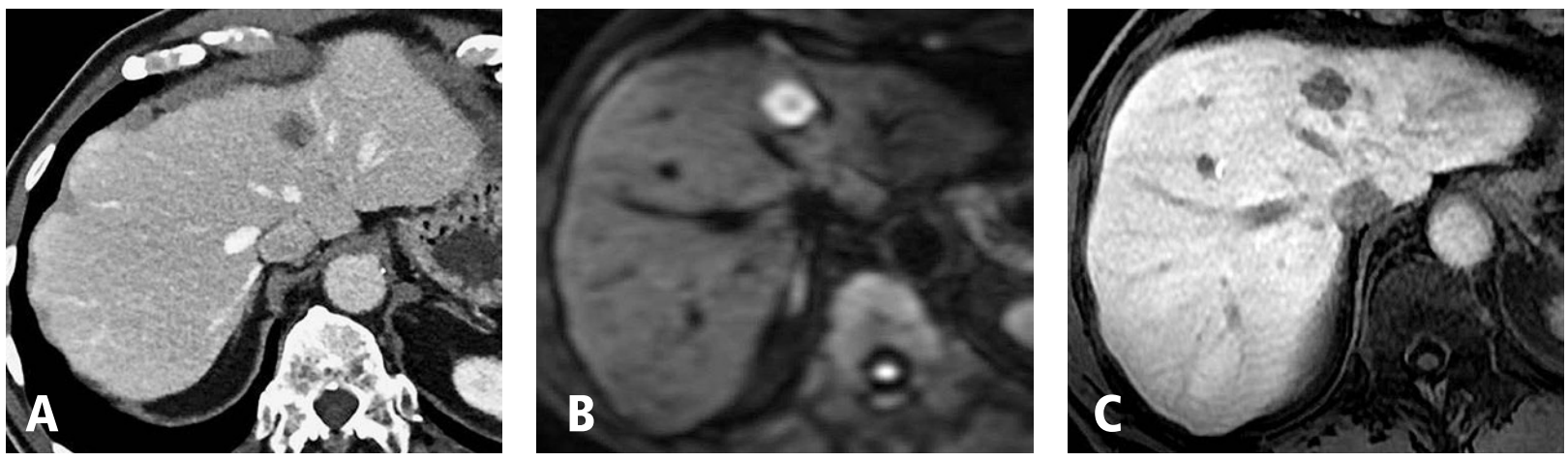
RECIST criteria help evaluate treatment response to medical therapy in fit patients with unrestectable disease, but these criteria are limited since they are based solely on anatomical one-dimensional tumour size. Moreover, according to Regge, significant variability in the measurements is observed.

'Tumour variations do not occur in uniform and symmetrical ways, and structural variations of the neoplastic tissue, such as necrosis, presence of inflammatory tissue, cavitation or changes in vascularisation are not frequently associated with dimensional variations. In addition, new molecular target agents and locoregional therapies induce tumour growth inhibition or lesion necrosis rather than tumour regression,' he said.

Although interesting PET research has shown that any type of morphological change probably implied there was treatment response, very few studies have assessed response with anything other than RECIST.

Mixed tumour response is an additional issue, and doctors need tools such as liquid biopsies, to integrate all the concerns.

'We are just at the beginning. The future is to put everything together: imaging data, genomics, everything we have.'



81 year old male with adenocarcinoma of the sigmoid colon and syncronous liver metastases. A) CECT scan shows a hypodense lesion in the 4th segment of the liver. B) Diffusion weighted MR imaging shows high signal intensity within the lesion due to restricted motion of water molecules. C) Delayed MR imaging after IV administration of gadoxetic acid shows that the metastasis maintains its dark signal while the liver becomes more enhanced

Daniele Regge is associate professor of radiology at the University of Turin and director of the radiology unit at the Candiolo Cancer Institute, Italy. From 2015-2017 he was president of the European Society of Oncologic Imaging. His main research focus falls on gastrointestinal and abdominal radiology and on assessment of tumour response to therapy. He is familiar with the most important radiological procedures such as magnetic resonance imaging, computed tomography and virtual colonoscopy, with a focus on oncology imaging.

Expert highl

Raising in CRC i

Report: Mélisande Rouger

Combining molecular information and high contrast resolution may well improve current performance in colorectal cancer (CRC) cases, according to Vicky Goh, who presented the latest results on PET/MRI during the last European Society of Medical Oncology (ESMO) meeting in Madrid PET/MRI brings the best of both modalities together: high contrast to noise and high spatial resolution combined with high sensitivity and molecular information. But that's not all, according to Vicky Goh, Professor of Clinical Cancer Imaging at Kings College London, UK.

'With PET/MRI, it's much more than just merging two modalities because we can use not just FDG but also other tracers – for example, to assess angiogenesis, hypoxia, and proliferation – and combine them. We can perform receptor specific targeted imaging and combine it with physiological aspects of MR imaging. We want to take advantage of PET/MRI's synchronicity, to have simultaneous assessment of different biological processes, and take advantage of this synergism to obtain increased specificity of our diagnostic evaluation and improved quantification,' Goh explained.

'MRI offers simultaneous multiparametric imaging with absolute spatial match under identical physiological conditions,' Goh pointed out. 'The technique provides a very comprehensive approach to patients with cancer, which I think is very important for personalised management of the disease.'

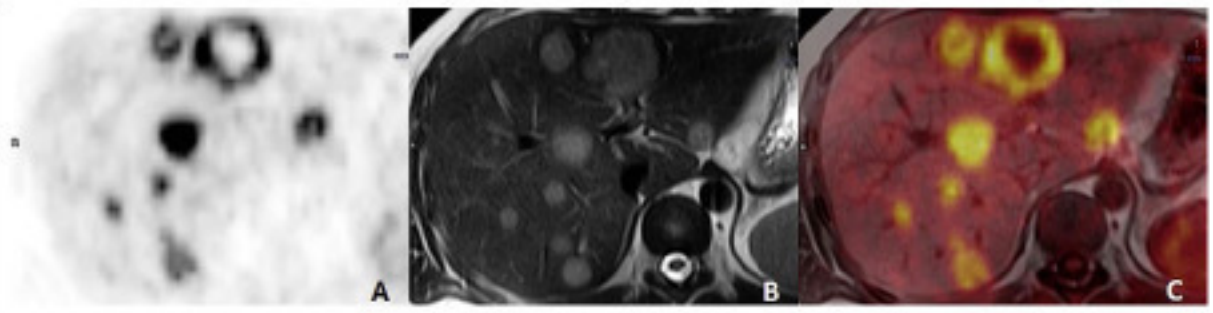
PET/MRI offers advantages over PET/CT, according to the radiologist. 'MRI overcomes the limitation of unenhanced CT in the spatial localisation of PET signal, for example, in pelvic cancers. It also contributes a lower radiation dose than PET/CT,' she said. Novel strategies are also possible via MRI for PET pharmacokinetic modelling, image registration and attenuation correction.

However, integrating PET/MRI has

Past-president of the European Society of Oncologic Imaging and current chair of the UK Royal College of Radiologists Academic Committee **Vicky Goh MD** has also been chair of clinical cancer imaging and head of the department of cancer imaging at the School of Biomedical Engineering and Imaging Sciences, Kings College London. She is also honorary consultant radiologist and academic lead at Guy's & St Thomas' Hospitals, NIHR Biomedical Research Centre. Having gained her medical doctorate from the University of Cambridge she trained in general medicine and radiology in London, and completed a fellowship in cross-sectional imaging in Toronto, Canada.

lights potential of PET/MRI in CRC imaging

the bar higher imaging



Axial 18-F Fluorodeoxyglucose (FDG) PET image (A), corresponding T2-weighted MRI (B) and integrated PET/MRI image (C) demonstrating FDG avid liver metastases

been challenging for manufacturers, requiring redesign of technology including RF shielding around the PET system integrated into the magnet, new detectors and electronics. These necessary additions have led to an expensive product. Workflow is also more complex compared to PET/CT, with much longer acquisitions – up to 60 minutes with the incorporation of locoregional sequences into a half-body PET protocol – and PET/MRI requires dually trained technicians and clinicians, which has been challenging in the short term.

'With 3-T MRI, the upside is that we obtain higher signal to noise. However, there is also higher energy deposition. The specific absorption ratio increases by a factor of four, with doubling of field strength. We also have an accentuation of some artefacts, for example, greater "susceptibility". Shorter radiofrequency wavelength also produces negative interference and central abdominal signal loss, the so-called 'standing wave effect', may be seen,' Goh explained.

Despite these obstacles, the new hybrid has evolved from status quo to status go ever since its clinical introduction in 2010. 'We really have had an appreciation of the potential for PET/MRI,' Goh said, quoting an increasing number of publications on the topic.

Recent research is backing up this potential. A systematic review gathering evidence studies in more than 2,300 patients, published last year, revealed that 18F-FDG PET/CT and PET/MRI performed equally well in cancer (Spick et al., Journal of Nuclear Medicine, 2016).

For prostate cancer patients, 68-Ga PSMA PET/MRI is better than multiparametric MRI for detecting and localising prostate cancer. Nodal specificity is certainly an advantage, and this will be a game-changer, the expert predicted.

18F-FDG PET/MRI also performs better than PET/CT in metastatic patients, for example within the liver and for bone lesions where characterisation may be enhanced by multiparametric sequences.

This is a benefit in determining disease burden and for therapy assessment. In an early study assessing response in ten patients with stage IV melanoma treated with PD-1 immunotherapy, 18F-FDG PET/MRI was able to demonstrate effects just two weeks after treatment onset.

In CRC staging, a recent study (Kang B et al., American Journal of Roentgenology, 2016) comparing PET/MRI and PET/CT showed that MRI had added value in 27.5% of patients, better characterisation of lesions in 23.5%, detected more lesions, particularly extracolonic, and implied change in treatment strategy in 21.6% of cases.

In assessing colorectal metastases, PET/MRI also had higher sensitivity than CECT, according to a study in Radiology (Lee et al., Radiology, 2016). Authors also observed fewer false negatives compared to PET or Primovist-enhanced MR alone.

'There's no doubt that, with PET/MRI, what we will be able to do is improve patient triage: for locoregional disease in terms of which treatment and its planning; and for metastatic disease, the true extent of disease and whether oligometastatic patients have treatable liver limited disease or whether they have systemic disease,' Goh said.

In CRC liver limited metastatic disease intended for resection, the probability of metastases remaining after neoadjuvant treatment remains an issue. But, here again, research has shown the potential of PET/MRI in improving detection and tumour viability.

Despite many remaining barriers to its clinical implementation, PET/MRI will raise the bar higher in CRC imaging, Goh concluded. 'It has the potential to improve performance in CRC for locoregional disease and for detection of metastases through higher sensitivity and specificity, and therapy assessment especially planning, delivery and early response.'

Canon—a bright future in healthcare.

CT

Utilizing advanced technology, the whole body can be rapidly scanned, helping to meet increasingly sophisticated clinical needs.

Ultrasound Diagnostic Systems

Improved medical care through such innovations as high-precision blood flow mapping technologies.

From diagnosis to treatment support—technology that's made for life.

Toshiba Medical Systems Corporation will become "Canon Medical Systems Corporation" in early 2018.

Our first president Takeshi Mitarai was a doctor, and soon after its founding,
Canon entered the medical industry in 1940.
And in December 2016, with the welcoming of the global medical solutions company
Toshiba Medical Systems into the Canon Group, we've begun a new chapter in our history.
Working together for patients and for you.
Together with Toshiba Medical Systems Corporation, who strive to improve the wellbeing of all people through contributions to medicine in the spirit of their "Made for Life," philosophy, we at Canon are strengthening and expanding our global healthcare business.

From in-vitro diagnostics to diagnostic imaging, we will deliver cutting-edge medical systems and solutions, including the Healthcare Informatics solutions that power them—to the world.
As a truly global company, we will work towards achieving our goal of "Kyosei",
the coexistence of humanity, by contributing to the advancement of healthcare.

Made For life

X-Ray Angiography Systems

From diagnosis to catheterization, we offer comfort and peace of mind with advanced technology.

MRI

Equipment that prioritizes the patient experience while assisting in various full-body diagnoses.

Canon

 global.canon

Experts warn that Spain's radiological equipment is out-dated

'One in three scanners are obsolete'

Obsolescence and strategies to manage equipment data to benefit patients were at the centre of debates during the Radiology Triangle meeting in Madrid earlier this year, writes EH correspondent Mélisande Rouger

In Spain, only 35% of CT equipment and 26% of MR equipment were less than five years old in Spain, according to a recent study by manufacturer Philips, which was revealed by Francisco Vazquez, general manager of Elekta, a radiation therapy and radiosurgery provider, speaking on behalf of the Spanish Federation of Healthcare Technology Companies (FENIN).

FENIN was already alarmed about this in 2015, reporting that Spain had the oldest MRI fleet in Europe, with one in three scanners considered obsolete (http://panelfenin.es/uploads/fenin/documento_estudios/pdf_documento_27.pdf)

However, MR scanners do not need to be changed that often because they can be updated, Antoni Capdevila Cirera, head of the diagnostic imaging department at Santa Creu i Sant Pau Hospital in Barcelona, pointed out. 'With MR you can update the software and gradients, so it's not necessary to change the magnet,' he told European Hospital. 'Many MR scanners are updated. As for CT, there hasn't been that much a change over the past five years to justify new equipment purchase.'

Nevertheless, FENIN points out that much of the ultrasound equipment is obsolete; one out of three machines currently used in daily practice is more than ten years old.

Capdevila concurred: 'A lot of our ultrasound equipment is 10 or 12 years old. There has been such a change in this field that a large part of the equipment has become out-dated.'

Yet, ultrasound equipment is among the cheapest in the imaging arsenal, but hospital managers often have other priorities for their budgets, for instance purchasing expensive oncological treatments. Other departments, such as cardiology or obstetrics, also need their own ultrasound machines.

However, it would be interesting for radiology departments to have the most recent developments in the modality, such as high-resolution ultrasound for skin study, and elastography for hepatic fibrosis, Capdevila believes. 'Luckily our department has these resources. But we have neither a PET/MR scanner nor MR-guided radiofrequency. This is in our plans for 2018. But I must confess I'm not convinced of the value of PET/MR for the future.'

Playing with thinning budgets

Spanish public healthcare lost about €10 billion between 2009 and 2013, as a result of austerity measures. The budget for public hospitals and healthcare institutions fell by 16.3 percent, about 0.8 percent of Spain's gross domestic product in just four years, the Finance Ministry reported in 2015. Far more important than buying new machines is to make the equipment pay off, Capdevila believes. 'We don't need the best scanners to evaluate all our patients; but we need to find a way to adjust our necessities to equipment cost.'

Healthcare decision makers should also plan what equipment they need long before the necessity is felt. There is a huge margin for improvement at this level.

'We are faced with obsolescence in decision-making. A CT scanner breaks and there is no time or money to replace it. We are going through a financial crisis, but there isn't any plan or vision for the future,' Elekta's Vazquez pointed out. ' It's only when the elections are nearing that people try to invest and make offers, and then they purchase 15 or 20 new scanners at the same time. But we haven't performed an accurate analysis of how this new technology is going to impact on our daily workflow at the hospital, or if every hospital, or only a few groups, need that equipment.'

Hospitals are increasingly teaming up with the industry to adapt their equipment to evolving necessities, a cooperation that offers flexibility compared to rigid public tenders, according to Capdevila.

