Acoustic angiography: a promising technique for imaging low-depth tumours

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Respiratory tract infection (RTI) is the fourth leading cause of mortality globally resulting in around three million deaths per annum, predominantly from pneumonia. In the West, whilst RTIs do not wreak the same toll that they do in the lower income countries, they are the most frequent reason for consulting a general practitioner (GP). The majority of RTIs affect the upper respiratory tract and are of viral origin; numerous studies conclude that there is no benefit in prescribing antimicrobials for an acute uncomplicated RTI. And as currently one of the most serious global healthcare concerns is antimicrobial resistance (AMR), it is imperative that diagnosis and treatment at primary care level do not augment this problem. Relevant national guidelines exist in most European countries, but there are considerable variations across the EU in the frequency that antimicrobials are prescribed for patients with RTIs, ranging from 28% in the Netherlands to 92% in Greece. Point-of-care testing by GPs, however, can allow more prudent use of antimicrobials. GPs are being encouraged to measure C reactive protein (CRP), a very early marker of inflammation produced by the liver, as an adjunct to clinical examination. Serum levels increase within six hours of infection, peak within two to three days and decline rapidly to baseline level once the infection is resolved. Bacterial infections result in high levels >100 mg/L, whereas levels in viral infections rarely exceed 50 mg/L. And a cost-effective CRP POC test that can be performed within five minutes is available. Although serum procalcitonin level is more specific for distinguishing between bacterial and viral infections, the POC tests for this analyte currently take longer to obtain a result and are thus more suitable for hospital settings. The consensus from European consortia concerned with managing RTI patients and combating antimicrobial resistance is that patients with CRP levels <20 mg/L should not be prescribed antimicrobials, those with levels >100 mg/L should, and for those with levels in between signs, symptoms and risk factors should all be scrutinized and antimicrobials prescribed if symptoms worsen. This approach appears to be acceptable to both patients and GPs. Randomized clinical trials have been carried out in several countries comparing ‘control’ groups of RTI patients with ‘intervention’ groups who were tested for CRP at point-of-care. As well as significantly lowering antimicrobial prescribing, referral to hospital for a chest X-ray was also significantly lower in the latter group. Clearly this cost-effective POC is of benefit to health services and current, as well as future, generations of patients.
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Sustained remission after treatment with investigational personalized cellular therapy in patient with multiple myeloma

A multiple myeloma patient whose cancer had stopped responding after nine different treatment regimens experienced a complete remission after receiving an investigational personalized cellular therapy known as CTL019 developed by a team at the University of Pennsylvania. The investigational treatment was combined with chemotherapy and an autologous stem cell transplant – a new strategy designed to target and kill the cells that give rise to myeloma cells.

Prior to receiving the therapy, the patient had already received nine different therapy regimens in the five years since her diagnosis, including a previous autologous stem cell transplant, which had only controlled her disease for a few months. Her bone marrow was almost entirely filled by cancerous cells when she entered the study. By 130 days after receiving the infusion of engineered cells, tests revealed no evidence of disease. The patient – who was the first to be treated as part of this trial – remains in remission more than 12 months after receiving this therapy.

Penn Medicine
http://tinyurl.com/qxgdf2m

Improved outcomes for catheter-based clot removal in patients with deep vein thrombosis of the legs

Patients who have lower extremity proximal deep vein thrombosis (LE-DVT), or a blood clot in their leg, are increasingly undergoing minimally invasive catheter-based blood clot removal – also referred to as catheter-directed thrombolysis (CDT) – rather than solely being treated with traditional blood-thinning medications (anticoagulation alone). This trend is due to recent literature showing reductions in lifestyle-limiting post-thrombotic complications of acute DVT in patients who undergo CDT compared to those that are treated with anticoagulation alone. One of those complications is post thrombotic syndrome, or PTS, a very frequent and disabling complication of DVT which is characterized by pain, swelling, itching, skin discoloration and heaviness in the legs and, in severe cases, skin ulcers.

Despite its benefits, however, data has shown CDT to be associated with increased bleeding complications. Riyaz Bashir, MD, Professor of Medicine at Temple University School of Medicine and Director of Vascular and Endovascular Medicine at Temple University Hospital, led a study aimed at determining whether those increased bleeding complications were correlated with the volume of CDT procedures performed at a particular institution.

The study found that a higher volume of CDT cases annually was associated with lower in-hospital mortality rates and lower intracranial hemorrhage rates. “These findings have potentially major future implications for the treatment of deep vein thrombosis,” said Dr. Bashir. “For the first time we have shown a significant inverse relationship between the institutional CDT volumes and adverse outcomes like death and intracranial hemorrhage.”

Dr. Bashir and his team used the Nationwide Inpatient Sample (NIS) database to identify 90,618 patients admitted to U.S. hospitals with an LE-DVT diagnosis from 2005 to 2010. They further narrowed that group down to 3,649 patients treated with CDT. The researchers then divided the hospitals into two groups: high volume centres, which performed six or more CDT procedures per year, and low volume centres, which performed less than six CDT procedures per year.

Dr. Bashir and his team found that in-hospital mortality in patients treated with CDT was significantly lower at high volume centres (0.6% vs. 1.5%) compared to low volume centres, and that intracranial hemorrhage rates were less than half at high volume centres (0.4% vs. 1.0%) as they were at low volume centres. “This does not mean that low volume centres should not perform CDT for patients with LE-DVT,” said Dr. Bashir. “It means that we should focus on standardizing CDT protocols that include careful patient selection as well as peri-procedural patient monitoring. In addition, establishment of centres of excellence in treating venous thromboembolic disease may provide the necessary framework within which bleeding risk to the patient can be minimized.”

Dr. Bashir says the next step should be to focus on lowering these bleeding complication rates at low volume centres by standardizing their CDT protocols. Also, patients with leg DVT – especially young patients – should feel comfortable considering clot removal, particularly at a high volume centre, as a viable option to prevent post thrombotic syndrome. “Our overall goal is to treat these DVT patients early on and prevent post-thrombotic syndrome and its adverse consequences on the quality of life. We feel this research provides more clarity and direction in identifying the best strategies for how to achieve that goal,” Dr. Bashir added.

Temple University School of Medicine
http://tinyurl.com/oywge3f

Simple test predicts obstructive sleep apnea in patients hospitalized for heart failure

Researchers at Thomas Jefferson University showed that a simple questionnaire, evaluation and pulse-oximetry monitoring can lead to early detection of sleep apnea in patients hospitalized for congestive heart failure (CHF).

“Since traditional screenings are not always effective in patients with congestive heart failure, additional tools are needed,” said lead author Sunil Sharma, M.D., FAASM, Associate Professor of Pulmonary Medicine in the Sidney Kimmel Medical College at Thomas Jefferson University. “Our team was able to validate a screening strategy that can be instituted during hospitalization and effectively detect sleep disordered breathing among patients with congestive heart failure.”

This study adds to a growing body of research suggesting a connection between sleep disordered breathing and heart failure. “While an estimated 70 percent of patients with congestive heart failure have underlying sleep disordered breathing, only a minority, roughly two percent, are diagnosed and treated. Yet early recognition and treatment of this disorder in patients with congestive heart failure has been shown to improve ejection fraction, acute heart failure and may even reduce readmissions and mortality,” Dr. Sharma continued.

Thomas Jefferson University
http://tinyurl.com/p82ouj
Infective endocarditis guidelines boost role of imaging in diagnosis

ESC Guidelines published on infective endocarditis boost the role of imaging in diagnosis of this deadly disease. “We emphasize the need for a multimodality imaging approach to diagnosing endocarditis,” said Professor Gilbert Habib, Chairperson of the guidelines Task Force. “While the 2009 guidelines focused on echocardiography, the 2015 guidelines show the important role of other imaging techniques such as PET-CT. These new imaging techniques are increasingly useful for the diagnosis and management of infective endocarditis and we recommend their use in a novel ESC diagnostic algorithm.”