However, interests of both parties differ and physicians perceive they have been tied to the industry's decisions, which have not always played in their favour, he believes. 'Providers say they want to cooperate with us, but their interests are different. Of course they want to sell their products and it's cheaper for them to make 200 identical scanners than 40 personalised machines. It's very hard for them to assume new challenges. They don't want to hear about the possibility for us to pay per examination instead of for a whole new machine.'

However, the industry appears to be ready to participate in patient management in the future, he added.

Presently the head of diagnostic imaging at Hospital de la Santa Creu i Sant Pau Hospital in Barcelona, in 1981-82 **Antoni Capdevila Cirera** published his first communications and works on the applications of ultrasound in medical practice and was one of the first European radiologists to be certified as an ultrasound radiologist. He has worked with MRI from 1984, especially on applications such as mass spectrometry, angiography and functional MRI. Publications include 60 articles in various medical journals, five chapters in related books, and he has produced 135 communications and posters, and 70 presentations.

Penalising absence of national strategy

All parties involved should be ready to share and exploit data, but a common strategy is missing, Vazquez pointed out. 'We don't have any system linking all the actors involved in healthcare and there is no organisation in the healthcare environment dedicated to exploit this data.'

Spain has 27 autonomous provinces and elaborating common work paths is very challenging. 'A lot of our equipment is expiring and we don't know whether there are any renovation plans and whether there is money to do so, or not. Every region does it its own way: some do public tenders; others make deals with private institutions. It's very hard to have a common strategy, also because regions have different necessities. Very often public tenders are based on technical, not economic criteria,' explained Pablo Valdés, Vice President of Spanish Society of Radiology.

The Spanish Society of Radiology also raised attention on equipment obsolescence in 2015 and has been working on guidelines to help hospital managers sort out what equipment they need based on their necessities.

Radiologist **Pablo Valdés Solís** directs the radiodiagnostic unit at Costa del Sol Health Agency. He has been vice president of the Spanish Society of Radiology since May 2016, where he previously served as head of strategy and head of communication. He was also in charge of the quality and management section and is currently secretary of the paediatric radiology section of the society. A further responsibility is to lead the professional skills certification project within the Spanish Society of Radiology. His main interests in medical imaging are ultrasound, emergency radiology and paediatric radiology.

Combining radiological and nuclear medical imaging procedu

PET/MRI leads hybrid imaging

Report: Michael Krassnitzer

Hybrid imaging is still a leading topic in radiology – underlined by the 14 related sessions held during the 29th European Congress of Radiology (ECR 2017) held in Vienna, this March. Those sessions focused on the combination of radiological and nuclear medical imaging procedures that aim to visualise morphology as well as function, structure and metabolism of an organ or region of interest.

Currently, many radiologists consider positron emission tomography plus magnetic resonance imaging – PET/MRI – to be the most promising candidate in hybrid imaging.

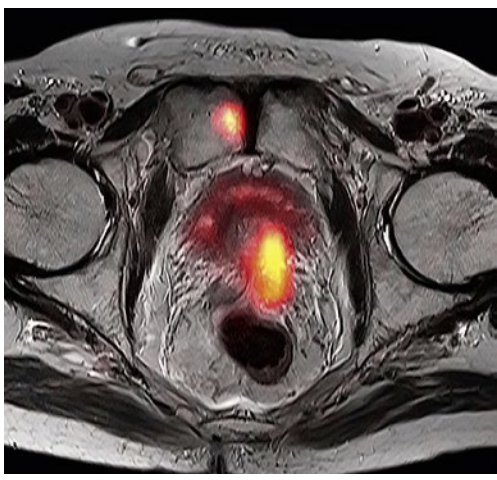
Among them, Professor Katrine Åhlström Riklund has no doubt: 'PET/MRI is going to be huge.' The professor, who is deputy director of the Department of Nuclear Research, medical director of the Nuclear Medicine Department and director of the Medical School at Umeå University in Sweden, pointed out a current study of 2,300 patients that has shown PET/MRI and PET/CT to yield equally good results in oncological imaging (Spick C et al., J Nucl Med. 2016). Today, 18F-FDG PET/CT is the gold standard any imaging participant has to meet.

In the Hybrid Imaging in Oncology several smaller studies were presented which shared one major insight. While PET/MRI has been proven equal, or even slightly superior, to other procedures it has failed to create the dramatic breakthrough that has been predicted for a number of years.

The very first study presented showed rather disappointing results. In pre-operative staging of surgical therapy of cervical cancer hybrid imaging did not offer meaningful additional information. 'When determining the Peritoneal Cancer Index, PET/MRI does not show any advantages over MRI alone,' Dr Montserrat Alemany Ripoll, Medical Director of the Department of Radiology at University Hospital Uppsala (Sweden) concluded.

However, a German study found PET/MRI to be superior to MRI in pre-operative staging of cervical cancer. 'The results demonstrate the usefulness of 18F-FDG PET data as a valuable additive to MRI alone for more accurate assessment of nodal or distant metastatic spread in patients with primary cervical cancer,' said Dr Johannes Grüneisen, junior physician at the Institute of Diagnostic and Interventional Radiology at University Hospital Essen.

At the same institute the diagnostic performance of PET/MRI and MRI alone was assessed in recurrent soft tissue carcinoma. Hybrid imaging results were positive, as the junior physician Dr Youssef Erfanian pointed out. '18F-FDG PET/MRI displays superior detection accuracy compared to routine MRI follow-up examinations.'



A Turkish study compared PET/MRI and non-contrast enhanced PET in the assessment of gastrointestinal tumours and found PET/MRI to be more effective in detecting lesions and metastases. 'We could detect significantly more lesions with the hybrid procedure,' Dr Filiz Çelebi of the Department of Radiology at Bilim University, Istanbul, explained.

Even results that do not evidence the superiority of PET/MRI can be described positively as a comparative study on PET/MRT and PET/CT in the staging of neuroendocrine tumours shows. '68Ga-DOTATOC PET/MRI provides an equivalent diagnostic performance for whole-body staging of patients with neuroendocrine tumours compared with PET/CT,' said Dr Lino Sawicki, researcher at the Institute of Diagnostic and Interventional Radiology at Düsseldorf University Hospital.

Enhancing radiation protection

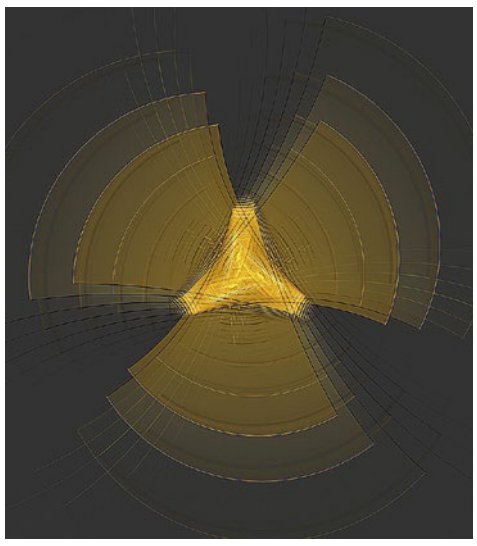
A new project funded by the European Commission calls together medical and radiation scientists, physicists and clinicians to enhance the radiation protection of patients and medical professionals. The four-year MEDIRAD project, which kicked off in June 2017, is led by the European Institute for Biomedical Imaging Research and comprises a consortium of 33 partners from 14 European countries. 'The strength of MEDIRAD is the unique multidisciplinary approach involving research groups focusing on radiology, nuclear medicine, radiotherapy, dosimetry, epidemiology, biology, bioinformatics, modelling, radiation protection and public health', says Prof. Elisabeth Cardis from ISGlobal (ES) and Scientific Coordinator of the project.

The use of ionising radiation in medicine has been steadily increasing, and this trend is set to continue, with obvious health benefits for the population thanks to improved diagnostic and therapy technologies. However, this increase in radiation exposure levels also raises a number of safety concerns: the potential health effects among patients and medical workers need to be evaluated, dose evaluation tools for clinical practice need to be developed, and practices need to be optimised in order to reduce exposure doses and ensure adequate radiation protection. MEDIRAD's overall goal is to address these needs by enhancing the scientific bases and practice of radiation protection in medicine.

To achieve this, MEDIRAD has three major operational objectives:

- to improve organ dose estimation and registration
- to evaluate and understand the mechanisms of the effects of medical exposures, focusing on two outcomes of public health relevance, namely cardiovascular effects of radiotherapy in breast cancer treatment and cancer risks following CT scanning in children and adolescents
- to develop science-based consensus policy recommendations for the effective protection of patients, workers and the general public

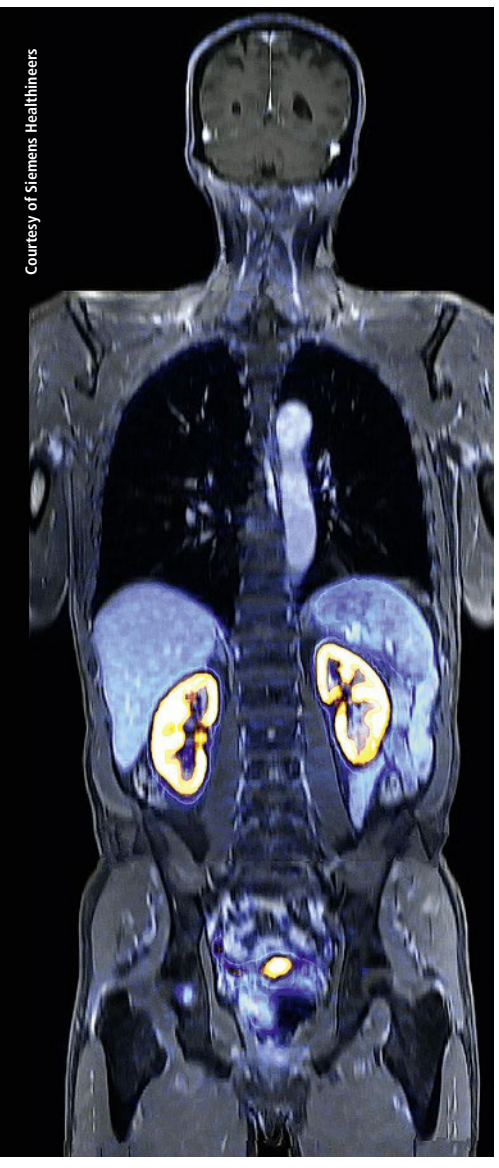
'This project will clearly contribute to more accurate risk estimations for radiation-induced cardiovascular events and thus support primary and secondary prevention', says Prof. Guy Frija from the University Paris Descartes (FR) and Clinical Coordinator of the project.



The project's overall goal is to enhance the scientific bases and practice of radiation protection in medicine

ures

A Turkish study compared PET/MRI and non-contrast enhanced PET in the assessment of gastrointestinal tumours and found PET/MRI to be more effective in detecting lesions and metastases



Courtesy of Siemens Healthineers

Enhancing clinical, sonographic, mammographic and MRI examinations

Risk profiling

Breast diagnostics are undergoing considerable change, with new technology facilitating alternative procedures. Genetics and nuclear medicine also enhance diagnostic possibilities. During our EH interview, Professor Rüdiger Schulz-Wendtland described current changes in breast diagnostics.

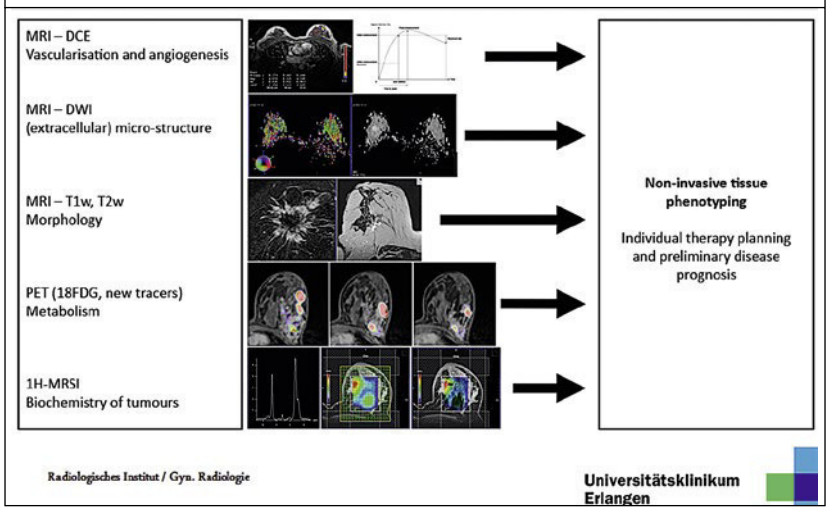
'To date, complementary breast diagnostics has comprised clinical, sonographic and mammographic examinations of the breast and, in some cases, also MRI scans. However, this spectrum will now be enhanced. In future, multimodal breast diagnostics will also include spectroscopy to capture the biochemical changes of tumours.

'Breast diagnostics will also be complemented by MRI/CT imaging. Specialists in nuclear medicine will also play an important part through the development of special tracers that accumulate in particularly inhomogeneous tumours and can help to visualise the biological composition in the MRI/CT image. This allows conclusions as to the aggressiveness of tumours. Combined with punch biopsy, it is now possible to compile a personal tumour profile for each woman, which will impact on the focus of treatment.'

The role of tomosynthesis within this concept

'Tomosynthesis is an important part of multimodal mammography, although it also gives rise to some vital questions. Is it required for primary diagnosis and, if yes, in what form? Must both planes, i.e. oblique and cc, be taken into consideration? Are synthetic 2-D images from one or two planes required? 'The critical point is radiation exposure. The dose for a 2-D mammography is lower than for dual-view tomosynthesis, although the latter allows the development of volumetrics. However, diagnostic safety IS more important than all these considerations, because studies have shown that dual-view tomosynthesis inclusive of reconstructive 2-D images only has slightly increased sensitivity and specificity. This is one reason why tomosynthesis with a curative intent has so far only been utilised when assessments are required.'

Parametric/molecular imaging in breast diagnostics

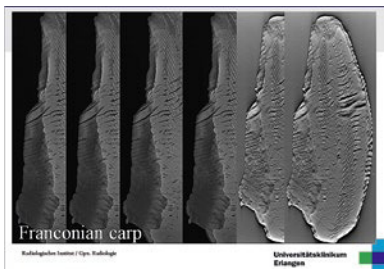


MRI is not an alternative

'It is not an alternative because MRI doesn't show the extent of microcalcifications, which are of essential importance for the surgical approach, and which can be captured three-dimensionally via tomosynthesis.

'In future, tomosynthesis may be replaced by contrast-enhanced CT, which is a new player in the game. In breast diagnostics its use is still experimental, but CT is currently experiencing a strong boost, because the results achieved so far, and also with our own equipment, are very promising.'

Experimental examination (Franconian carp) to illustrate tomosynthesis (cross-sectional image)

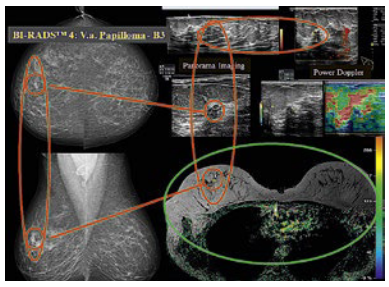


Genetics in cancer diagnostics

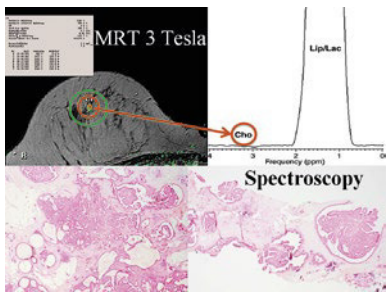
'I'm firmly convinced that genetics will have a role. The storage of DNA data sets to help fight crime is currently paving the way for the concept of DNA data set storage in general. Without this development, we would continue to have significant problems with acceptance. Admittedly, this may be a look into the very distance future, but storing DNA data sets may be a suitable way to replace unnecessary screenings with genetic risk profiling.