For the first time, the guidelines recommend that an endocarditis team operate in a reference centre. The team should include cardiologists, cardiac surgeons and specialists in infectious diseases, while reference centres should have immediate access to diagnostic procedures and cardiac surgery.

“A multidisciplinary approach is mandatory for the treatment of patients with infective endocarditis,” said Professor Habib. “In our centre we showed that this approach dramatically reduced one year mortality in patients with infective endocarditis from 18.5% to 8.2%. Management by an endocarditis team in a reference centre is one of the most important new recommendations.”

Also new are recommendations for specific situations including infective endocarditis in the intensive care unit, infective endocarditis associated with cancer, and marantic (non-bacterial) infective endocarditis.

Important recommendations are given for the combination of early diagnosis, early antibiotic therapy and early surgery. “Endocarditis is a deadly disease if treated too late,” said Professor Patrizio Lancellotti, co-Chairperson of the Task Force. “The new guidelines focus on methods to reduce delays in diagnosis, early introduction of antibiotics, and sending patients to a surgeon very early. The 2009 guidelines were the first to introduce the concept of optimal timing of surgery in patients with infective endocarditis and this is highlighted again in 2015.”

Antibiotic prophylaxis was a controversial area of discussion by the guidelines Task Force. One of the main changes in the 2009 guidelines was the reduction of prophylaxis because there was no real scientific proof of its efficacy and it may be potentially dangerous. Thus, antibiotic prophylaxis was recommended only for patients with the highest risk of infective endocarditis undergoing the highest risk dental procedures. Similar changes were proposed by the American guidelines. Good oral hygiene and regular dental review were considered to have a more important role in reducing the risk of infective endocarditis.

European Society of Cardiologists http://tinyurl.com/pgd4c6t
The Internet of Things - hospital connectivity’s smart new frontier

The Internet of Things (IoT) has been hailed by some commentators as one of the biggest revolutions in the hospital environment since the invention of patient monitoring equipment thirty years ago. The latter triggered dramatic improvements in outcomes and explains the panoply of equipment now standard in every hospital room - from pulse oximeters, ECGs and apnea monitors to infusion pumps and ventilators.

False positives and negatives
Few doubt that healthcare today has improved because of such equipment. However, as the devices proliferated, another kind of risk has emerged. These monitoring devices operate independently, with no means to assimilate information from multiple sources and intelligently understand patient status. As a result, some devices can occasionally fail to issue an alarm (a false negative), while others do so wrongly (a false positive). On their part, healthcare staff members - whose numbers have shrunk as many of their tasks began to be handled by the devices - often tend to shut off what they believe are nuisance alarms. Many are just that - nuisances. Some are not. In both cases of false positives and false negatives, human lives are often put at risk.

Nine of 10 healthcare IT departments ready for IoT
The Internet of Things (IoT) is seen to offer a way out of such challenges. IoT uses sensors, radio-frequency identification (RFID) and Real Time Location System (RTLS) to capture or monitor data and automatically trigger certain events. In times past, healthcare sensors covered devices such as vital signs monitors. Today, those monitors and much other hospital equipment is connected by the IoT — using data which has less to do with medicine than with delivering efficient healthcare. One recent survey by Forrester Consulting found 52% of the healthcare IT departments already incorporating IoT technology. 90% are ready to adapt IoT-based solutions. In the healthcare setting, IoT transfers real-time actionable data from monitoring devices to clinicians, precisely targeting the latter - whether they are emergency medical practitioners and intensivists, interns and nurses or auxiliary service providers. Due to IoT, front-line clinical staff can get operational requests filled and delivered quicker, freeing them to concentrate on their core job of healing the sick and improving patient outcomes.

Four categories of healthcare IoT devices
The Atlantic Council classifies four categories of medical devices which meet its definition of healthcare IoT. The first is consumer-based, such as health bands, calorie meters and fitness tracking devices. The second consist of wearable, external devices such as insulin pumps. The third includes internally implanted devices such as pacemakers and defibrillators. The final category consist of stationary devices, such as patient-monitoring devices, or even machines equipped with sensors and RFID.

Machine decisions and interventions
The role of IoT in healthcare is witnessed by the rapid growth of innovative apps and wearables. Within the next two years, one forecast estimates a market of 80 million wearable health devices. These devices will not only empower patients by providing information about their own health. They can also be used by physicians - or even machines themselves - to make decisions on intervention. One example would be arrhythmia detected by a wearable sensor, triggering a smartphone call to a cardiologist, alerting the patient with an emergency
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New IoT devices continue to emerge, sometimes at a breathtaking pace. For example, given the problems accompanying erratic compliance with taking medication, a new product called iCap was being readied for launch. The product “will tell a paired-up mobile device when a cap was opened, if a cap is opened, how long a cap was open and whether a scheduled dosage was missed.” The device is also extremely frugal on power. Its battery needs to be charged “only around once a year.”

Maximizing uptime
The IoT has played a major role in reducing mean time between failures of medical equipment - in other words, in maximizing uptime. External wireless sensors in medical devices are an integral part of the IoT environment. They monitor machines and provide data which can be used to predict failure and/or alert technicians to a need for preemptive maintenance. Such intervention is not only preventive. Servicing can be synchronized with routine maintenance, thus expanding availability by several orders of magnitude. In some cases, the sensors can also provide inputs to a hospital maintenance team before being ready for the next patient.

Beyond patient monitoring, an IoT device can be tested and diagnosed remotely - saving a great deal of time and money. For example, a technician can connect to an MRI from outside a hospital and run diagnostics to determine any impending problems - for example, should helium levels be nearing depletion. This would avoid a machine shutdown and cumbersome rescheduling of patients’ appointments.

On the other hand, should a machine have failed, the cause of the problem can be tracked, while a Knowledge Management application deploys to find answers. When a definitive cause is determined, a replacement part can be sent by courier along with instructions to a technician on how to fit the part and get the system running.

Optimizing device usage
IoT-connected resources such as transportable medical machinery also yield benefits. IoT provides real time location, and can optimally schedule usage - by transferring a specific machine to the nearest available patient needing the service it provides. For example, if a CT scanner in one location is utilized only 50% of the time, while one is accompanied by waiting lists, radiologists can reassign patients to use the former during off-peak times.

In effect, IoT-enabled equipment provides real time tracking and audits of usage patterns. These locate equipment for the immediate need of a patient, schedule it for the next appointment while performing maintenance at available intervals in between. For hospital administrators, IoT also provides metadata on resource distribution over time and utilization across sites, along with access issues and choke points - as well as overviews of failure.

The flow of equipment is streamlined, while its use is optimized, with improved availability and utilization delivering healthcare with a lower need for standby equipment which is only occasionally used. Once again, such contributions positively impact on patient care and outcomes, and given the price tags of modern medical machines, enhance healthcare cost effectiveness too.

Bed occupancy - early IoT application
One of the earliest applications of IoT in a hospital was the use of sensors to provide room and bed occupancy status data to operational staff. Working in tandem with information from a hospital’s admission-discharge system, the IoT system embedded in a hospital bed (still sometimes called a ‘smart’ bed) provided alerts to staff to commence cleaning in a room from which a patient had been discharged, followed by indicating the availability of a clean room for a new patient to the hospital admission-discharge system.

Connectivity is key feature
A key feature of IoT is connectivity - and such an attribute provides immediate benefits. For instance, it is known that low pulse oximeter readings result in alarms. Such an alarm is however likely to be a real clinical problem, only if the reading is accompanied by a low respiratory rate. The IoT enables a pulse oximeter to cross-check carbon dioxide (CO₂) levels from a...
respirator before sounding the alarm. An IoT-linked infusion pump which stopped administering drugs in such a condition could stop a risk of overdose and save lives.

The advantage of remote sensing and intervention cannot be overstated. By some estimates, there has been a 64% fall in hospital re-admissions for patients whose blood pressure and oxygen saturation levels were monitored remotely.

Connected devices in a hospital are of course not novel. However, connections have so far largely been proprietary. New standards have emerged for interconnectivity of healthcare devices, such as IHE and HL7. Nevertheless, even devices connected across standards usually require the presence of a human being to read the device data and make decisions. IoT is a new paradigm. It enables communication between ‘anywhere and anywhere,’ with machine analytics empowered to replace human decision-making.

Integrated clinical environment

One major effort to build an IoT standard system for hospitals is the Integrated Clinical Environment (ICE) standard, ASTM F2761. This takes data definitions and nomenclature from the IEEE 11073 (x73) standard for health informatics, and leverages another standard known as DDS (Data Distribution Service), an Internet of Things protocol from the Object Management Group (OMG). The DDS DataBus connects all components with appropriate real-time reliable delivery (controlled distribution). Its architecture is designed to enforce correct interaction between participating devices. DDS can integrate with the cloud, or connect to other protocols to form a complete connected infrastructure.

On its part, the ICE standard specifies requirements for the safe integration of medical devices from different manufacturers via an electronic interface into a single medical system for the care of a single patient. The standard is intended to have greater error resistance and improved patient safety, as well as better workflow efficiency than can be achieved with independently used medical devices.

Security

A hospital IoT is nevertheless also a source of some concern. Regardless of how a hospital IT department sets up its IoT architecture, it means an influx of new access points to a network. In addition, the IoT transfers sensitive data from patient monitoring and diagnostic devices, and it will be imperative to ensure that unauthorized people cannot access the network via these devices, or access the devices via the network. These factors will pose wholly new security and interoperability challenges for hospitals. However, some of which may only be known after IoTs gain more widespread use. Although the IoT holds forth immense new promises, the way to it is by no means yet clear.
Acoustic angiography - towards new tumour morphology metrics

Acoustic angiography is a method to acquire images that possess both high resolution as well as a superior contrast-to-tissue ratio. As opposed to clinical ‘grey scale’ ultrasound, acoustic angiography filters out tissue signals. This allows visualization of blood vessels with little interference from background tissues.

Trade-offs in imaging modality
The structure of blood vessels can be visualized via several imaging modalities, such as magnetic resonance imaging (MRI), computed tomography (CT) and ultrasound. However, each entails making a compromise between several factors. In terms of cost, MRI tops, followed closely by CT, while ultrasound is inexpensive. MRI also takes the longest time for acquiring data, ultrasound the shortest. While CT is bulky and MRI requires a dedicated shielding facility, ultrasound is mobile and portable. CT has recently also been subject to considerable concerns on radiation dose.

Other trade-offs include imaging depth and image resolution. More recently, photo-acoustic imaging has begun offering similar portability as ultrasound with high resolution imaging and significant functional information (such as blood oxygen saturation). However, it remains limited in penetration depth.

High-frequency technology enhances image quality
On its part, although ultrasound was until recently considered to have little ability to assess microvasculature structure, advances in high-frequency technology have led to dramatic improvements in image quality. Nevertheless, it still lacks the resolution and contrast of CT and MR. There have been attempts to finesse ultrasound further. However, once again, it has not been possible to escape some compromises.

Ultrasound and microbubble contrast agents
For example, noncontrast-enhanced ultrasound excels at imaging anatomical features, but is limited due to scatter when blood flow in small vessels is sought to be imaged. To compensate, clinical ultrasound relies on the application of intravascular microbubble contrast agents (MCAs). These respond to ultrasound pulses in a nonlinear fashion, allowing their acoustic scatter to be detected and separated from tissue enabling images, while signal processing segments blood vessels from the tissue background. Such a workaround is effective near MCA resonance frequencies (below 10 MHz), which is sufficient for clinical imaging applications.

With contrast-enhanced ultrasound, on the other hand, nonlinear techniques are ineffective at high frequencies (given the <10 MHz resonant frequency level for MCAs). As a result, increasing the imaging frequency for higher resolution simply leads to a decrease in sensitivity to contrast agents.

Microbubble harmonics and attenuation
To cope with this dilemma, MCAs are excited near resonance to produce high frequency microbubble harmonics. In practical terms, this means that “microbubbles can be excited near resonance (5 MHz, for example), and a receiver can detect harmonics at 15-45 MHz.” With energy below 15 MHz filtered out, such a system can detect microbubbles with nearly complete suppression of tissue background – resulting in extremely high sensitivity and signal to noise ratio. On the other hand, since microbubbles excited to near resonance function as high-frequency point ‘transmitters’, the high frequency components are attenuated in only one way. In effect, thus, such a system can achieve on the order of twice the resolution at a similar penetration depth as standard ultrasound methods. While this dual-frequency, ultra broadband contrast imaging approach has enormous potential, it has not been possible until recently. This is because no commercial ultrasound transducers exist that can simultaneously transmit near 2-5 MHz, and receive with reasonable sensitivity at a much higher frequency (15-45 MHz).

Dual-frequency transducers
A key technical element in acoustic angiography consists of dual-frequency ultrasound transducers. The transducers are used to excite microbubble contrast agents near resonance and detect their harmonics at several times the basic frequency. Due to this, the resulting images contain little background from tissue scattering. They provide high contrast images with resolutions to the order of 130 microns. Moreover, given that microbubbles are strictly an intravascular agent, acoustic angiography enables the visualization of microvascular architecture with unmatched clarity.
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Tumour imaging applications
The major application for acoustic angiography is expected to be for detecting cancer. The technique is useful in identifying early stage tumours, “based on vessel bendiness or ‘tortuosity’,” according to Dr. Paul Dayton of the Lineberger Comprehensive Cancer Center at the University of North Carolina (UNC - Chapel Hill), who is credited with inventing the technique. This is because establishment of blood supply is a critical stage in cancer growth.

Tortuosity and tumour assessment
The fact that tortuosity provides useful data in the assessment of tumours has been known for over a decade. In 2005, a study in ‘Academic Radiology’ explored the association in considerable depth, noting that “malignancy provokes regional changes to vessel shape” and that “vessel tortuosity abnormalities appear early during tumour development... and do not simply mirror tissue perfusion.” The study was led by a team under Dr. Elizabeth Bullitt, also of UNC - Chapel Hill. It sought to detect and quantify tortuosity abnormalities in magnetic resonance angiography (MRA) images and found that quantitative measures of vessel shape appear to “offer a new approach” to the identification and study of tumours, and for diagnosing cancer.

Limits in both MR and CT angiography
The study, however, underlined one inherent limitation in its design - namely, the lack of data from vessels with diameters less than the voxels in the acquired image. Though computed tomographic angiography (CTA) would have visualized smaller vessels than MRA, it was not used given MR’s greater sensitivity to tumour delineation (as compared to CT). Methodological issues also played a role in the choice of MRA. The study sought to statistically compare vessel numbers and shapes across subject and a difference in circulation times between individuals made CTA injection timing difficult. This was because a delay in injection timing would have led to missing out small vessels while premature timing could have whitened out tumours, making it impossible to discriminate individual vessels within tumour boundaries.

Acoustic angiography: the advantages
These MRA-specific challenges may now have been resolved by acoustic angiography. According to a study in 2012 by Dr. Dayton and colleagues at the Lineberger Center at UNC - Chapel Hill, acoustic angiography enables the visualization of vessels “in minutes with a very quick scan, using very inexpensive imaging methods.”

The Lineberger study also established some of the immediate practical advantages of acoustic angiography. It uses intravascular contrast agents, which allows acquiring images of only blood vessels. The results “showed a definitive difference between vessels within and surrounding tumours versus those associated with normal healthy vasculature. Apart from the contrast agent, other supporting innovations included an ultrasound probe to transmit and receive at two different frequencies (transmitting at 4 MHz and receiving at 30 MHz), while algorithms separated imaging of normal vessels from tortuous ones.