'Instead of carrying out large-scale, time-consuming universal examinations, which a high percentage of the female population does not even need, more specific focus could be given to risk patients. This would provide the best possible early diagnosis and preventive measures for those women who need it the most.'

Complementary breast diagnostics: mammography, ultrasound, power Doppler, elastography and MRI with 3-T



MRI with 3-T and spectroscopy: low choline peak, histologically B3, positive resection margin, papilloma verified with punch biopsy



Professor Rüdiger Schulz-Wendtland is Senior Consultant at the Institute of Radiology, University Hospital Erlangen. A radiology and radiotherapy specialist, he headed the Department of Gynaecological Radiology since 1994. He heads up a working group that was the first diagnostic unit in Germany to succeed in introducing digital mammography into clinical routine. Presently, he is President of the German Society for Senology (DGS).

'The fastest, highest resolution breast tomosynthesis system ever '

NEW: The 3Dimensions mammography system

'Clinicians across Europe have made clear their desire for breast cancer screening technology that offers improved accuracy, clarity and workflow, and the 3Dimensions system addresses each of those specific areas,' Hologic's Jan Verstreken, Regional President for EMEA and Canada, pointed out during the launch of the new system.

This is the latest in the firm's breast cancer screening, diagnostic and interventional solutions portfolio, and offers 'a variety of groundbreaking features designed to provide higher quality 3-D images for radiologists, enhanced workflow for technologists, and a more comfortable mammography experience, with low-dose options, for patients,' Hologic reports.

A world leader in breast cancer screening technology, the firm pioneered the 3-D mammography exam, which detects up to 65 percent more invasive breast cancers and is the only mammogram approved by the USA's Food and Drug Administration as superior for women with dense breasts compared to 2-D alone.

Innovations improve image clarity

'The 3Dimensions system offers a number of innovative features that improve image clarity and help manage dose, setting it apart from every other screening technology on the European market,' said Pete Valenti, Hologic's Division President, Breast and Skeletal Health Solutions.

The system offers Clarity HD high-resolution 3-D imaging, delivering the industry's fastest, highest resolution 3-D images to accelerate screening and analysis. It has been 'designed to clearly reveal subtle lesions and fine calcifications to help pinpoint cancers early,' the report continues, adding that the advanced detector and 3-D imaging algorithm work together to deliver exceptional 3-D images, regardless of breast size or density.

Clarity HD has reduced recalls by up to 40 percent compared to 2-D alone; however, the new system does offer Intelligent 2-D imaging technology, which features smart mapping, enabling radiologists to instantly move from suspicious areas detected on the 2-D image to the point of interest on the 3-D slice.

Patient comfort

3Dimensions also includes the new SmartCurve breast stabilisation system, a more comfortable mammogram – improving comfort in 93 percent of women surveyed, who had reported moderate to severe discomfort with standard compression – without compromising image quality. The system features a curved compression surface that mirrors the shape of a woman's breast to reduce pinching and allow uniform compression over the entire breast. 'Advanced processing software, specifically developed for the SmartCurve system, ensures optimal image quality,' Hologic explains.

Another feature available with the 3Dimensions system is the Quantra 2.2 breast density assessment software, which enables standardisation in patient protocols, providing reproducible and consistent breast density assessment.

Source: Hologic

Now on sale in Europe: Hologic reports that this new system offers groundbreaking features to produce higher quality 3-D images, enhance workflow, with low-dose options and delivers a more comfortable mammography experience

HOLOGIC®
The Science of Sure

The **best** just got **better**—every way you look at it.

NEW

Introducing the Hologic 3Dimensions™ Mammography System

- **Sharper:** THE fastest and highest resolution 3D™ images in the industry.[1] And, it's the ONLY tomosynthesis exam clinically proven to detect up to 65% more invasive breast cancer than 2D alone.[2]
- **Smarter:** Clinically proven comfort[3] without compromise in image quality due to advanced processing software that takes the curved compression geometry into account.
- **Simpler:** Enhanced workflow for both the technologist and radiologist, without compromising on speed, dose or accuracy.

Also available in 2D

Learn more at 3DimensionsSystem.com

3Dimensions™

1. Data on file and from public sources, 2017. **2.** Results from Friedewald, SM, et al. "Breast cancer screening using tomosynthesis in combination with digital mammography." JAMA 311.24 (2014): 2499-2507; a multi-site (13), non-randomized, historical control study of 454,000 screening mammograms investigating the initial impact of the introduction of the Hologic Selenia® Dimensions® on screening outcomes. Individual results may vary. The study found an average 41% increase and that 1.2 (95% CI: 0.8-1.6) additional invasive breast cancers per 1000 screening exams were found in women receiving combined 2D FFDM and 3D™ mammograms acquired with the Hologic 3D™ Mammography System versus women receiving 2D FFDM mammograms only. **3.** In an internal study comparing Hologic's standard compression technology to the SmartCurve™ system (18 x 24cm).

Seeking a view through the dense breast

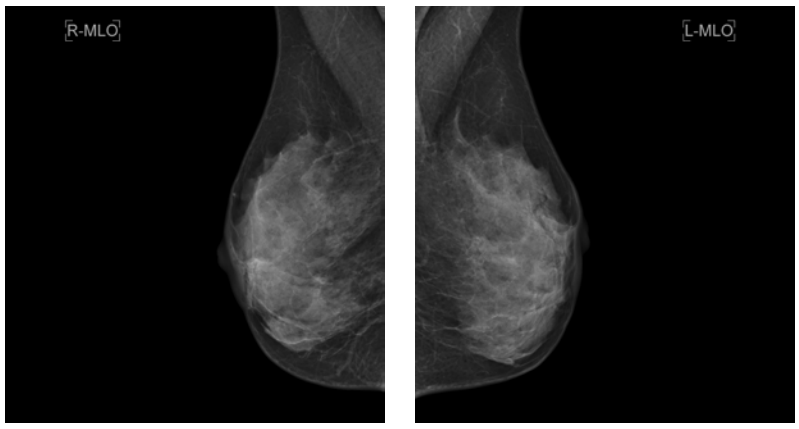
Abbreviated breast MRI

Despite rigorous quality assurance of breast cancer screening programs, 'both, over- and under-diagnosis of breast cancer is a challenge,' says leading radiologist Christiane K Kuhl, from the Department of Diagnostic and Interventional Radiology, at the University of Aachen, Germany. 'Mammography is a good screening test – yet has its limitations especially, but not only, in women with dense breast tissue. Since breast cancer continues to represent a major cause of cancer death in women, we have good reason to search for improved screening methods.'

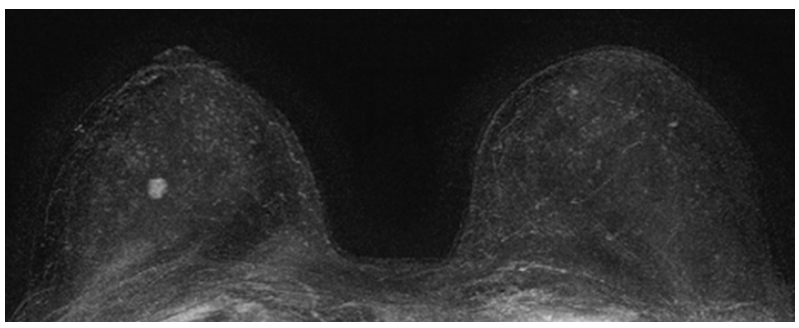
The current established gold standard of breast cancer screening, i.e. digital mammography, is associated with both, over- as well as under-diagnosis of breast cancer. Over-diagnosis means that screening mammograms pick up indolent cancers, which, even if left undiagnosed and thus untreated, would never become life threatening. Under-diagnosis means that screening mammograms fail to pick up many aggressive cancers that will, if undetected/untreated, progress to metastatic disease and thus contribute to breast cancer mortality.

The major reason for both over- and under-diagnosis is the fact that breast cancer biology is variable. 'Over the past years, our understanding of breast cancer as a heterogeneous group of diseases has greatly increased. Today, breast cancer is characterised by its genomic features. The different molecular subtypes of breast cancer explain the quite variable imaging presentation, risk of progression, response to treatment and patient survival between different breast cancers.'

Detection of breast cancer in digital mammography – and also in digital breast tomosynthesis – relies on the depiction of pathophysiological processes that are associated with slowed tumour growth. 'Mammography is good at finding cancers that are slowly growing – in other words: mammograms have a technology-inherent, and thus unavoidable, bias to detect less aggressive cancers. On the other hand, particularly aggressive breast cancers can exhibit pushing margins, may not cause architectural distortions, and may not be associated with calcifications. Thus, especially the faster growing cancers can remain undetected on mammography until they are large enough to become clinically palpable,' the radiologist explains.



Mammography (ACR-D) of extremely dense tissue in a 55-year old with no personal or family history of breast cancer. The mammogram is normal (BIRADS-1)



On MRI, a small breast cancer is visible, pT1b (8 mm), grade 3, NST, ER positive, PR negative, Her2-negative, Ki-67 30%

Additionally, there are host-related factors that will modulate the detectability of breast cancer on mammograms. 'Breast cancers tend to be similarly white on a mammogram compared to normal fibroglandular tissue. Therefore, normal fibroglandular tissue can obscure cancers. At age 50, about half of women have intermediately dense or extremely dense breasts that may obscure cancers. Yet, dense breast tissue means not only a reduced mammographic accuracy in finding cancers – but is an established risk factor for developing the disease,' Kuhl explains.

The concept of all current mammographic screening programs is to offer one and the same method – mammography – for every woman. This is the exact opposite of modern concepts of personalised medicine,' Kuhl explains. 'We need screening methods that are tailored to the need of the individual woman in order to avoid both, over- and under-diagnosis of breast cancer.'

Due to the sensitivity profile of radiographic breast imaging per se, the limitations of mammographic screening will only be marginally addressed by using improved radiographic imaging, such as digital breast tomosynthesis. 'It's beyond discussion that breast MRI is the most accurate screening method currently available. However, sustainable concepts of screening do not aim at increasing the overall number of detected cancers at all costs,' she emphasises, 'but to improve, and thus ensure, early detection of biologically important breast cancer – and avoid diagnosis of conditions that will not impact on patients' outcomes.

'The most important advantage of breast MRI compared with mammography is that its sensitivity profile is reversed to mammography: Breast MRI is indeed best in finding cancers with adverse biological profile, whereas it may remain normal in women with low-grade DCIS.

'Breast MRI thus offers the sensitivity profile that does match what contemporary screening is expected to deliver.'

Abbreviated breast MRI

'Due to the high cost of MRI it is currently reserved for a small group of women who carry a very high breast cancer risk. Yet recent data suggest that even, only a small fraction of this group indeed undergo MRI screening. MRI is not even considered for all remaining women who carry an average to moderately increased risk – despite the fact that breast cancer is the main cause of cancer death in these women as well. Accordingly, MRI is greatly under-utilised both in high risk and average risk women.

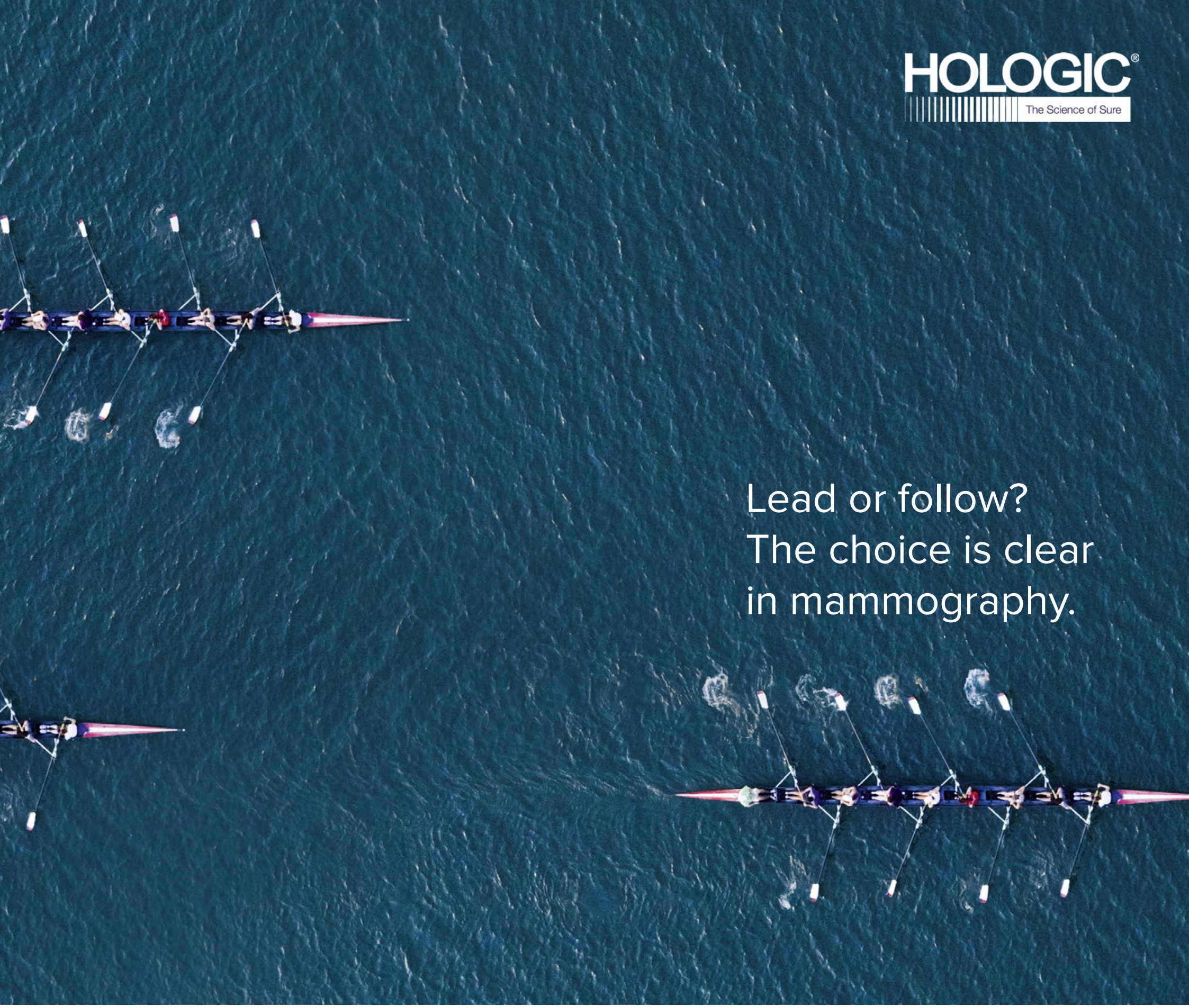
One aspect that drives costs is how MR systems are used. So far, MRI protocols – including those for breast cancer screening – employ complex and demanding technology to interrogate tissue properties to maximum. Therefore, clinical MRI protocols consist of an entire battery of pulse sequences that are time consuming to acquire and read. 'The concept of abbreviated MRI is to focus on specific components tailored to answer a specific clinical question – and cut out all other components, to keep it simple and short', Kuhl explains. 'For MRI breast screening, the question is arguably: Is breast cancer present or not? It takes about three minutes' magnet time to answer this question but, more importantly, with abbreviated MRI, it takes only a few seconds of radiologists reading time to establish this diagnosis.'