Determining tumour response to therapy
Another area for attention is even more ambitious - to evaluate the ability of acoustic angiography to determine a tumour’s response to therapy. Once again, research in the mid-2000s has demonstrated that vessels can unbend or normalize in response to effective therapy. One of the best known efforts in this area consist of a series of studies, with the researchers again led by Dr. Bullitt of UNC - Chapel Hill.

In a 2004 paper on malignant gliomas, Dr. Bullitt demonstrated that vessel tortuosity abnormalities “resolve during effective treatment and recur with tumour recurrence” and concluded that vessel shape analysis “could provide an important means of assessing tumour activity.” Two years later, her team presented the results of yet another MRA-based investigation, into metastatic breast cancer, at the 9th International Conference on Medical Image Computing and Computer-Assisted Intervention at Copenhagen in October 2006. Their findings: “vessel shape may predict tumour response several months in advance of traditional methods.”

Meanwhile, Dr. Dayton’s team at the Lineberger Center is now seeking to assess if rather than MRA, blood vessel visualization and tortuosity analysis via the less expensive technique of acoustic angiography can detect such normalization “prior to conventional assessments of tumour response to therapy, such as measurements of tumour size” via a CT or MRI scan.

The future: clinical trials and research projects
In spite of such promise, there is still much to be done. Acoustic angiography works only for tumours at a shallow depth into tissue, such as melanomas or thyroid cancer. Subsequent studies aim to address this imaging-depth issue.

In June 2014, the Lineberger Center began recruiting 60 volunteers from the UNC Breast Clinic undergoing core needle biopsy or surgical biopsy to evaluate the quality of acoustic angiography images and determine whether the technique provides additional diagnostic information over traditional ultrasound, and improves the assessment of breast lesions. In particular, the additional diagnostic information is meant to “hopefully enable us to reduce false positive tests and discriminate lethal cancers from non-lethal disease.”

The trial also seeks to analyse images with image processing techniques in order to determine quantitative morphology metrics exhibited by the blood vessels. These metrics, in turn, are due to be utilized to develop a ‘malignancy score’ equation to predict malignancy of a lesion. The trial is expected to present its initial findings in August 2016.

The prospects for acoustic angiography got a further boost after the US National Institutes of Health (NIH) announced a $1.26 million (€0.92 million) grant to develop automated vessel modelling and computer-aided diagnosis methods in support of the technique. So far, manual measurements have been time consuming and prone to error. The first phase of the project seeks to optimize the process in a pilot project to “run in minutes, rather than hours, and offer significantly improved accuracy.”

A subsequent phase seeks to integrate the pilot into a commercial imaging system which will “provide affordable and easy-to-use technology that could accelerate the pace of cancer research, bringing lifesaving therapeutics to the patient’s bedside sooner and with a lower development cost.” Partners in the project have committed themselves to release algorithms for vessel modelling and analysis as open-source software.
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PET/MRI: enabling combined metabolic-anatomical imaging

PET/MRI is a hybrid combination of two imaging modalities. The first consists of positron emission tomography (PET) for ultra-sensitive imaging of metabolism and tracking uniquely labelled cell types or cell receptors. The second consists of the structural and functional characterization of tissue provided by magnetic resonance imaging (MRI).

The combination of metabolic and anatomical imaging provides superior diagnostic capabilities in certain clinical situations - above all, for cancer.

**PET: 18F-FDG and tumour response**

PET has a uniquely high sensitivity, in the picomolar range, and uses radio-labelled tracers which provide molecular information for characterizing tumours and metastases. The tracers are injected in minute, non-pharmacological doses, and 3-D images are subsequently reconstructed by computer to show the concentration and location of specific tracers.

PET rapidly began to gain traction in the early 2000s, after it was realized that the imaging of specific molecular targets associated with cancer would permit earlier diagnosis and better management of oncology patients. A review published in 2002 foresaw PET becoming increasingly important in cancer imaging over the decade. Since then, PET has offered a way out of some of the key limitations in anatomical approaches for imaging cancer biology.

More recently, PET has begun to gain widespread acceptance for assessments of tumour response to chemotherapy and radiotherapy, when combined with the 18F-fluorodeoxyglucose (18F-FDG), glucose analogue. The commercial availability of the latter catalysed widespread introduction of PET in smaller hospitals and medical centres. Although quantitative analysis of 18F-FDG uptake is required for predicting tumour response early in therapy, according to some a visual interpretation of scans is often sufficient to assess response after the completion of therapy.

**PET/CT seeks to address anatomical information deficit**

PET images, however, still lack detailed anatomical information. An effort to address such a lack was to fuse PET data with high-resolution, three-dimensional morphological images from computer tomography (CT), which have been achieving sub-millimetre spatial resolution for well over a decade. Since the mid-2000s, PET examinations have indeed been performed in combination with CT and hybrid PET/CT systems have shown far greater accuracy in data registration from the two modalities than achievable by software fusion of separate images. The hybrid data has of course also proven to be of higher diagnostic value than either PET or CT on their own - apart from also simplifying the logistics of patient management. New PET installations are now almost exclusively comprised of combined PET/CT scanners.

Key advantages of the combination, according to a 2009 study by Vanderbilt University Medical Center in the US include superior lesion detection, improvement in the localization of foci of uptake resulting in “better differentiation” of physiological from pathologic uptake, “precise localization” of malignant foci (for example, in skeletal vs. soft tissue or in the liver vs. adjacent bowel), the characterization of serendipitous lesions and confirmation of “small, subtle, or unusual” lesions.

**Impact on clinical management**

These advantages, in turn, have impacted on clinical management in patients with a wide range of diseases by either guiding further procedures or excluding the need for them. Other outcomes include changes to both inter- and intramodality therapy (even soon after one form of treatment had been initiated) and the provision of high quality prognostic information.

The conclusions of the 2009 Vanderbilt study mentioned above was straightforward: PET/CT fusion images “have the potential to provide important information to guide the biopsy of a mass to active regions of the tumour and to provide better maps than CT alone to modulate field and dose of radiation therapy.”

**Limitations of PET/CT**

In spite of new perspectives brought into play by PET/CT, clinical cases have still indicated limitations. One major drawback was that in spite of a significant radiation dose, “CT provides only limited soft tissue contrast.” Simultaneous data acquisition is however ruled out since PET and CT scanner share a common patient bed and are hard-wired back-to-back. In other words, the CT and PET scans are acquired sequentially rather than simultaneously. The temporal mismatch causes image artefacts due to movement by patients or their...
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organs between the two scans or even by differences in breathing protocols used in PET versus CT. These artefacts, in turn, can seriously compromise the accuracy of registration.

**PET/MRI**

Researchers have since sought other modality combinations as a way to overcome such limitations. One of the most promising initiatives has been the integration of PET detectors into an MRI scanner to permit simultaneous data acquisition. There are firstly several clinical indications where MRI is considered preferable to CT, such as bladder cancer, and in the assessment of brain tumour volumes. MRI is also more accurate than CT “in the temporal lobes, posterior fossa, brainstem, and spinal cord.” In addition, its soft tissue contrast capability and lack of ionizing radiation are also strong pluses in MRI’s favour. MRI is equipped with a host of protocols to selectively enhance contrast (and visual discrimination) between different tissues in vivo. PET/MRI thereby blends MRI-derived information on anatomy and function for correlation with quantitative, pathology-specific PET-derived data on other aspects of tissue function. In effect, PET/MRI hybrids can combine functional and morphological images with high soft tissue contrast, good spatial resolution of anatomy and accurate temporal and spatial image fusion.

**More than the sum of their parts**

Given that MRI has functional imaging attributes, in addition to its anatomical capabilities, PET/MRI is also seen to hold specific relevance in cancer patients needing tailored therapy and to monitor response to treatment. Indeed, the combination of PET with MRI provides many advantages “which go far beyond simply combining functional PET information with structural MRI information.” Unlike PET/CT, furthermore, PET/MRI offers the possibility of truly simultaneous PET and MRI scanning. Such temporal correlation of data from both modalities can be of special interest for brain imaging as well as in the fields of cardiology and oncology.

**Towards multi-parametric imaging**

Convergence is also being driven by other factors. As discussed previously, PET in combination with the glucose analogue 18F-FDG is being used to assess response to chemotherapy and radiotherapy. Some also believe that knowledge from molecular imaging-guided therapies could quickly be transferred to PET/MRI, for a combined multi-parametric strategy. Accordingly, there are expectations that “hybrid PET/MRI scanners might become game-changers for how MRI is used in clinical routine.”

On the other side, diffusion-weighted MRI (DWI) is another fast evolving functional imaging modality to evaluate oncologic and non-oncologic lesions throughout the body, with specific implications for bone marrow assessments. As of now, whole-body DW imaging is “almost at the stage where it can enter widespread clinical investigations, because the technology is stable and protocols can be implemented for the majority of modern MR imaging systems.” Studies see information provided by 18F-FDG PET and diffusion-weighted MRI as potentially complementary, because the two methods “are based on completely different biophysical underpinnings.”

**Technical hurdles ahead**

The barriers facing hybrid PET/MRI are technical, as well as economic and operational. Technically, both modalities process electronic signal pulses which can be subject to distortion and degradation of performance. Other than the need to avoid signal distortion, the key challenge in merging PET and MRI hardware is that PET detectors are based on photomultiplier tubes. These require protection from the strong magnetic field accompanying an MRI.

One of the key functional information capabilities of MRI, blood oxygenation level dependent (BOLD) imaging, has led to PET/MRI providing in-vivo multi-functional information on physiological processes. BOLD is an integral element of functional MRI (fMRI), which is of special interest in neurology and psychiatry, as it assesses brain function by detecting a contrast dependent on the blood oxygenation level (BOLD effect) and this on a combination of perfusion as well as oxygenation. To make use of the potential of combined PET and MRI to reveal such multi-functional information as well as anatomy in a single patient examination, any mutual interference between the two imaging modalities needs to be avoided to allow each of the two modalities to perform to their optimum capabilities.

**Clinical utility of PET/MRI**

In economic terms, PET/MRI is more expensive and also has a lower throughput than PET/CT. The key question, therefore, is when should PET/MRI be used? In other words, does it fulfil a real clinical need?

One of the institutions seeking to answer this is the Righospitalet in Copenhagen, Denmark, which installed an integrated PET/MRI system at the end of 2011. In 2013, a Righospitalet team published a paper after using the PET/MRI system to diagnose, tailor and monitor therapy in more than 1,200 cancer patients. The paper describes the use of PET/MRI scans on brain tumours, pediatric oncology as well as lung, abdominal and pelvic cancer. In general, the cases show that PET/MRI “performs well in all these types of cancer when compared to PET/CT.” However, the authors called for future large-scale clinical studies to establish definitive protocols for use.

**Beyond cancer, to cardiology and multimodal quantitative imaging**

Access to the near-simultaneous physiological and biologic measurements offered by PET/MRI hybrids have already made it “the most sophisticated quantitative imaging modality in cardiology.” Though there still are no obvious clinical indications defined for its use, some efforts are being made. For example, the Technische Universität in Munich is assessing the feasibility of an 18F-FDG PET/MRI hybrid for imaging the heart. Although PET/MRI is likely to increase workflow complexity, it will also result in reducing radiation exposure - for example, by obviating the need for CT-based attenuation correction. Ultimately, the long-term strength of PET/MRI lies in its ability to deliver multi-modal quantitative imaging parameters based on dynamic data acquisition in both its complementary channels.
Advantages of MRI in prostate cancer diagnosis and treatment

The conventional method of prostate cancer detection is based on blood tests showing elevated prostate specific antigen (PSA) levels followed by an uncomfortable digital rectal examination (DRE) and a 12-needle biopsy under ultrasound guidance. Professor Jelle Barentsz, Head of the Prostate MR Reference Centre in Nijmegen, Netherlands, has pioneered a novel approach using magnetic resonance imaging (MRI) to effectively confirm or exclude suspected prostate cancer as well as determine the aggressiveness and spread of the disease, and even treat it in a number of cases. Despite obvious advantages, this approach has yet to gain wider acceptance, not least among radiologists who need to be trained for the procedure. Insurance companies and national health systems also have to be convinced of the benefits of the MRI-based method.

The limitation of the standard PSA test is its low specificity – only 20% of confirmed high PSA patients actually have a tumour and only half of these are aggressive cancers, the other half consisting of indolent, slow-growing tumours that never develop into aggressive, invasive carcinoma and would therefore normally not require treatment but nevertheless risk surgical “overtreatment” in the absence of sufficiently accurate diagnosis. DRE, on the other hand, is notorious for its low sensitivity (70% of all carcinomas are not palpable) and unreliability as the examination is essentially limited to the posterior part of the prostate. As for ultrasound (TRUS) biopsy, in 40% of all cases, the needles miss the cancer and in another 40% fail to reach the tumour’s most aggressive part.

Multiparametric MRI technology

The combination of conventional anatomical MRI (T2-weighted imaging), Diffusion Weighted Imaging (DWI) and Dynamic Contrast Enhanced (DCE) MRI is known as multiparametric MRI (mp-MRI) and is an accurate tool for the identification and characterization (location, size and aggressiveness) of clinically relevant tumours. The latest MRI equipment is capable of creating 3D images in sharp focus. DWI enables the analysis of the movement of water molecules which is reduced in tumours. DCE uses a Gadolinium-based MR contrast agent to measure tissue perfusion which is higher in tumour tissue. Furthermore, another MR technique, using iron nano-particles (nano-contrast agent Ferumoxtran-10/Combidex/Sinerem) lowers the detection limit of metastases in lymph nodes from 8 to 3 mm. Overall, the high specificity and high negative predictive values (NPVs) afforded by mp-MRI (Prof. Barentsz reports 0.97 NPV in the prostate and 0.95 in lymph nodes) gives the technique a major potential role in detecting prostate cancer.

MRI-guided prostate cancer treatment

Since the most aggressive part of the tumour can be reached with a needle during the biopsy of malignant cases, it is also possible to use this needle in a controlled way to destroy the tumour with a laser or by cryo-ablation without damaging the surrounding tissue. Laser treatment can even be performed on an outpatient basis when the carcinomas are small and easily accessible. For this purpose, Prof. Barentsz and his team have developed and patented a small MR-compatible robotic manipulator to guide the needle in the MRI system.

In other cases where nano-MRI helps the detection of small metastases by image-guided surgery, it becomes possible to initiate early, image-focused and patient-tailored treatment, e.g. targeted radiotherapy. This results in fewer side effects and better outcomes at lower costs. Hormonal treatment may be delayed or even avoided.
micrometastases

New contrast agent spotlights tiny tumours and micrometastases

Researchers at Case Western Reserve University have developed a magnetic resonance imaging (MRI) contrast agent that detects much smaller aggressive breast cancer tumours and micrometastases than current agents can identify.

“Currently, there is no imaging technology in clinical use that can detect tumours or metastases smaller than 2 millimetres in diameter,” said Zheng-Rong Lu, professor of biomedical engineering and leader of the research. “This can detect them as small as 300 microns—a few hundred cells.”

Metastasis is the most common cause of breast cancer deaths. Scientists believe early detection and treatment of primary and metastatic tumours increases the chances of survival. The key to earlier detection is a small peptide gadolinium-based MRI contrast agent that binds to molecular markers, called fibrin-fibronectin complexes. The complexes are expressed in high-risk primary tumours and metastases. The small peptide is a chain of five amino acids. Called CERKA for short, the peptide doesn't attach to healthy tissues. But in metastatic tumours and aggressive primary tumours—especially those preparing to metastasize—more fibronectin is expressed and more image contrast generated, the researchers found.