Kuhl introduced the concept of abbreviated MRI in her landmark paper published in the Journal of Clinical Oncology in 2014, where she showed that abbreviated protocols work perfectly well, and allow breast cancer diagnosis with the same superb sensitivity and specificity typical as does a full-protocol, 'conventional', multiparametric breast MRI. Since that publication, a number of articles followed by authors in Europe, Asia, and the Americas, which confirmed the reproducibility and clinical utility of this approach

'The results of all studies so far suggest that abbreviated MRI yields equivalent diagnostic accuracy as does full-protocol MRI, and thus could be a powerful breast cancer screening tool for a wider group of women. 'However, we need the same measures of quality assurance established, put to practice and enforced that are also part of mammographic screening, before we can even think of offering Ab-MRI on a broader scale. The first step is to test the concept rigorously in a large, multi-centre clinical trial in terms of effectiveness, patient acceptability and cost, against our best radiographic screening modalities, to ensure that it truly can reduce both over- and under-diagnosis.'

Thus, the EA1141 study has been set up (sponsored by Eastern Cooperative Oncology Group / American College of Radiology Imaging Network - ECOG/ACRIN). Under the lead of Christopher Comstock, MSKCC, Gillian Newstead, University of Chicago, and Christiane Kuhl, University of Aachen, this study aims to compare abbreviated MRI with digital breast tomosynthesis for breast cancer screening of dense breasts. 'If combined with dedicated MRI systems optimised for breast imaging and which ensure fast patient throughput,' Kuhl concludes, 'ab-MRI could be a viable alternative for population-wide screening.'

Professor Christiane Kuhl, MD, has been Director of the Clinic of Diagnostic and Interventional Radiology at University Hospital Aachen, Germany, since 2010. After completion of her medical studies, Professor Kuhl was appointed professor at the Department of Oncological Diagnostics and Interventional Radiology at University Hospital Bonn, Germany. As one of the most renowned German breast cancer researchers, she explores the benefits of MRI-based early detection of breast cancer. Kuhl has received several German and international awards for her work.



Take the lead with Hologic

- Not all breast tomosynthesis systems are created equal.
- When you partner with Hologic, it means proof—not promises. The Hologic 3D Mammography™ exam has proven results backed by more than 200 clinical studies.
- Only Hologic 3D Mammography™ exams detect up to 65% more invasive breast cancers compared to 2D alone.[1]

Contact your Hologic representative for updates on the latest innovations in mammography.

1. Results from Friedewald, SM, et al. "Breast cancer screening using tomosynthesis in combination with digital mammography." JAMA 311.24 (2014): 2499-2507; a multi-site (13), non-randomized, historical control study of 454,000 screening mammograms investigating the initial impact of the introduction of the Hologic Selenia® Dimensions® on screening outcomes. Individual results may vary. The study found an average 41% (95% CI: 20-65%) increase and that 1.2 (95% CI: 0.8-1.6) additional invasive breast cancers per 1000 screening exams were found in women receiving combined 2D FFDM and 3D™ mammograms acquired with the Hologic 3D Mammography™ System versus women receiving 2D FFDM mammograms only.

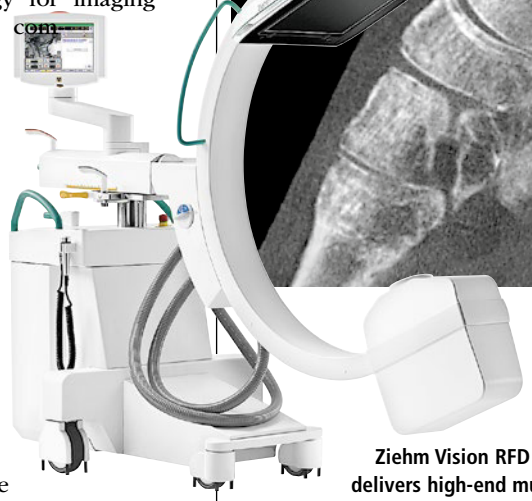
2-D and 3-D bundle brings greater intraoperative control

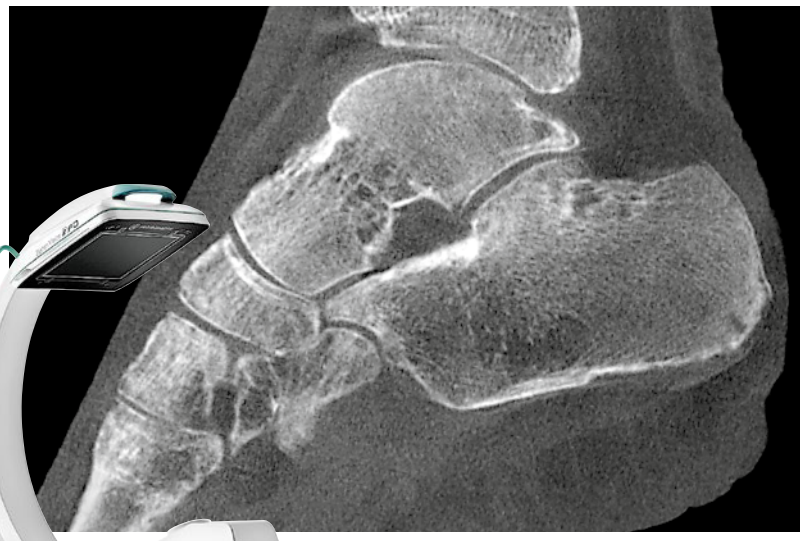
New mobile C-arm includes CMOS technology

'Building on more than 10 years' experience in 3-D imaging, the new Ziehm Vision RFD 3-D features cutting-edge CMOS technology, bundling 2-D and 3-D functionality for greater intraoperative control, reducing the need for postoperative CT scans, and costly corrective surgeries,' the manufacturer reports. 'This mobile C-arm is thus ideal for high-end orthopaedic, trauma and spinal interventions as well as highly specialised maxillofacial and cochlear procedures, for instance.'

CT-like image quality

The only 3-D C-arm with a flat-panel detector now also provides the latest CMOS technology for imaging excellence, the company reports. 'The enhanced imaging chain enhances resolution with crystal clear visualisations of the finest anatomical structures, complemented by SmartScan functionality for the complete imaging information in real time. The powerful 25 kW C-arm propels today's surgeon to the forefront of intraoperative 3-D imaging.'





Ziehm Vision RFD 3-D delivers high-end multidisciplinary capabilities for hybrid room applications and specialised procedures

Extended intraoperative imaging capabilities

The versatile device combines 2-D with 3-D technology to provide high-end multidisciplinary capabilities for hybrid room applications and specialised procedures, such as cochlear and maxillofacial. 'Precise information from every angle during the procedure helps to avoid unnecessary postoperative CT scans and corrective surgery,' Ziehm adds.

Image-guided surgery, workflow wizards, & dose control

The Ziehm Vision RFD 3-D redefines daily clinical OR routines with image-guided surgery and workflow wizards, which enhance intraoperative control, along with the ability to pull the postoperative CT scan forward to the operating room (OR).

The device has minimised dose exposure without compromising on image quality. Dose settings and enhanced SmartDose features cut exposure during 3-D imaging significantly, Ziehm points out.

Different volume sizes for resolution

CMOSline represents a system configuration that is based on a Ziehm Imaging CMOS flat-panel detector. Choice can be made from a range of 3-D volume sizes to meet diverse clinical needs. 'In addition to the standard volume of 16 cm x 16 cm x 16 cm, the system now also provides two further volume sizes for specialised applications,' Ziehm adds.

'A dedicated larger field of view with 19.8 cm x 19.6 cm x 18.0 cm (axial x sagittal x coronal) covers larger anatomical regions and delivers more structure for procedures such as pelvis surgery with 512 voxel.

'The higher number of voxels in all volume sizes guarantees a better resolution without increasing dose levels from those used with the convenient 320 voxel.

'Further, with an edge length of 10 cm x 10 cm x 10 cm, the mobile 3-D C-arm provides a suitable option for Zoom-In or intraoperative imaging in cochlear implantation.'

The higher number of voxels in all volume sizes guarantees a better resolution without increasing dose levels from those used with the convenient 320 voxel

CMOSline systems

This device is part of the new Ziehm Imaging CMOSline. The premium systems offer a Ziehm Imaging CMOS detector tailored to physicians' needs. 'The feature-rich SmartDose concept now comes in a further developed version with the ground-breaking Beam Filtration* technology. The new dose reduction technique for an optimised X-ray spectrum supports the enhanced CMOS imaging chain. This combination enables an exceptional reduction in the skin entrance dose for all CMOSline systems in comparison to systems with conventional filtration technology,' Ziehm continues. 'Positioned at the forefront of technology, surgeons who rely on CMOSline systems increase quality of care in their daily clinical routines.'

* The technology Beam Filtration reduces dose exposure for all CMOSline systems in comparison to conventional filtration techniques (Status before September 2017). Data on File. Results may vary.

EUROPEAN HOSPITAL

European Hospital Verlags GmbH
Theodor-Althoff-Str. 45,
45133 Essen, Germany
Phone: +49 (0)201 87 126 850
Fax: +49 (0)201 87 126 864
E-mail: info@european-hospital.com

www.healthcare-in-europe.com

Editor-in-Chief: Brenda Marsh

Art Director: Olaf Skrober

Editorial team: Wolfgang Behrends, Lena Petzold, Marcel Rasch

Senior Writer: John Brosky

Executive Director: Daniela Zimmermann

Founded by Heinz-Jürgen Witzke
ISSN 0942-9085

Correspondents
Austria: Michael Kraßnitzer, Christian Pruszinsky. **China:** Nat Whitney **France:** Jane MacDougall. **Germany:** Anja Behringer, Annette Bus, Walter Depner, Cornelia Wels-Maug, Holger Zorn. **Great Britain:** Brenda Marsh, Mark Nicholls. **Malta:** Moira Mizzi. **Spain:** Mélisande Rouger, Eduardo de la Sota. **The Netherlands:** Madeleine van de Wouw. **USA:** Cynthia E. Keen, i.t. Communications, Lisa Chamoff.

Subscriptions
Liane Kaiser,
Theodor-Althoff-Str. 45, 45133 Essen, Germany

Subscription rate
6 issues: 42 Euro, Single copy: 7 Euro.
Send order and cheque to:
European Hospital Subscription Dept

Printed by: WVD, Möhrfelden, Germany

Publication frequency: bi-monthly

Representatives
China & Hongkong: Gavin Hua, Sun China Media Co, Ltd. Phone: +86-0755-81 324 036
E-Mail: gavin_hua@163.com

Germany, Austria, Switzerland:
Ralf Mateblowski
Phone: +49 6735 912 993,
E-Mail: rm@european-hospital.com

France, Italy, Spain: Eric Jund
Phone: +33 493 58 77 43,
E-Mail: ej@european-hospital.com

GB, Scandinavia, BeNeLux: Simon Kramer
Phone/Fax: +31 180 6200 20
E-Mail: sk@european-hospital.com

Israel: Hannah Wizer, International Media Dep. of El-Ron Adv. & PR Co., Ltd.,
Phone: +972-3-6 955 367
E-Mail: hw@european-hospital.com

South Korea: CH Park, MCI
Phone: +82 2 730 1234,
E-Mail: mci@unitel.co.kr

Taiwan: Charles Yang, Phone: +886 4 232 236 33, E-Mail: medianet@ms13.hinet.net

USA & Canada: Hanna Politis, Media International
Phone: +1 301 869 66 10,
E-Mail: hanna@media-intl.com

Interactive mobile application provides continuous surveillance

Smartphone monitors cardiac rhythm

Report: Jane MacDougall

Insertable cardiac monitors (ICM) are designed for long-term use. Unlike external heart monitoring devices, an insertable monitor, smaller than a key, is placed under the skin of the upper chest, with no sticky pads or protruding wires, meaning that the patient can live as normal a life as possible. ICMs can record the heart's rhythm for up to three years either automatically or onto a patient held device.

The information generated helps the treating physician to understand clinical symptoms and, in many cases, such as cryptogenic stroke, find the underlying cause to be atrial fibrillation (AF). A series of recent clinical trials has attested to the value of ICM in detecting AF which would otherwise have gone undetected in most patients had monitoring been limited to 30 days. However data acquisition has remained cumbersome and unlike the ICM itself, does impact on the patient's comfort and way of life.

A Cardiology team in Lille, Northern France, from the Heart and Lung Institute of the CHU has recently used a new generation of ICM, which can automatically record the heart rhythm via an application that can be downloaded to a Smartphone. The Lille hospital group has a 20-year history in the use of telemedicine, having first developed Tel Urge, a network designed to treat neurosurgical emergencies at a distance.

Today, the group's healthcare teams have seven different networks for telemedicine in use for consultations, advice and monitoring of medical devices, therefore this new application fits well with the group's established way of working.

The ICM that has been implanted in Lille is the Confirm Rx, which although originally provided by St Jude Medical, is now available from Abbott and is the world's first smartphone compatible ICM.

Equipped with Bluetooth low-energy wireless technology, patients can connect using their own mobile devices; telephones, tablets etc. The ICM continuously monitors the heart rhythm and automatically records events of interest via the myMerlin app, as configured by the attending cardiologist.

Transmission of data via the app is secure and proactive. The doctor has access to the data at the secure web platform Merlin.net and, in the case of an incident, also receives alerts in real time.

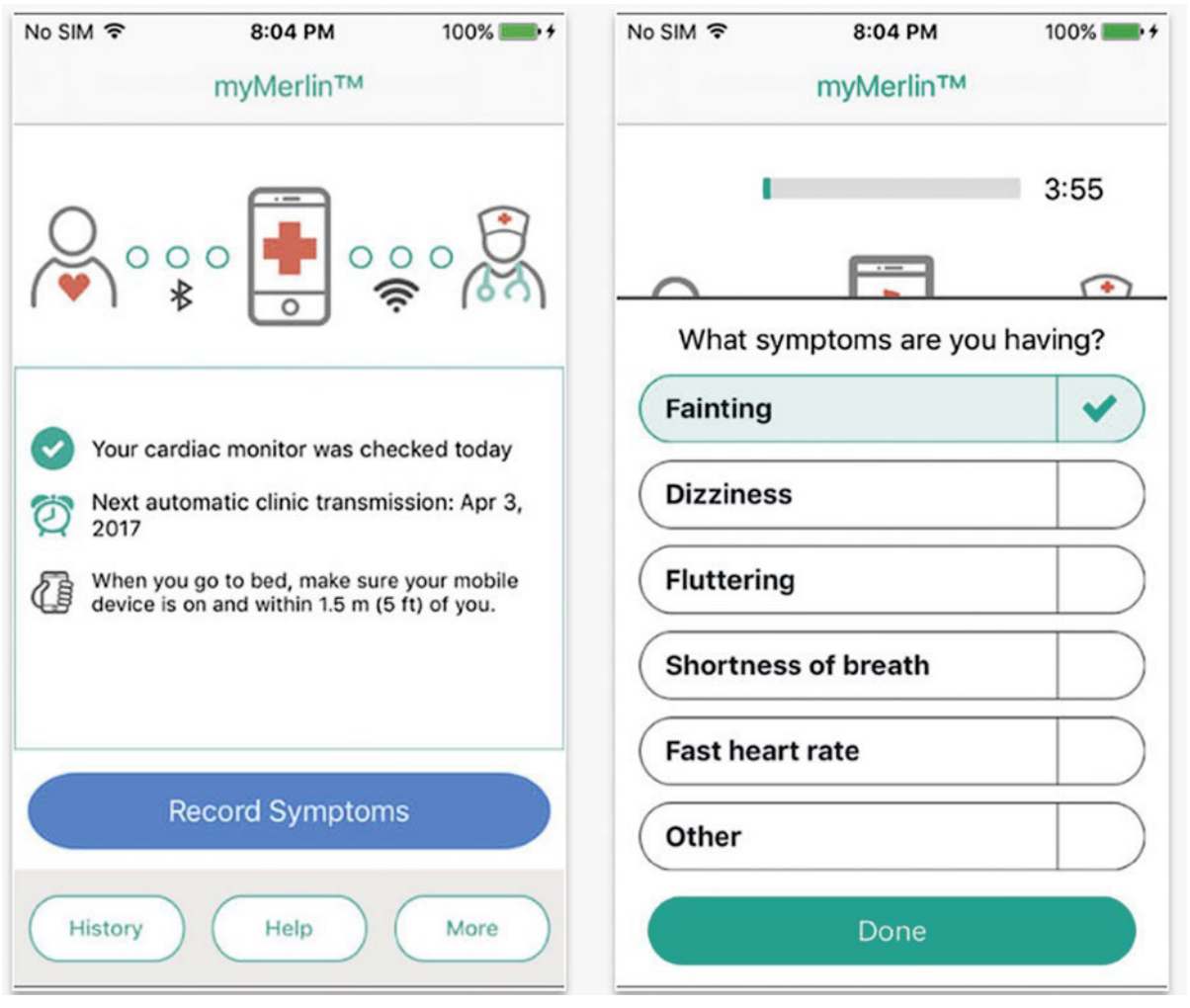
The app has an intuitive user-friendly interface that allows patients to record symptomatic events, view past and upcoming transmissions and ensures that they stay connected with the doctor.

Monitoring of the heart's rhythm becomes easy, effective and discreet. Insertable cardiac monitors are very comfortable and this innovative yet simple method of data collection does not interfere with patients' daily activities, or their mobility.

Close interaction with their health via the app has been shown to allow greater involvement in their condition and its management.

It has also been demonstrated to be particularly useful in helping patients to recognise triggers for their arrhythmia and, if possible, how to avoid them.

The hope is that uptake of the app will improve patient compliance with their treatment and help reduce the burden of the disease on healthcare usage.



The user-friendly interface allows patients to record symptomatic events easily and reminds users of upcoming transmissions

KEY FACTS ABOUT ATRIAL FIBRILLATION (AF)

- In Europe, more than 10 million people suffer from AF and by 2050 this figure is predicted to have multiplied by five due mainly to our ageing population.
- In AF, the heart rate becomes rapid and irregular due to the atria beating so fast that they tremble.
- Untreated AF can lead to stroke if preventive treatment is not introduced.

Catheter ablation reduces mortality and hospitalisation in HF patients

The CASTLE-AF Study

Forthcoming CASTLE-AF study results indicate a 38 percent reduction in composite risk for all-cause mortality and worsening heart failure (HF) hospitalisation in patients with coexisting HF and atrial fibrillation (AF) treated with catheter ablation—when compared with patients receiving pharmacological therapies that current guidelines recommend.

First presented at a late-breaking trials session at the 2017 ESC Congress, CASTLE-AF found a 47 percent reduction in mortality and a decrease of 44 percent in hospitalisation for worsening HF, when the endpoints were measured separately. Due to lack of data, the most appropriate treatment for patients with coexisting HF and AF has been frequently debated amongst physicians. Lead investigators Dr Johannes Brachmann and Dr Nassir Marrouche say that this makes CASTLE-AF a potentially guideline-changing study with a considerably positive impact on patient outcomes. 'The results of this trial underscore the importance of catheter ablation as a mode of treatment, indicating that the procedure should be performed as early as possible and as a first-line therapy in this group of patients,' Marrouche believes.


Courtesy of Biotronik

Brachmann expects the study to have a considerable impact on how HF patients with coexisting AF are treated in the future. 'The indicative results from CASTLE-AF could pave the way for wider adoption of catheter ablation and may prompt changes in current guidelines for treatment.'

Marrouche and Brachmann led what is, so far, the world's largest randomised clinical trial to compare the efficacy of catheter ablation against the current guideline recommendation for HF patients being treated with an ICD or CRT-D and suffering from atrial fibrillation.

The study, sponsored by Biotronik, enrolled 398 patients in 33 centres in the USA, Europe, and Australia between 2008 and 2016. Investigators measured the primary composite endpoint with a mean follow-up of more than three years—making CASTLE-AF the first catheter ablation study to follow this patient population for that length of time.

New blood test speeds up heart attack diagnosis

Report: Mark Nicholls

A new blood test to detect heart attacks has been developed by a team of researchers at King's College, London, which could speed up diagnosis, according to results from pan-European trials. The test is quicker than the standard test, which combines an ECG with a blood test to measure the levels of troponin. Under current guidelines, suspected heart attack cases are tested for high blood troponin levels on arrival in Accident and Emergency (A&E) units and three hours later are tested again.

Whilst many must remain in hospital for further tests to rule out a heart attack, around two thirds of those who arrive with chest pain have not actually had a heart attack. The research team suggests this new test will prove particularly valuable in A&E units by freeing up bed space.

Michael Marber, Professor of Cardiology at Kings College London

Developed by an international research team, the new blood test has been reported to exclude a heart attack in up to twice as many people as a troponin-based test

and head of the UK research, explained that the new test uses similar technology to the troponin test, but analyses the level of a protein called cardiac myosin-binding protein C (cMyC).

Levels of cMyC in the blood increase more rapidly after a heart attack, and to a higher extent, than troponin. 'This research is the first of its kind for cMyC,' Prof. Marber said. 'We've shown that this is not only just as good as the current test for working out who has had a heart attack, but it's also much better at working out who hasn't.'

He hopes the new test could be available in hospitals within the next five years.

As well as King's College London, research also took place at University Hospital Basel, University Heart Centre in Hamburg, Hospital del Mar in Barcelona, Hospital Clinico San Carlos in Madrid, University Silesia in Katowice and Martin Luther University Halle-Wittenber in Halle.

The international team carried out blood tests for troponin and cMyC on nearly 2,000 people presenting with chest pain. Compared to troponin tests – which come in two forms, Troponin-T and Troponin-I - the cMyC test correctly excluded a heart attack in up to twice as many people.

Study data showed that, in the laboratory tests, Troponin-T ruled in 12%, ruled out 25% and marked 63% of people for observation, with 75% who would have been admitted to hospital for further testing with these results. Troponin-I ruled in 15%, ruled out 15% and marked 70% of people for observation, with 85% who would have been admitted to hospital for further testing.

However, in the laboratory tests, cMyC ruled in 15%, ruled out 32% and marked 52% of people for observation, with 67% who would have been admitted to hospital for further testing.

At St Thomas' Hospital in Central London, where the UK research team is based, they carry out 7,800 heart attack tests each year. If rolled out widely, researchers say cMyC could save the hospital over £800,000 (more than €900,000) by reducing admissions and freeing up nearly 2,500 bed-days every year.

The British Heart Foundation, the UK Department of Health, the Medical Research Council, a range of other healthcare providers and industry funded the study.

BHF Medical Director Professor Sir Nilesh Samani said the troponin test, used for around 20 years, is currently the most powerful tool clinicians have for diagnosing less obvious heart attacks, but acknowledges 'there's always room for improvement. These initial results with the cMyC test look very promising for patients, who could be more quickly diagnosed and treated or reassured and sent home.

'This test could also allow hospitals to save hundreds of thousands of pounds by freeing up valuable hospital beds. However,' he underlined, 'further research is necessary before it can be recommended as a replacement for the troponin test.'

Professor Sir Nilesh Samani is Medical Director of the British Heart Foundation and currently BHF Professor of Cardiology at the University of Leicester, Head of the Department of Cardiovascular Sciences at the University, Director of the NIHR Biomedical Research Unit and a consultant cardiologist at Glenfield Hospital in Leicester. In 2015 Professor Samani was knighted for services to medicine and medical research. Among his many research achievements, he has co-led the discovery of over 50 genes associated with coronary heart disease.

Michael Marber is Professor of Cardiology and consultant cardiologist, currently co-leading the Cardiovascular Theme within the National Institute of Health Research (NIHR) Comprehensive Biomedical Research Centre at Guy's & St Thomas' NHS Foundation Trust (GSTFT) and King's College London (KCL). His research interests focus on the processes that contribute to myocardial injury during ischaemia and reperfusion.

New system will increase LC-MS/MS adoption

Simplified mass spectrometry for bioanalysis

Clinical diagnostic labs need efficiency to support patient care and remain cost effective. A recent article in European Hospital highlighted the challenges and needs for diagnostic testing in clinical labs and showed that liquid chromatography-tandem mass spectrometry (LC-MS/MS) is an important tool for efficient diagnostic testing. However, the technique is not used to full potential due to the complicated technology. The ideal system should be easy to use, fully automated, have a broad range of assays with ability to expand to wider tests and should eliminate complex sample preparation. It also needs to be CE-marked and FDA cleared. We spoke to Aaron Hudson, Senior Director and General Manager of SCIEX Diagnostics, about the new Topaz LC-MS/MS System for clinical diagnostics, and its potential to meet all those needs.

'Today, immunoassays are the prevalent technology used in clinical labs for routine testing. These classical tests generally offer a high degree of automation and fast time to result, but they have a number of drawbacks for clinical labs,' Aaron Hudson pointed out.

'First, their accuracy is not guaranteed – traceability and standardisation efforts are on going. Immunoassays require a highly selective antibody and while these can be generated for protein-based antigens, developing selective antibodies for small molecules is much more difficult. Many antibodies cannot distinguish between small alterations, such as different protein isoforms or post-translational modifications, and are limited in their specificity between structurally similar compounds and metabolites, especially at low concentrations.

'These small differences can often have profound diagnostic implications and thus commonly require mass spectrometry, a higher-order technique, for definitive accuracy. Modern mass spectrometers can detect to the attomole level, and are typically more sensitive and specific than immunoassays.

'However, MS-based methods can be much more complex than standard immunoassays. The typical software interface of current MS systems is far from the user-friendliness and convenience of typical clinical chemistry analysers, and often requires oversight by personnel with PhD-level training in mass spectrometry.

The new Topaz LC-MS/MS System

Courtesy of Sciex

New CE-approved mass spec technology

'To overcome these challenges Sciex developed the Topaz System, designed to lower barriers to adoption of mass spectrometry and make it accessible to all clinical labs.

'The heart of the system lies within the ground-breaking ClearCore MD software, a platform that simplifies workflows and method development, and incorporates features that enhance usability to help new users build proficiency quickly.

'The Topaz System is built on the platform of Sciex's most robust technologies to date. The software has been designed from the ground up with a focus on making it simple to use, removing the need for high-level specialists to run the mass spectrometer in the clinical lab. It offers great flexibility with an open system, where lab-developed tests can be raised and used, as well as a closed system for running locked, pre-validated assays.

'More than three years has been spent on writing the software, to develop the simple and user-friendly interface. During development, feedback was received from end-users, particularly technicians from clinical labs, to ensure that tasks, such as uploading to the laboratory information management system and development of lab-specific tests, were easily executed.

'The Topaz System was built under FDA guidance for Human Factors and Medical Devices, so user input was a prerequisite that ensures the system meets the needs of end-users in clinical labs.'

Assays for clinical use

'For the USA a turnkey, FDA-approved Vitamin D test is available for the Topaz System. Because Vitamin D has been linked to several clinically important diseases, it is necessary to provide accurate results from Vitamin D tests. Since Vitamin D consists of two isomers, Vitamin D2 and D3, it is important to accurately determine the concentrations of both - something that immunoassays struggle to do. The Vitamin D 200M Assay for the Topaz

19th century horse gallops through bacterial DNA

CRISPR system embeds images in DNA

Report: By Mark Nicholls

A research team in the United States has developed a revolutionary technique that has encoded an image and short film in living cells.

Scientists at the Wyss Institute for Biologically Inspired Engineering and Harvard Medical School (HMS) used CRISPR gene editing to encode the image and film in DNA, using this as a medium to store information and produce a code that relates to the individual pixels of each image. The team hopes to use the technique to create 'molecular recorders', an approach ultimately to lead to better methods to generate cells for regenerative therapy, disease modelling and drug testing.

For the research, the HMS group inserted a gif – five frames of a horse galloping - into the DNA of bacteria and then sequenced the bacterial DNA to retrieve the gif and the image, verifying that the microbes had incorporated the data as intended.

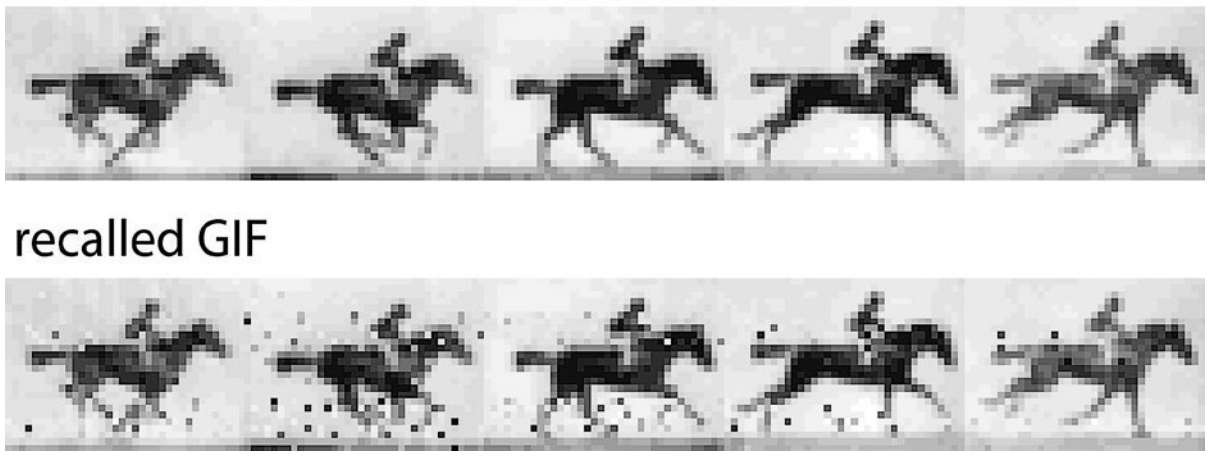
The images chosen were of a human hand (because it has the type of intricate data the researchers hope to use in future experiments) and a galloping horse by 19th century British photography pioneer Eadweard Muybridge, because it has a timing component that could help to understand better how a cell and its environment may change over time.

The team used still and moving images because they represent constrained and clearly defined data sets. The film also gave the bacteria a chance to acquire information frame by frame.

The breakthrough follows work in 2016 when the HMS team built the first molecular recorder based on the CRISPR system.

The recorder allows cells to acquire elements of chronologically provided, DNA-encoded information that generate a memory in a bacterium's genome. The information is stored as an array of sequences in the CRISPR locus and can be recalled and used to reconstruct a timeline of events.