“We not only detect the tumour, but detect it's aggressiveness,” Lu said.

The engineers tested the agent on mice bearing breast cancer metastases. Signals generated during a molecular MRI showed the agent was effective at delineating primary tumours and micrometastases in the lung, liver, lymph node, adrenal gland, bone and brain as small as 300 micrometers. The agent increased the signal output from metastases by 77 percent to 122 percent.

The engineers confirmed the findings using Wilson's high-resolution fluorescence cryo-imaging system, which is sensitive enough to identify single cancer cells, but unusable on human patients.

Cape Western University
http://tinyurl.com/nlkmkm9

Ultrasound sensors for improved breast cancer screening

The first prototype ultrasound sensors for a new improved breast screening technique have been developed as part of an Innovate UK funded collaboration between the National Physical Laboratory (NPL), University Hospitals Bristol (UHB), North Bristol NHS Trust (NBT), Precision Acoustics Ltd and Designworks. The team is now looking for commercial partners to translate the novel development into a clinical device.

NHS breast cancer screening in England is currently conducted using X-ray mammography, and further investigations may involve a clinical examination, more X-ray mammograms and conventional ultrasound.

During mammography, each breast is compressed between the two plates of an X-ray machine, which some women find very uncomfortable, and two X-rays are taken at different angles. However, the inability of 2D X-ray mammography to separate overlying tissue can lead to false positives and false negatives, and the hazards associated with ionizing radiation limit the frequency with which X-rays can be performed. Conventional ultrasound is highly operator-dependent and suffers from imaging problems, making cancerous tissue difficult to distinguish from healthy tissue.

NPL, UHB, NBT, Precision Acoustics and Designworks are developing a prototype clinical system for a new breast screening technique - using ultrasound computed tomography (UCT) - that may overcome the problems of diagnosing breast disease using conventional X-ray mammography and ultrasound scans. The new ultrasound method will be safer and lower cost than currently-used screening techniques, and the results should be easier for clinicians to interpret.

NPL has developed and patented a novel detection method employing pyroelectric sensors, which convert ultrasonic energy into heat, generating electrical signals which are eventually used to form the ultrasound image. These large-area thermal sensors should generate far fewer image artefacts than conventional piezoelectric detectors, which are sensitive to the phase of the arriving ultrasound waves.

In the new procedure, the patient’s breast will be placed in a warm water bath between an ultrasound transmitter and receiver. Ultrasonic waves are sent through the breast and the amount of energy emerging is measured using the prototype ultrasound sensor. The ultrasound transmitter array and the receiver are rotated around the breast, and the resulting measurements are combined to produce a 3D image of breast tissue properties. Different tissue types, including those that are cancerous, can then be identified from this image.

National Physical Laboratory
http://tinyurl.com/ozfhx3s

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Brain scans predict response to antipsychotic drugs

Investigators at The Feinstein Institute for Medical Research have discovered that brain scans can be used to predict patients’ response to antipsychotic drug treatment. Psychotic disorders, such as schizophrenia and bipolar disorder, are characterized by delusions, hallucinations, and disorganized thoughts and behaviour. They are estimated to occur in up to three percent of the population and are a leading cause for disability worldwide. Psychotic episodes are currently treated with antipsychotic drugs, but this treatment is given without guidance from lab tests or brain scans, such as functional magnetic resonance imaging or functional MRI (fMRI). Doctors often use “trial-and-error” when choosing treatment for psychotic disorders, without knowing if patients will respond well. This lack of knowledge places a large burden on not only patients and their families, but also healthcare professionals and healthcare systems.

Led by Anil Malhotra, MD, director of psychiatry research at Zucker Hillside Hospital and an investigator at the Feinstein Institute, and Todd Lencz, PhD, associate investigator at the Zucker Hillside Hospital and the Feinstein Institute, researchers used fMRI scans obtained before treatment to predict ultimate response to medications in patients suffering from their first episode of schizophrenia. Connectivity patterns of a region of the brain called the striatum, which tends to be atypical in patients suffering from psychotic disorders, were used to create an index. This index significantly predicted if psychotic symptoms were decreased in the studies’ patients. What’s even more significant is that the researchers applied this index to confirm their results in a separate group of patients with more chronic illness – those who were hospitalized for psychotic symptoms. They found that treatment outcome could be predicted in the replication group as well.

“This study is the first to report a predictive fMRI-derived measure validated in an independent study group of patients treated with antipsychotics.”

The Feinstein Institute for Medical Research
http://tinyurl.com/oz8gy8u

Accuracy of dementia brain imaging must improve

MRI scans and other tools to detect and diagnose dementia are helpful but not definitive – according to new research from the University of East Anglia.

A report evaluates for the first time how well different types of brain imaging tests work to detect Alzheimer’s and predict how the disease will progress. The results show that the accuracy of brain imaging must be improved before it can be rolled out on a scale that could be useful to healthcare providers and patients.

Co-author Prof Chris Fox says that overplaying the current benefits of imaging could create unnecessary healthcare costs for the NHS and that ‘patient burden’ – caused by tests carried out, stress, and the potential anxiety associated with being diagnosed before symptoms appear – should also be taken into account.

“The spectrum of dementia stages is very broad and everybody is different. Some newly diagnosed patients don’t yet show obvious signs of memory loss, whereas others may have severe dementia at the time a diagnosis is made.

“Advances in neuroimaging research have revealed that the disease progresses in the brain over time. Accumulating evidence suggests that changes in the brain can be detected years before the disease manifests clinically. “This has fuelled a great deal of interest in the use of brain imaging to detect Alzheimer’s disease and predict how and when dementia will develop in patients who are at risk”.

“The number of new diagnostic and prognostic tools for dementia is steadily increasing and there are a lot of different scanning techniques currently being used in clinical research settings. “These include different types of MRI scans, which use strong magnetic fields and radio waves to produce detailed images of the inside of the brain, and Positron Emission Tomography (PET) scans, which use a small amount of a radioactive drug, or tracer, to test how tissues in the brain are actually functioning”.

The international research team assessed how well the most widely-used imaging techniques measure the pathological changes expected in the brain and the accuracy with which they can predict an individual’s clinical outcome.

They also assessed ‘multimodal imaging’ – which combines different types of MRI and PET scans to give a more detailed diagnosis.

University of East Anglia
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Probing the image quality and dose of thorax X-rays

A 354-patient study on image quality and dose values for thorax images with the DX-D 300 digital radiography system and MUSICA 3 software was carried out at the Institute of Imaging Diagnostics and Therapy (BDI) in Erlangen. Dr. Karina Hofmann-Preiss, summarizes here the details and findings of the study.

Agfa HealthCare’s DX-D 300 digital U-arm system has been in use at the Waldkrankenhaus St. Marien healthcare centre since May 2013. Radiologist Dr. Karina Hofmann-Preiss and her team attach great importance to patient comfort and high image quality as well as the minimization of radiation exposure. For Dr. Hofmann-Preiss, the DX-D 300 kills two birds with one stone. “We get higher-quality and more diagnostically meaningful images with a lower radiation dose.” The high image quality of the DX-D 300 was achieved primarily by the cesium iodide detector and the MUSICA image processing software. In the autumn of 2013 it was still unclear what dose reduction the radiologists at the Institute of Imaging Diagnostics and Therapy (BDT) would ultimately be able to achieve during individual examinations, as some assessments of the individual examinations still remained to be carried out. At that time it was estimated that the dose could be reduced by at least 15% compared with the previously used imaging plate systems.

In May 2014, the DX-D 300 was equipped with MUSICA 3, the next, further optimized generation of the image processing software. To collect reliable information about the dose and image quality with MUSICA 3, thorax X-rays were evaluated for a period of five weeks after the software was installed.