The latest breakthrough confirmed the scientists' ability to engineer CRISPR system-based technology that enables the chronological recording of digital information in living bacteria.



For the research, the HMS group inserted a gif of a horse galloping into the DNA of bacteria and then sequenced the bacterial DNA to retrieve the gif and the image

The CRISPR system helps bacteria develop immunity against viruses in their environments.

Capturing viral DNA molecules

Dr Seth Shipman, a postdoctoral fellow in Genetics at HMS, explained that, as a memory of survived infections, it captures viral DNA molecules and generates short 'spacer' sequences from them, which it then adds as new elements upstream of previous elements in a growing array located in the bacterial genomes' CRISPR locus.

The CRISPR-Cas9 protein – a widely used genome-engineering tool – uses this memory to destroy the same viruses when they return, but other parts of the CRISPR system have not so far been much exploited.

In this study, the scientists showed that two proteins of the CRISPR system, Cas1 and Cas2, which they had engineered into a molecular recording tool, together with new understanding of the sequence requirements for optimal spacers, enables a significantly scaled-up potential for acquiring memories and depositing them in the genome as information.

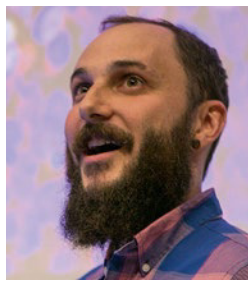
'We designed strategies that essentially translate the digital information contained in each pixel of an image or frame into a DNA code that, with additional sequences, is incorporated into spacers,' Shipman explained. 'Each frame thus becomes a collection of spacers. We then provided spacer collections for consecutive frames chronologically to a population of bacteria, which, using Cas1/Cas2 activity, added them to the CRISPR arrays in their genomes. After retrieving all arrays again from the bacterial population by DNA sequencing, we finally could reconstruct all frames of the galloping horse movie and the order in which they appeared.'

Effectively, to read the information back, the researchers sequenced the bacterial DNA and used a computer code to unscramble the genetic information.

'We took on this research because we see the potential for cells to gather information about their own biology and their environment,' Shipman said. 'For that to happen, we need a way to capture and store information within a cell while it's still alive – that's what we are testing.'

It took researchers three to four years to go from the idea of cells encoding information using the CRISPR-Cas adaptation system to this latest work and it took several days to do the recordings.

'Going forward,' Shipman continued, 'we'd like to see this work used as the basis for building living biological recording devices that might function as a research or medical diagnostic tool.'



Seth Shipman PhD is a neuroscientist and postdoctoral fellow in Genetics at Harvard Medical School and a member of a team at the Wyss Institute for Biologically Inspired Engineering. He gained his doctorate, focused on Neuroscience, at the University of California, San Francisco. His key interests lie in genetics and the advancing understanding of brain function.

As Senior Director and General Manager of SCIEX Diagnostics **Dr Aaron Hudson** leads the company's clinical diagnostics strategy and execution. A Sciex director since 2010, he has had roles in the firm's global marketing strategy, plus academic and omics business. Previous work includes European sales and marketing for Waters and Applied Biosystems, from which Sciex later formed as a separate company. Along with his Molecular Genetics PhD, he holds a BSc in Biochemistry from the University of Sheffield, UK.

System is intended to be used in conjunction with other clinical or laboratory data to assist the clinician in making individual patient management decisions in an adult population in the assessment of Vitamin D sufficiency.

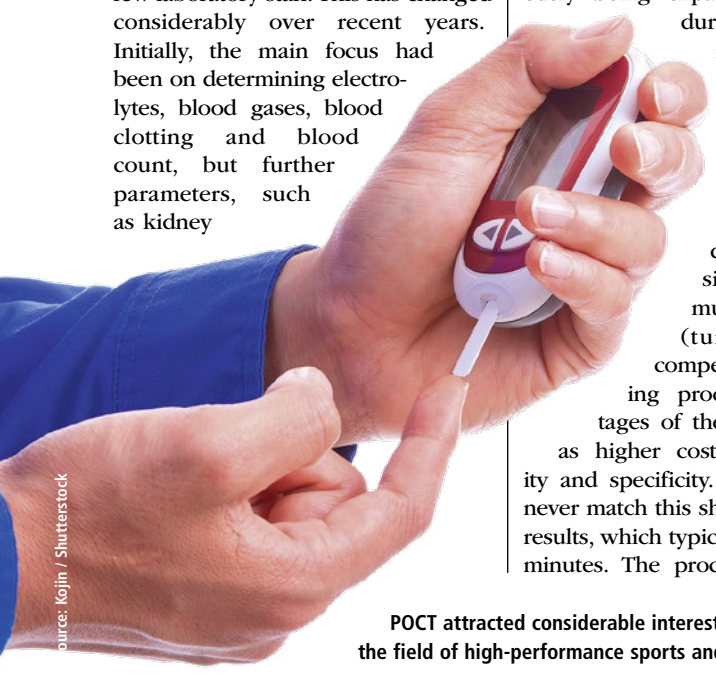
'For the European market, Sciex is currently working closely with partners in Europe, including Chromsystems, to validate clinical assays for the Topaz System. Using a turnkey assay will give clinical labs return of investment in a very short period of time, and adding lab-developed tests to the repertoire will make it even more efficient,' Hudson summed up.

Point of care testing presents many questions need answers

POCT – a critical review and perspective

Report: Walter Depner

Not long ago, POCT was a specialist diagnostic discipline used by only few laboratory staff. This has changed considerably over recent years. Initially, the main focus had been on determining electrolytes, blood gases, blood clotting and blood count, but further parameters, such as kidney function, cardiac enzymes, urine tests and testing for autoimmune diseases have now been added. Whilst the applications for POCT are continuously being expanded, the procedures have become more effective, knowledge is increasing, materials and devices are refined and the exchange and processing of data has improved significantly. The much shorter TAT (turn-around-time) compensates for existing procedural disadvantages of the procedure, such as higher costs, lower sensitivity and specificity. A laboratory can never match this shorter TAT – POCT results, which typically take five to 15 minutes. The procedure also offers flexibility, independent of whether it is utilised in a surgery, in a patient's home or at an accident scene.



Source: Kojin / Shutterstock

POCT attracted considerable interest from the start in the field of high-performance sports and sports science

Three very different examples illustrate the difficulties involved:

How useful is POCT management for chronic or acute illnesses such as Diabetes mellitus for instance?

In diabetology, the HbA1c value is internationally recognised as a long-term marker. According to the German Diabetes Society, a Diabetes diagnosis is confirmed if the value is ≥ 6.5%, whilst a value of < 5.7% means Diabetes can be ruled out. In practice, this requires measurements to be of very high precision.

Another issue is comparability on an international level. The NGSP (National Glycohaemoglobin Standardisation Programme) was introduced to improve the comparability of HbA1c values. The results continue to be indicated in percentage, whilst the IFCC unit is mmol/mol. Using reference materials, the IFCC (International Federation of Clinical Chemistry and Laboratory Medicine) developed a reference method to guarantee that measurement results can be compared to recognised reference values.

Despite standardisation of the measuring procedures it transpired that, out of seven certified HbA1c POCT Systems, only four complied with the required +/- 6% deviation from the target value. In Germany for instance, the General Medical Association allows a deviation of max. +/- 18% from the target value, whilst other countries, e.g. Switzerland, Norway and the USA, only allow deviations of 6%. The situation is compounded by the fact that there is no homogeneity for the matrix in ring trial samples, such as the use of fresh whole blood.

Requirements for POCT during laboratory adoption

Without IT-networking of POCT devices/systems it is not possible to ensure documentation obligations are met, or only with a large amount of manual effort. Networking of all POCT devices is essential to ensure that all specifications are met. It must also be ensured that POCT results are entered into the patient file. A further requirement is the assurance of meaningful statistics for laboratories, as well as hospitals. Along with purely technical procedures, networking therefore also necessitates the introduction of organisational structures to guarantee compliance with all legal regulations. The issue of liability is often also underestimated in the context of POCT. The use of POCT creates very complex liability constellations, and particularly so in hospitals, as areas of responsibility overlap between doctors, hospitals and manufacturers.

The doctor must be able to rely on receiving information about the characteristics of a product, its application and risks from the respective manufacturer to ensure appropriate use. Therefore, the manufacturer is liable for potential malfunctioning of medical devices, and doctors may be jointly liable in cases where they might have been able to detect any such malfunctioning.

The third example is often still considered a marginal issue:

POCT in high-performance sports

Measuring processes in sports are not carried out in an emergency context, even though POCT attracted considerable interest from the start in the field of high-performance sports and sports science. The best-known type of measurement is lactate meas-

POCT devices can be superior to equipment in large labs

Laboratory medicine in Switzerland

Report: Walter Depner

Health insurance is compulsory for **Switzerland's** 8.2 million inhabitants. The Federal Office of Public Health (BAG) monitors and publishes costs. In 2015, costs per insured person were 3,640 Swiss Francs a year. Lab services in out-patient care cost 97 Francs (2.7%) and 61 Francs (1.7%) for surgeries. The surgeries' turnover of POCT equipment was about 500 million Francs, and about 800 million Francs for contract labs. Due to DRGs lab in-patient care costs are not shown.

Lab service tariffs are published in the BAG analysis list and apply to all insured people in Switzerland. A special chapter lists 'fast analyses', which can only be billed by general practitioners (GPs) using near-patient tests.

QUALAB

The Swiss Health Insurance Act states that service providers and insurers must agree quality of services in contracts. In laboratory medicine, the requirements are determined by the Swiss Commission for Quality Assurance in the Medical Laboratory (QUALAB). This contract regulates prerequisites for the reimbursement of laboratory services and is therefore only relevant when reimbursement is carried out through an insurer.

QUALAB specifies how internal and external quality control should be carried out. Internal quality control must be measured daily, unless the testing device is included in a special list of simple equipment, which only needs checking every two weeks. The tolerance for internal quality control must be smaller or equal to the tolerance specified for external quality control. Participation in four ring trials annually is obligatory for all labs and for POCT in GP surgeries and hospitals.

Tolerances for testing are determined independent of devices and type of laboratory. The tolerance allowed for HbA1c for instance is 9%, notwithstanding whether testing was carried out in a large contract laboratory or with a POCT device in a diabetology department.

KBMAL

The Swiss Union for Laboratory Medicine developed the KBMAL guidelines for medical laboratories in Switzerland. As most of the larger Swiss laboratories have the ISO 17025 or ISO 15189 accreditation for medical laboratories, these norms were used as the basis of KBMAL. Additionally, KBMAL refers to all relevant legal texts. One important aspect of KBMAL is the classification of laboratories into different types based on location and management qualifications.

Two POCT types

1) A practice lab is located within a surgery and is managed by a relevantly certified doctor. 2) Decentralised near-patient testing in the hospital is done in different departments outside the lab.

The hospital lab is responsible for this type of diagnosis. Managers must ensure that quality assurance measures are followed by trained staff.

Practical experience

There are around 7,000 laboratories in Swiss surgeries. These offer a range of around 50 types of analysis.

Around 300 hospitals carry out laboratory testing via POCT – the most common types being for glucose and blood gas. In addition, testing for HbA1c, INR and dipstick tests are also offered. Some hospitals have walk-in surgeries offering the same devices used in surgeries, to take pressure off accident and emergency departments.

As a result of obligatory quality control for all lab types, distribution and quality of devices used is easily obtained via data gathered in quality control centres.

A laboratory based in a clinic is typically equipped with a haematology analyser; chemistry analyser; a device to analyse CRP, HbA1c and albumin in the urine; a device to determine cardiac markers as well as a monitor for oral anticoagulation.

Hospitals spend much time documenting services rendered; therefore labs demand networked solutions. Compared to equipment found in large laboratories, POCT devices fare well with many types of analysis.

The larger scattering of POCT devices is compensated for because devices, and individually packaged reagents, are easy to compare due to calibration by manufacturers. Thus there is little variation from lab to lab.

During the ring trials, participants' results are grouped and evaluated by device. The groups are usually more homogeneous for POCT devices than

In a practice laboratory typical devices include ABX Micros, Spotchem Afinion and Cobas h232 (as seen here), as well as, for example, Sysmex XP300 DRI-CHEM, Reflotron and Triage CoaguChek

urement to determine endurance performance. However, many other parameters that allow precise measuring of body functions are often also determined with the help of POCT, although some of these do not belong in the realm of traditional medicine.

One decisive reason for POCT in sports is that it can be used without the need for medical and laboratory staff, and with capillary blood samples and mobile devices. However, proper utilisation of the existing medical potential of this new type of POCT measurement requires the necessary technical and organisational prerequisites, such as standardised blood sample collection (fasting blood sample for instance) and the combined evaluation of many different measurement data etc.

Under appropriate conditions, a single POCT measurement can certainly become part of a diagnostic system. A 'normal' laboratory diagnosis is usually based on a measurement; the diagnosis of a competitive athlete can be based on many different measurement results obtained not only in a sports-scientific context. Apart from the analytes examined, this also depends on the questions involved.

POCT is a topic that continues to have much potential, but which equally throws up a lot of questions that need answers.

Biochemist **Roman Fried PhD MBA**, from the Institute of Clinical Chemistry, University Hospital Zurich, heads the Medical Laboratories of Switzerland (FAMH) and is Managing Director of the Association for Medical Quality Control in Switzerland.

for wet chemical equipment in larger laboratories. All these points sometimes lead to POCT devices actually being superior to equipment used in large laboratories.

Larger laboratories only achieve better results with cardiac markers.

External quality control works effectively with POCT analytics. The four ring trials per year regularly remind users that quality assurance measures are an essential part of testing. Quality control centres can also utilise these evaluations to inform participants about innovations.

This is important as the competence of the people performing the tests ultimately decides quality.

Medical practice assistants (MPA), trained to deal with all relevant POCT devices in a three-year course, perform testing in GP practice labs.

In a hospital, mostly nurses carry out POCT testing; their training level can vary a lot. In many hospitals a POCT coordinator monitors all aspects of POCT and ensures users are continuously trained.

One positive side effect of regular training is that it improves the overall understanding of laboratory analysis. If users gain more experience in pre-analytics as a result of Point-of-care-testing this will ultimately also benefit central laboratories or contract laboratories.

Plans, patience and a lot of persuading are necessary

Integrating three laboratories

For POCT, point-of-care testing, a lab has to purchase new equipment, perform new measurements and handle new parameters – right? Right! However, more importantly, POCT requires the adaptation and integration of the existing lab organisation, with all its consequences, from additional quality control down to new areas of responsibility. Dr Herbert Stekel is currently integrating three previously external lab operations, including POCT, into one central lab at his 1,000-bed hospital in Linz, Austria. In conversation with EH correspondent Walter Depner, he outlines the regulations and complexities.

Source: Merkushev Vasiliy / Shutterstock

Asked what exactly ISO 22870 means for POCT, GP Dr Herbert Stekel pointed out that, like any other standard, ISO 22870 offers recommendations. 'It defines technical, management and quality requirements. A crucial aspect is the fact that the standard places responsibility for POCT firmly in the lab – this includes the selection of equipment and methods, staff training and quality control during operations.'

Depner: Another more general question: ISO, the International Organisation for Standardisation, has currently more than 160 member states covering the majority of the global population. Is any standard that was adopted by ISO automatically binding in all member states?