**Scope of study**

A total of 354 patients participated in the study, with an age range of 17 to 94 (Fig. 1). Examinations were carried out on 190 male patients and 164 female patients. In 74 cases only posteroanterior (PA) images were taken and in 280 cases two-plane images. The exposure parameters were 117 kV for PA, 125 kV for lateral X-rays with automatic exposure, anti-scatter grid \( r = 8:1 \), \( f_0 = 180 \text{ cm} \), 52 L/cm. The dose area products of all examinations...
were calculated in cGy x cm² and the effective dose for the individual X-ray was estimated from this by using the conversion factor 0.002. The BMI was calculated for 275 patients from the group and was between 18 and 44 (Fig. 2).

**Initial results**

For both the PA and lateral images, the dose area products for all BMI values were clearly below the current German dose reference value of 16 cGy x cm² or 55 cGy x cm² for lateral images. The average dose area product for PA images in this collective was 6.44 cGy x cm² and for lateral images was 16.01 cGy x cm² (Figs. 3 and 4). The average effective dose for a PA thorax X-ray in the patient group was 0.013 mSv and for a two-plane X-ray was 0.046 mSv.

The lowest dose area product with a BMI of 18 was 3.1 for PA and 5.02 cGy x cm² for lateral. In this case the effective dose for the complete examination was 0.016 mSv. The maximum dose area product for a PA image was 14.7 cGy x cm², and correspondingly the dose area product for a lateral image in this case was 36.3 cGy x cm². Here the effective dose was 0.1 mSv for the complete examination.

The image quality was assessed in line with the quality requirements of the guidelines published by the Bundesärztekammer on quality assurance in diagnostic radiology.

**Conclusion**

Even at a very high BMI there were no limitations on the representation of characteristic features, important details or critical structures.

Both the retrocardiac lung and the mediastinal structures can be well assessed even with very overweight patients (Fig. 5 and 6).

In particular, the retrocardiac lung and the mediastinal structures were easier to assess in an intra-individual comparison between MUSICA 2 and MUSICA 3.

**References:**

- German Federal Office for Radiation Protection; Announcement of updated diagnostic reference values for diagnostic and interventional X-ray examinations, 07.22.2010
- Bundesärztekammer; Guidelines on quality assurance in diagnostic radiology – Quality criteria for diagnostic X-ray examinations, 11.23.2007

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*A survey on access to pediatric imaging in French public and private hospitals*

Conducted by Adexsol among 754 healthcare professionals (514 radiologists and 240 pediatricians), this survey provides for the first time, data on the medical imaging offer for children.

Pediatric imaging diagnosis waiting times seem long, especially for MRI and to a lesser extent for the CT Scan, according to the survey, published during the French Radiology Days (JFR) in Paris last October.

Results show pediatricians usually refer children to ambulatory radiologists for general imaging – standard radiography and ultrasound (except for infants). The private sector is used more for 6 year old + children than for younger children.

The more complex the imaging, the more the public sector is used, especially university hospitals, no matter the age of the children. MRI patients are most often referred to the public sector. Respectively 88% and 79% of respondents refer their under 6 year old and over 6 year old patients to a public hospital for MRI. Regarding CT scans, more than 3 pediatricians out of 4 refer children to hospital (85% of respondents for under 6 years old and 72% for over 6 years old).

The need for specific patient management to perform the diagnosis explains such figures: pre-treatment for the younger ones and simulation for the older ones, to enhance confidence and for monitoring purposes during and after the diagnosis. Except for emergency situations, standard radiography diagnosis is performed the same day for 68% of respondents and within a week for the others. CT scan waiting times for children under 6 years old are between 8 and 31 days. With regards to MRI, waiting times are above 31 days for half of respondents.

Is it acceptable for parents to wait for a month or even between 4 and 6 months for an MRI diagnosis?

In emergency situations, at night and weekends, children are referred to the university hospital for 62% of respondents and to another type of public hospital for 38% of them, referrals to the private sector being very rare.

Unsurprisingly, the university hospital plays an essential role in pediatric emergencies since 62% of respondents refer their patients to it. Access is good except for MRI as 21% of respondents don’t have access to this modality, in emergency cases. For radiologists, the need for specific training and management is one of the first reasons for not performing certain types of specific diagnosis on children.

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Integrated patient care

It is helpful to have a goal, even in the knowledge that it can never be reached. Some enthusiasts in the Integrating the Healthcare Enterprise (IHE) community, including myself, follow the road towards developing IHE integration profiles to reach the goal of an integrated patient care (IPC), see figure 1, even knowing that it means reaching for the impossible.

The eight components contributing towards IPC shown in figure 1 are not representative of healthcare in general, but may be seen in the context of decision making for patient-specific therapeutic approaches. The healthcare unit which typically plays a major role in the process of therapy decision making is the therapy planning unit or tumour board. Here, ideally, many information sources available about the patient (radiology, pathology, oncology, surgery, etc.) should be considered before subsequent diagnostic or therapeutic steps are being taken.

In a real clinical setting this means that a combination of quantitative and qualitative information about the patient has to be mentally integrated by the physician to create an abstract representation (model) of the patient. This model must be as close as possible to reality to serve as a basis for decision making in medical diagnosis and therapy. Based on the model created in the physician’s mind and perhaps with some consultation with colleagues, a diagnosis, prognosis (prediction) and treatment plan and associated workflow is deduced. This is commonly known as clinical judgment.

IPC applied in the tumour board environment can only be achieved if some basic interoperability between all disciplines engaged in the care of a particular patient is being supported. Specifically, communication methods and tools as well as appropriate procedures have to be put into place, such as

- Standards for the transmission of data
- Communication infrastructures
- Common terminology and understanding (ontologies)

In addition, behavioural agreement of all parties involved with respect to the acceptance and use of patient and interventional workflow models is a further essential requirement. This type of interoperability would not only benefit the tumour board but also the hospital or healthcare organization at large. But how can communication infrastructure and procedures be put in place in the healthcare setting to achieve something like access to the right information, at the right place and right time, by the right people?

Many roads lead to Rome, but one way to move towards IPC is by

a) leaning on what has already been achieved by the IHE community with existing integration profiles and advancing their adoption while at the same time,

b) developing specific new integration profiles, for example for the tumour board, therapy planning units, surgical units, etc.

The “leaning on” part is being followed by the European Union (EU) and the “developing specific new integration profiles” is a path taken by a relatively large community supporting the new IHE Surgery Domain.

EU recognizes IHE profiles for procurement

On July 28, 2015, the European Commission announced its decision to identify 27 IHE profiles that should be referenced in public procurement documents for health IT systems throughout the European Union as part of its eHealth European Interoperability Framework (eEIF).

The Commission’s announcement states, “The 27 IHE profiles have the potential to increase interoperability of eHealth services and applications to the benefit of patients and medical community.”

This extensive list includes profiles that define standards-based interoperability for laboratory, pharmacy, radiology and enterprise information and communication systems, as well as health information exchanges.

Some of the interesting IHE Integration Profiles (IPs) in this list which relate to workflow and interoperability are:
12. IHE XD-MS: Cross-Enterprise Sharing of Medical Summaries Integration Profile.

21. IHE SWF: Radiology Scheduled Workflow;

25. IHE LTW: Laboratory Testing Workflow;

27. IHE LW A: Laboratory Analytical Workflow.

It will be interesting to observe the real impact these specific workflow-oriented IPs will have in the healthcare community in general, and for an IPC in particular.

As regards extending this list with future potential IPs, for example for tumour boards and surgery units, one could imagine IPs such as:

XX. IHE SSWF Surgery Scheduled Workflow?

XX. IHE XD-SMS: Cross-Enterprise Sharing of Surgical Models Summaries Integration Profile?

XX. CRSI Consistent Representation of Surgical Information?

This is only a short list of potential IHE IPs which have been proposed and discussed in the newly forming IHE Surgery Domain.