Stekel: 'It's applicable – but not binding. Standards organisations have no legislative powers. Thus a standard needs to be adopted by the legislature in order to become legally binding, for example through integration in the medical device law, or a similar act. However, beyond this legal issue standards reflect current knowledge and provide a basis for expert opinions. Therefore, healthcare facilities are well-advised to adopt the recommendations defined in a standard.'

When organic structures are about to be changed, plans, patience and a lot of persuading are needed to get buy-in from the team. However, Herbert Stekel is certain that the synergies from including POCT are worth the effort

POCT affects many hospital IT areas, from the lab information system (LIS) to the hospital information system (HIS). The integration of POCT in these systems involves software as well as hardware issues. How complex is this integration?

'POCT is an organisational structure to provide lab services. To be able to establish proper documentation, a link to a LIS or HIS is recommended. This link is an important selection criterion: modern systems offer easy integration; some include even remote device monitoring.'

What does the standard adoption imply for staff – be it training, quality control, technical support or responsibilities? Can current lab members (or staff in other areas) handle additional tasks created by POCT, or are more technicians needed?

'As far as I can tell from our 1,000-bed facility, 1.5 full-time equivalent of a medical-technical assistant is required. This will also cover on-site support for blood gas analysers, training, internal testing and a hotline.'

POCT is performed in ambulances, cars, helicopters, at traffic accidents, in hospital departments, lab satellites, and there are patient self-measurements. The lab must carry the greater part of this burden. How can it cope with this additional work?

'To be precise, according to ISO 22870, patient self-measurement is not POCT. I mentioned the additional staff requirements above – no doubt POCT cannot be implemented en passant if all aspects, particularly training, are taken seriously. In terms of professional knowledge, POCT is not challenging for a lab team. The hospital and lab teams consider the closer and personal contact between labs and departments is a positive side effect of POCT.'

As a specialist in medical-chemical laboratory diagnostics, general practitioner **Herbert Stekel MD**, heads the Institute for Medical and Chemical Laboratory Diagnostics at Kepeler University Hospital Linz, Austria. His professional focus is on lab organisation, lab economics, POCT, pre-analytics and lab IT.

It won't suffice to follow ISO guidance. Quality obligations include mandatory ring trials. How does your lab handle those, and how is that handled among international labs?

'In addition to purchased ring trials for blood gases, we use controls and ring trials we designed ourselves. Some systems that integrate inter alia glucose measuring devices support control measurements on different levels.'

In your lab, you are in the process of integrating three different lab sites. Does POCT make your task easier or more difficult?

'In our current situation harmonising the POCT environments is an additional task. As always, when organic structures are about to be changed, plans, patience and a lot of persuading are needed to get buy-in from the team. Processes need to be adjusted and even re-designed. But in the end you will also find many synergies. It's really worth the effort.'

MiniCollect weds carrier tube

Since autumn 2016 a small tube has made daily life easier for users and patients. A simple but effective addition now offers many new advantages in analysis, the manufacturer reports.

Following the successful launch of MiniCollect, a new capillary blood collection system, Greiner Bio-One has launched the tube MiniCollect Complete to simplify the analysis process.

For centrifugation, MiniCollect tubes can be threaded into a Premium carrier tube using a simple rotational movement, the Austrian manufacturer Greiner Bio-One reports. 'In the Complete version, the MiniCollect tube is already irreversibly assembled in the carrier tube. This brings many advantages for sample analysis in instruments.'

When combined, the dimensions correspond to a standard 13 x 75 mm tube format, the firm adds. 'This allows the tube to be placed directly into a standard centrifuge adapter. Previously, it was necessary to adjust the settings on the analysis device, because the tube format was different for venous and capillary blood samples. The combined tube means that both capillary and venous blood samples can now be analysed in the same way, without complex modification of the device.

'Another advantage is that the carrier tubes can be identified using standard label formats. MiniCollect Complete are primary tubes. Both blood collection and subsequent analyses can be carried out using the same tube. It is not necessary to transfer the sample material to a secondary tube for analysis.'

The tube also has a new cap. 'The membrane can be pierced by a cap-piercing analysis needle while the cap is closed, before automatically resealing after the needle is removed,' Greiner adds. 'The caps are completely sealed, meet the highest standards and can be sent via pneumatic post with confidence, and without losing any sample material.'

Combined filling volume and integrated blood collection scoop

Combined filling volumes for the EDTA and serum tubes make the preparation of samples more straightforward, the firm points out. 'Two easily visible filling marks on the tube provide greater flexibility for use. It is no longer necessary to decide on a certain volume in advance, which therefore reduces logistical efforts.'

The blood collection scoop integrated into the wide tube opening enables the drop of blood to be transferred to the MiniCollect primary tube quickly and easily, minimising adhesion. 'The sample immediately comes into contact with the additive inside the tube.'

No to unnecessary agitation

The sight of a puncture needle often causes anxiety in children. 'One of the main advantages for our young patients is that the safety mechanism of the MiniCollect safety lancets means that no needle is visible at any point before or after the puncture. This makes the situation more relaxing for all involved,' explains Petra Langmayr, former paediatric nurse and product specialist at Greiner Bio-One. After the puncture, the needle retracts automatically and is safely enclosed within the plastic casing. The risk of needlestick injuries is prevented.

* Product availability depends on country-specific registrations.

Point-of-care testing enters the community

Transportable equipmen key factor for the Labor Anywhere program.

The Laborator Anywhere pro

Report: Mark Nicholls

Point-of-care testing is being used to successfully deliver diagnostics to hard-to-access patients in a community in northwest England.

The 'Laboratory Anywhere' programme initially targeted the Gujarati community to aid them with timely diagnosis for diabetes and cardiovascular disease, but it is now being extended to people with mental health issues and learning disabilities, and also to offer additional tests.

Led by Dr Martin Myers, Associate Divisional Medical Director for Pathology for Lancashire Teaching Hospitals, he explained that the Laboratory Anywhere program is a value-orientated approach to delivering diagnostics where needed for a patient or a clinician to make decisions.

Whilst central laboratories may offer economies of scale and specialist testing, he suggests they can be remote from the patient pathway. The Laboratory Anywhere initiative bridges this gap.

This is delivered via a multidisciplinary team, with the Associate Divisional Medical Director of Pathology supported by healthcare scientists for the choice and verification of the diagnostic devices, training, delivery, and informatics. The program also involves close liaison with clinical support staff and patients to ensure that the service is relevant and appropriate.

Myers first set up the Point of Care Testing (POCT) Committee more than 20 years ago at Lancashire Teaching Hospitals and successfully implemented it in local hospitals and the community before the focus shifted, in 2001, towards delivering diagnostics to 'hard-to-access' patients, such as the Gujarati community, which was seen as at a high risk of diabetes and cardiovascular disease but were not always accessing the traditional patient pathways.

'Our principle was simple; we would take healthcare to the people rather than expect the people to follow our patient pathways,' he explained.

With Professors Romesh Gupta and Satyan Rajbhandari and others, the Lancashire Gujarat Health Users' Forum was set up and Health Melas (health festivals) established to deliver health checks including glucose, cholesterol (performed by Healthcare Scientists) and physiological checks (performed by medical students from Manchester University) to identify at-risk patients.

Now in its 15th year, the Health Mela has been extended to all members of society, with 4-6 events annually.

Learning and mental health issues

From the initial tests for the Gujarati groups, Laboratory Anywhere now reaches patients with learning disabilities and will be rolled out to patients with mental health issues.

'Both these groups are at risk of diabetes and cardiovascular disease and are dying 10-20 years earlier than expected due to physical disease because of lack of access to simple diagnostic tests, or being needle phobic,' Myers said. 'This is unacceptable and the value-orientated Laboratory Anywhere model is designed to bring diagnosis to these patients.'

A Clinical Advisor to the Chief

Courtesy of Orion

t is a
atory

ry

ogram

Martin Myers MBE is a Consultant Clinical Biochemist and Associate Divisional Medical Director for Pathology at Lancashire Teaching Hospitals, where he continuously addresses pathology re-design, using advanced automation and point of care testing (POCT). His scientific interests include the use of automation, POC testing and informatics in improving the quality of the diagnostic process, while his clinical interests include the use of laboratory testing to improve patient pathways.

Scientific Officer of NHS England, Myers is leading a national pilot for the National Health Service (NHS) to deliver the Laboratory Anywhere model to these patient groups, with HbA1c, Total Cholesterol and HDL cholesterol measured.

The hope is that the Laboratory Anywhere concept will be adopted throughout the UK and beyond, to diagnose and monitor diabetes and cardiovascular disease in hard-to-access groups in developing countries, where socio-economic and political issues have resulted in lack of laboratory services, Myers added.

Laboratory Anywhere uses portable Lab-in-a-bag or Lab-in-a-Box technology to take to the patient. The devices vary depending on the purpose; for diabetes and cardiovascular disease, simple devices to measure HbA1c, glucose, cholesterol and HDL cholesterol on a finger prick blood sample are used, whilst for more complicated questions, such as assessing renal function, blood gases, and calcium, cartridge-based devices can measure up to 20 analytes at the same time from one blood sample.

In a Health Mela, his team screens more than 200 people in six hours. However, he acknowledges that whilst measuring HbA1c and lipids in 4-8 minutes is good and glucose meters take seconds, he is keen to see developments where the analytical time can come down to less than a minute for some tests.

Into outreach services

The Laboratory Anywhere model is also being used by outreach services (Sepsis and Acute Kidney Injury teams) with Myers' team now about to implement the Laboratory Anywhere for frailty units, care homes, urgent care centres and GP surgeries, with results captured on the patient record.

Overall, the impact of Laboratory Anywhere has been 'remarkable', Myers said.

'Patients enjoy the concept, and support what we are doing. As well as diagnosing some patients with diabetes and elevated lipids, many patients are identified as at risk and therefore we can intervene before disease develops.

'Advances in technology,' he concluded, 'mean healthcare scientists can bring the laboratory wherever it's needed and no longer can lack of access be used as an excuse for not reaching out to patients'.

Infection management in bone surgery

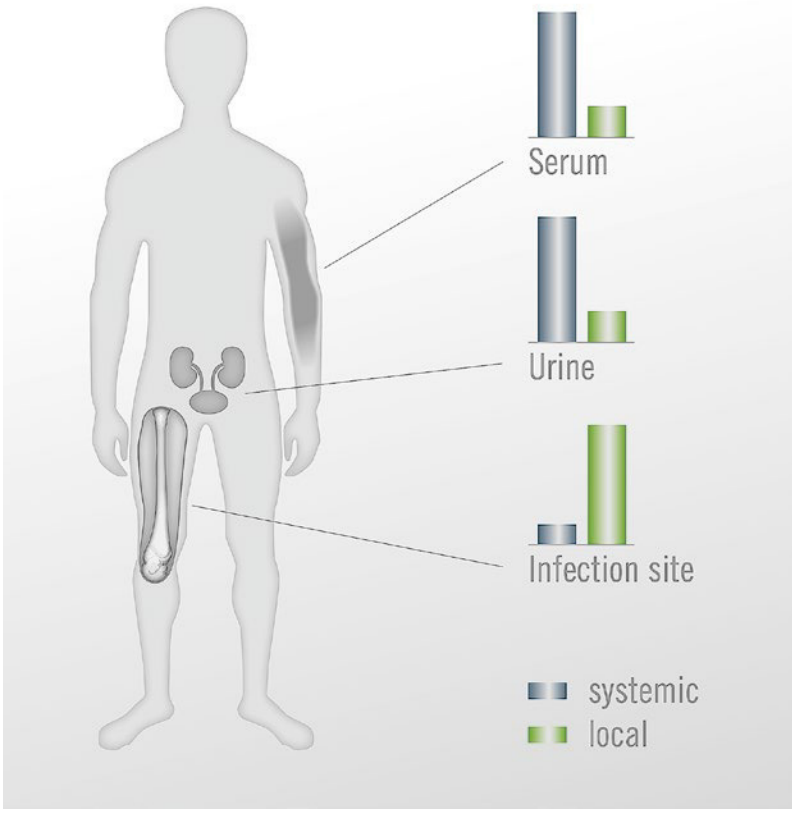
The benefits of antibiotic-loaded cement

The use of antibiotic-loaded bone cement (ALBC) is an effective supporting option to prevent and cure infections in bone surgery as well as in arthroplasty. This is the quintessence of the Satellite Symposium 'Defect - Infect - Regeneration – Infection Management with ALBC in Bone Surgery', hosted by Heraeus Medical GmbH during the 36th Annual Meeting of the European Bone and Joint Infection Society (EBJIS) held in Nantes, France, this September.

Olivier Borens, orthopaedic surgeon at the University Hospital Lausanne, Switzerland, discussed the benefits and specifics of local antibiotic treatment via antibiotic-loaded bone cement (ALBC) in his talk on 'Surgical management - What are the options to fill a bone defect?' 'First, the antibiotics are being eluted locally to the important site. Second, there is no systemic toxicity. Third, the protection allows for the induction of a good membrane, and fourth, it brings antibiotics to a usually devascularised area,' he explained.

In large bone defects, dead space management becomes important. 'This can also be done with PMMA enriched with antibiotics.' However, ALBC should always be combined with systemic antibiotics to avoid an infected space. 'PMMA is available pre-loaded with one or two antibiotics but, if needed, can also be mixed with other antibiotics after comprehensive diagnosis,' states Borens.

Tristan Ferry, infectious disease specialist from the Hospices Civils de Lyon, explained in his presentation the 'Rationale for the use of local antibiotics in patients with septic pseudarthrosis.' A septic pseudarthrosis always requires personalised treatment, depending on the location, the size of the bone gap and the type of pathogen, he said.



Active compound concentration of systemic (left) and locally (right) administered antibiotics in the body

'Usually, a multi-disciplinary team will perform a two-stage Masquelet approach - a mechanical management of the bone gap and management of the infection.' According to Ferry, the first goal should be infection treatment at the time of the bone resection. 'Staphylococci are the most important pathogens, but one third of patients were also infected with Gram-negative bacilli.' Therefore, he recommended using a combination of two antibiotics.

The second goal is to prevent super infection at the time of bone grafting: 'Increase the dose of gentamicin locally, and second, combine two antibiotics acting on staphylococci,' he advised, and also recommended combining local and systemic antibiotic therapy.

Mike Reed, Consultant Orthopaedic Surgeon and Professor from the University of York Northumbria (UK), described the application of 'High Dose Dual Antibiotic Bone Cement in Hip Hemiarthroplasty.'

He found that ABLC eluting two antibiotics was very effective in preventing biofilm formation after hip hemiarthroplasty. 'Therefore, we can use ALBC not only to treat, but also to prevent infections,' he said. Another reason for using cement is to support the implant: 'ALBCs such as COPAL have the same physical properties of other cements.'

Based on a randomised trial involving more than 800 hip hemiarthroplasty patients receiving either PALACOS R+G (Single AB) or COPAL G+C (dual ABs) Reed pointed out that the deep infection rate had been dramatically reduced to one third (from 3.5 to 1.1) with COPAL G+C.

'If you look at deep and superficial surgical side infections (SSI) combined, the use of COPAL G+C is even more potent, reducing the rate from 5.3 to 1.7.' The reason is the high concentration of antibiotics well above the minimum inhibitory concentration.

'We also examined whether preventive ALBC use is driving the development of antibiotic resistances,' Professor Reed pointed out. 'But' he added, 'based on observations and tests of nearly 2,000 patients, there is no sign of resistance development.'

Finding the needle in a haystack

MicroRNA supports testicular cancer detection

When we talk about seeking a needle in the haystack usually we are describing an impossible task. Now, researchers in Bremen, Germany, have managed to find one vital 'needle'. Meike Spiekermann and the team developed a reliable blood-based marker test to detect testicular cancer. Even better: the method seems to have far-reaching potential, Daniela Zimmermann reports

The global incidence of testicular cancer is uneven: while the disease is hardly present in large areas of Africa, the number of new cases in Asian countries is higher and in Europe and the USA most cases of testicular cancer occur. As yet, there is no clinical explanation for these differences. Germany reports 4,000 new cases of testicular cancer annually – more than most other European countries. Meike Spiekermann more or less stumbled across the issue of testicular cancer when she spoke with Dr Gazanfer Belge, a human geneticist and private lecturer at the University of Bremen. He mentioned a project he had started with Hamburg-based urologist Professor Klaus-Peter Dieckmann. They aimed to identify a reliable blood-based marker for testicular cancer – which did not exist at that time.

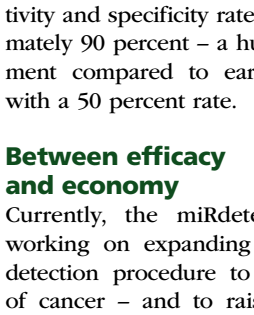
British researchers, however, had already indicated a possible connection between microRNA and testicular cancer. 'The researchers had analysed the relevant microRNA family, the so-called cluster, and concluded that it might be able to detect testicular cancer,' Spiekermann explains. However, the UK team did not succeed in identifying a specific marker as most suitable. Since there is an urgent clinical need for such a marker, the biologists and Dieckmann immediately set out to analyse samples.

At Venture Lounge 2016, a European start-up event, Meike Spiekermann and Dr Nina Winter received an award for the development of the blood test

Spiekermann herself was surprised by her success: 'It was like finding the proverbial needle in the haystack.' She not only found the marker she was seeking – even better, the marker is already being tested in a clinical validation study and shows promising results. Based on the knowledge gained by the British team the microRNA, numbered 371 turned out to be the best marker for testicular cancer. 'Previous analytical methods were not able to deliver a similar degree of sensitivity and specificity,' Spiekermann pointed out. To drive the further development of the procedure, in 2016 Spiekermann and colleagues Dr Nina Winter, Kerstin Lucht-Hübner, Professor Klaus-Peter Dieckmann and Dr Gazanfer Belge founded miRdetect GmbH.

No 371 struts its stuff post surgery

MicroRNA 371 is used primarily for monitoring of the treatment. 'The marker is not required for screening since a simple palpation will detect the cancer early,' Spiekermann explains. When testicular cancer is suspected, microRNA 371 nevertheless can provide unambiguous information and prevent superfluous surgery. The marker is used post surgery to validate the therapy. 'Our marker allows us to monitor the response to chemotherapy: If the treatment is successful, the marker in the blood decreases measurably.'



Nina Winter PhD is co-founder and managing director of miRdetect GmbH in Bremen. Up to 2015, she was a PhD student and, as a post-doc, she was research fellow at the Centre for Human Genetics, University of Bremen.

A second strength of the marker is in follow-up. Currently, CT is the modality of choice to check for a relapse – which means repeated radiation exposure. 'Since primarily young men between 20 and 45 are affected by testicular cancer it's important to monitor them over a long period of time safely and without radiation,' Spiekermann advises. As in most cancer types, a testicular tumour can spread, with the metastases going undetected. Here the new marker might also offer a more reliable procedure for earlier detection.

While the marker does not allow precise localisation of the tumour, it does offer information on the presence of a tumour and whether close monitoring or continued therapy is required. The marker achieves sensitivity and specificity rates of approximately 90 percent – a huge improvement compared to earlier markers with a 50 percent rate.

Between efficacy and economy

Currently, the miRdetect team is working on expanding the tumour detection procedure to other types of cancer – and to raise funds for this effort. 'Since the current test is only suitable for testicular cancer, the economic yield is limited due to the small number of cases,' observes Dr Eckhard Schwenner, strategic advisor at miRdetect. 'However, the fact is that we did develop a method to reliably detect minute volumes of certain genetic material of any origin.'

Meike Spiekermann is co-founder and managing director of miRdetect GmbH in Bremen, Germany. She is currently writing her dissertation on microRNAs at the University of Bremen, where from 2013 to 2016, she was a research fellow.

The researchers hope to apply this principle to other forms of cancer with larger case numbers – for example, pancreatic cancer. 'The microRNA we are using for testicular cancer is entirely unsuitable here,' Spiekermann explains, 'but the major advantage is that this substance is released into the blood by the tumour itself. This explains the high degree of sensitivity of the test.' Consequently, the 'only' task of the researchers is to find the specific markers for pancreatic cancer. 'Other researchers have already looked in that direction. Maybe we might want to continue where others have already given up,' Spiekermann ventures.

Practically speaking, the Bremen team is looking for their second needle in the haystack. 'If we can expand the test to other fields of application the big players on the market will take note,' Schwenner hopes.

Meanwhile, the miRdetect testicular cancer test is about to receive the CE label – the prerequisite for launching a product on the market. 'Our focus is on making the test available for patients,' Spiekermann underlines. To achieve this goal, the company has established a European network of more than 40 hospitals. 'We have been working hard for years,' she concludes, 'now we are happy for others to benefit from our test.'

Interactive scrub-up trough gives audit-proof documentation

A truly innovative hygiene device

According to the WHO campaign: Save Lives – Clean your hands, five million healthcare-associated infections (HAIs) occur annually, a large proportion of which are avoidable. To achieve this, numerous institutions, initiatives and campaigns are committed to improvement of infection protection. Integromed GmbH, from Leipzig, aims to contribute to this with its latest development, the SensoClean.

'Germs are mainly transmitted by the hands of the nurses and doctors,' points out Sherief Emam, Head of Research and Development at Integromed. 'This is where our SensoClean scrub-up trough comes in. But, we don't just provide a product that allows clinicians to wash and disinfect their hands thoroughly and hygienically.'

Optimised for use by all clinicians

Unconventional functions

While traditional scrub stations are passive devices and not been modernised for a while, SensoClean features several functions not found in conventional products.

'During SensoClean development, we always had it in the back of our minds that sustainable compliance calls for regular feedback and motivation. We can guarantee this with the integrated guiding software, which shows the necessary steps and provides a symbolic feedback on the extent to which the user has observed the prescribed minimum time for the process.

'On top of that, we have developed an artificial intelligence software to capture and evaluate the users' hand movements. In this way, SensoClean is the first interactive scrub-up trough that can provide an audit-proof documentation process. The complete system can be adapted to the individual regulations of each hospital.'

Touchless operation reduces the risk of accidental transfer of germs

In any event, the system is certainly outstanding when it comes to design. Information such as washing and disinfecting movements, time and date, water temperature and filling levels are shown on a large glass display. 'Design and function go hand in hand with the SensoClean. The smooth, seamless surface and perfectly finished weld seams are not just very attractive but also very hygienic. Information can be read easily and comfortably on the large display.' User-friendliness was a key element during the development

Time to speed up the adoption of digital pathology

Deep learning and AI progress

Report: Mark Nicholls

Early adoption of image analytical tools and artificial intelligence (AI) are crucial if health systems across Europe are to see the full potential of digital pathology, according to leading expert Professor Johan Lundin, Research Director at the Institute for Molecular Medicine Finland (FIMM) at the University of Helsinki. Although European institutions increasingly embrace digital pathology, he remains concerned that progress is slow and several organisations have not yet moved onto the next level of introducing analytical tools.

Speaking from his experience in Finland and Sweden, he pointed out that, during the last two years, major university institutions where pathology is part of the operation have acquired microscopy scanners that are the basis for going digital and the instruments for digitising a sample.

However, he said that the pattern in some parts of Europe was slower than he would have expected. 'There are many reasons for this,' he said. 'One of the most important is that, so far, digital microscopy and pathology have mainly been limited to viewing. If you compare viewing a sample under a microscope, or viewing it on screen, there is not much difference or much to gain - maybe only in speed and access to the sample archives. For the everyday work of the pathologist, I do not think they experience it as a clear improvement.'

Critical to changing this, and exacerbating the implementation of digital pathology, is the addition of image analytical tools and machine learning and artificial intelligence to analyse and pre-process the samples. 'With these you have a clear reason why you should go digital but without going digital you will not be able to use those tools,' he pointed out. 'Another driver is to create better interfaces, where it is more convenient to view and handle the samples digitally.'

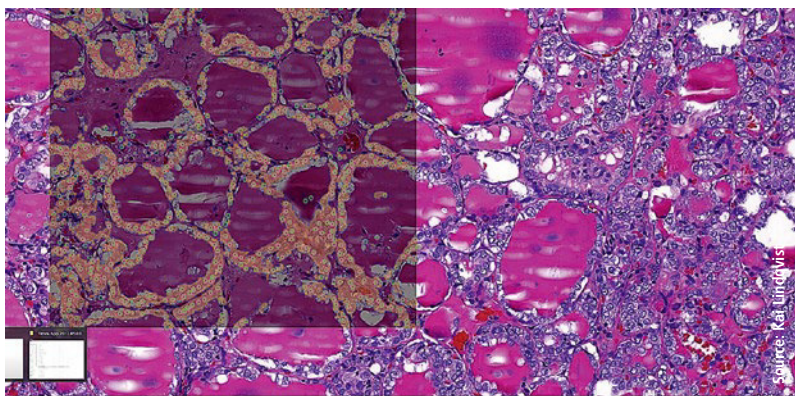


Image analysis of the thyroid gland

To profit from the implementation of digital pathology, it is vital to add image analytical tools and machine learning and artificial intelligence to analyse and pre-process samples

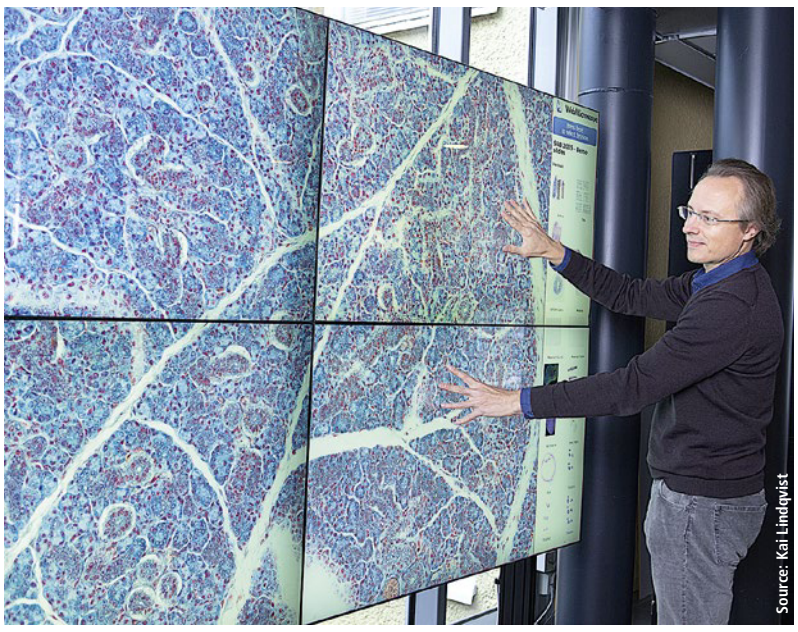
An area where there is room for advancement, he said, is in the development of more sophisticated instrumentation with almost all instruments currently available still based on conventional technologies and typically centralised rather than located where the samples are prepared.

Professor Lundin believes there are a number of steps to take to help overcome these hurdles.

'When you see the huge advances in artificial intelligence applied to pathology in the 1-2 last years, you realise there is no going back from that progress. It will definitely come, but the question is when and how fast?

'We have seen from other parts of medicine - like diagnosing a melanoma from a photograph of a skin lesion, or looking at the diabetic changes in the fundus of the eye – that the algorithms have reached expert levels of performance, so that means the same will of happen in pathology. Of course,' he continued, 'it will not replace pathologists, but it will provide a number of really efficient tools to add to the clinical workflow.

'What is really needed is to organise and develop the actual digitisation process to be much more efficient and also to develop the workflow and way pathologists interact with images and with the results from the automated analysis.'



Another important factor is providing the pathologists with better interfaces to view and handle the samples digitally. The web microscope developed by the company Finmic, where Lundin is a consultant, is an example for such an interface

Cost, in terms of hardware, scanners and instrumentation, remains an issue, but Lundin is convinced that the addition of analytical tools, such as automated analysis, will translate into improvements in efficiency and speed.

He notes that several institutions are introducing digital pathology on a step-by-step basis, initially by acquiring a scanner, and then digitising archival material for teaching and seminars before leaning towards clinical samples.

A key challenge is to bridge the gap between technical researchers and clinical pathologists, one which Professor Lundin hopes the 14th European Congress of Digital Pathology – Helsinki. May 29 to 1 June 2018 – will help address.

As joint President of the conference – which will also incorporate the Nordic Symposium on Digital Pathology – he said: 'The whole topic of the conference is digital diagnostics and augmented intelligence.

'I hope to gather together researchers from the technical field and the clinical pathologists to build a bridge between algorithm development and the users of these methods.

'It will give the opportunity to discuss and see examples from current applications and the most recent advances in deep learning and artificial intelligence that shows the complex things you can now classify and analyse with the machine tools,' added Lundin, who is also involved in the European Congress of Pathology in Amsterdam (2-6 September).

Professor Johan Lundin is Research Director at the Institute for Molecular Medicine Finland (FIMM), hosted by the University of Helsinki, and Guest Professor in Medical Technology at the Karolinska Institute in Stockholm. He is also Associate Professor for Biomedical Informatics at the University of Helsinki. His key research aims to fully utilise development within information and communication technologies to improve diagnostics and care of the individual patient. He is also a consultant for Finmic, an academic spin-off company that is commercialising the web microscope developed within his group.

of the product Emam explains. 'We have integrated a number of functions that cannot be found in this form in conventional products. For example, SensoClean has an integrated warm white LED light that points towards the hands and is switched on automatically with the water. What's more, the temperature can be easily adjusted whilst washing your hands, touchless of course.'

The flow of water is also activated touchless by sensors, as is the operation of the dispensers.

If necessary, the SensoClean from Integromed can also be fitted with an integrated UV lamp that is also switched on by simply holding your hands beneath it. 'But this is only used during training, where a disinfectant containing a fluorescent concentrate is used to check how successfully the hands have been disinfected,' Emam explains. 'We decided to include this option because a sustainable improvement of compliance is dear to our hearts. And regular training is indispensable to guarantee sustainability.'

Integromed (www.integromed.de) will present SensoClean at MEDICA 2017 in Dusseldorf this November.

Join one of Europe's leading health care conferences taking place in combination with the world's No. 1 medical trade fair – MEDICA 2017!

Further information, programme and registration: www.medica.de/EHC2

4th EUROPEAN HOSPITAL CONFERENCE

Chances and Challenges of E-Health

16 NOVEMBER 2017

CCD Congress Center Düsseldorf (CCD Ost)

hope European Hospital and Healthcare Federation

ASSOCIATION EUROPÉENNE DES DIRECTEURS D'HÔPITAUX
EUROPÄISCHE VEREINIGUNG DER KRANKENHAUSDIREKTOREN
EUROPEAN ASSOCIATION OF HOSPITAL MANAGERS

AEMH

Gesellschaft Deutscher Krankenhaustag

MEDICA®

Messe Düsseldorf®