**IHE Surgery Domain kick-off meeting**

At the IHE Surgery Domain Kick-off Meeting during CARS 2015 (Computer Assisted Radiology and Surgery) in Barcelona, Spain in June 2015 (www.cars-int.org), a wide spectrum of viewpoints were presented by the research community and industry on the future role of IHE in the interventional domain.

In particular, it was acknowledged, that it is a challenging task to put into practice in the Operating Room (OR) many of the new technological and system advances, associated interventional procedures and the corresponding redesign of healthcare infrastructures. Three main areas of technology development for the Digital OR (DOR) have been identified:

1. Devices, including signal detection and recording, robotics, guidance systems, simulation technologies, which allow precision in the delivery of personalized operative healthcare;

2. IT Infrastructure, including DICOM, IHE, EMR, Therapy Imaging and Model Management System (TIMMS) infrastructure for the storage, integration, processing and transmission of patient specific data (e.g. a type of surgical PACS);

3. Functionalities, including specific interventional processes, patient specific modelling, optimization of surgical workflow, visualization, validation, etc.

The interoperability problem between these technological areas was highlighted at the kick-off meeting in a number of specific projects presentations from different parts of the world, for example:

1. Devices, including signal detection and recording, robotics, guidance systems, simulation technologies, which allow precision in the delivery of personalized operative healthcare;

2. IT Infrastructure, including DICOM, IHE, EMR, Therapy Imaging and Model Management System (TIMMS) infrastructure for the storage, integration, processing and transmission of patient specific data (e.g. a type of surgical PACS);

3. Functionalities, including specific interventional processes, patient specific modelling, optimization of surgical workflow, visualization, validation, etc.

The funding received for these nationally supported and mainly academically driven projects amounts to something like €60 to 80 million, and if anything at all, reflects the importance given to the issue of integration and interoperability in the OR on a worldwide basis.

As an example, figure 2 shows the Japanese vision of an integrated OR, presented as a Smart Cyber Operating Theatre (SCOT) achieving information integration in the OR.

It is also noticeable that industry, whether small or large, is developing specific viewpoints on the issue of interoperability in the OR, for example in the presentations given by:

**Viewpoints from industry**

K.-M. Irion, Karl Storz GmbH & Co. KG, Tuttlingen (D)

Bridging the Radiology - Surgery Gap

R. Schilling, EchoPixel, Inc., Los Altos Hills, CA (USA)

IHE-FHIR-based trial implementation of a surgical interoperability platform

J.-U. Meyer, MT2IT GmbH & Co. KG (D)

In these and many other presentations given at the IHE Surgery kick-off meeting, it was acknowledged that existing IHE Integration Profiles and those envisaged by IHE Surgery may well contribute to finally realize vendor-independent integration of systems and devices in the OR, and thereby contribute to clear the way towards the goal of integrated patient care.

Perhaps, after all, this does not necessarily mean reaching for the impossible.
Brazil’s Mixed Public and Private Hospital System

MAUREEN LEWIS  
CO-FOUNDER AND CEO OF ACESO GLOBAL; VISITING PROFESSOR AT GEORGETOWN UNIVERSITY’S SCHOOL OF FOREIGN SERVICE, USA

EVANDRO PENTEADO  
PLANNING AND QUALITY MANAGER AT THE PRIVATE HEALTH HCCR HOSPITAL, SÃO PAULO, BRAZIL

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ABSTRACT: Brazil’s hospital sector is vibrant and growing. Under the 1988 Brazilian constitution all citizens have the right to health care, anticipating the global commitment to Universal Health Care. Brazil’s public sector prides itself on having one of the world’s largest single payer health care systems, but complementing that is a significant and larger private sector that is seeing big increases in investment, utilization and prices. This article outlines the structure of the hospital system and analyzes the nature and direction of private health sector expansion. Twenty-six percent of Brazilians have private health insurance and although coverage is concentrated in the urban areas of the Southeastern part of the country, it is growing across the nation. The disease burden shift to chronic diseases affects the nature of demand and directly affects overall health care costs, which are rising rapidly outstripping national inflation by a factor of 3. Increasingly costs will have to be brought under control to maintain the viability of the private sector. Adaptation of integrated care networks and strengthening of the public reimbursement system represent important areas for improvement.

Système hospitalier mixte public et privé du Brésil

Le secteur hospitalier du Brésil est dynamique et en pleine croissance. Selon la constitution brésilienne de 1988, tous les citoyens ont le droit aux soins de santé, anticipant l’engagement mondial pour les soins de santé universels. Le secteur public du Brésil se targue d’avoir un des plus grands systèmes de soins de santé à payeur unique du monde, mais complète un important et le plus grand secteur privé qui voit les fortes hausses de placement, l’utilisation et les prix. Cet article décrit la structure du système hospitalier et analyse la nature et la direction de l’expansion du secteur privé de la santé. Vingt-six pour cent des brésiliens ont une assurance maladie privée et même si la couverture est concentrée dans les zones urbaines de la partie sud-est du pays, il se développe à travers le pays. Le déplacement de charge sur les maladies chroniques affecte la nature de la demande et a un impact direct sur les coûts globaux des soins de santé, qui augmentent l’inflation nationale qui est rapidement multipliée par un facteur de 3. L’augmentation des coûts devra être maîtrisée pour maintenir la viabilité du secteur privé. L’adaptation des réseaux de soins intégrés et le renforcement du système public de remboursement représentent d’importants axes d’amélioration.
Challenges and Perspectives for Tertiary Level Hospitals in Bolivia: The case of Santa Cruz de La Sierra Department

ANDRÉ MEDICI
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ABSTRACT: Current legislation transferred public tertiary hospitals in Bolivia from the Municipalities to the Regional Level. However, the Regional Governments are experiencing technical and financial constraints to reform infrastructure, modernize equipment and introduce reforms to allow better governance, management and sustainability of these hospitals. This article summarizes the recent experience of the Government of Santa Cruz de la Sierra in Bolivia where five tertiary hospitals and one blood bank (most of them in precarious working conditions) had been transferred in 2012 from the Municipal Government of Santa Cruz (the capital) to the Regional Government of Santa Cruz. To face the challenges, the Regional Government of Santa Cruz implement several improvements, such as contract new clinical and administrative personal, increase hospital budgetary autonomy, outsource hospitals’ auxiliary services, take measures to eliminate waiting lists and make several new investments to modernize and equip the hospitals. The World Bank was contracted to evaluate the future financial sustainability of these investments and to advice the Government to propose changes to increase the hospitals’ management performance. The article describes the remaining challenges in these hospitals and the proposals from the World Bank Study. In the area of quality of care, the main challenge is to improve client satisfaction and continuous outcomes monitoring and evaluation according quality standards. In the area of Financing, the challenge is how to assure the sustainability of these hospitals with the current level of health financing and the insufficient financial transfers from the National Government. In the area of Governance, reforms to streamline and simplify internal processes need to be introduced in order to establish mechanisms to increase transparency and accountability, allowing the hospital to have a good administration and adequate participation of the main actors in the guidance of the institution.

Défis et perspectives pour les hôpitaux de niveau tertiaire en Bolivie : Le cas du département de Santa Cruz de La Sierra

En Bolivie, la législation actuelle a passé les hôpitaux publics tertiaires du niveau des municipalités au niveau régional. Toutefois, pour réformer les infrastructures, moderniser les équipements et faire des réformes pour permettre une meilleure gouvernance, gestion et viabilité de ces hôpitaux, les gouvernements régionaux sont confrontés à des contraintes techniques et financières. Cet article résume l’expérience récente du gouvernement de Santa Cruz de la Sierra en Bolivie où cinq hôpitaux du tertiaire et une banque de sang (la plupart d’entre eux dans des conditions de travail précaires) avaient été transférés en 2012 du gouvernement Municipal de Santa Cruz (la capitale) au gouvernement régional de Santa Cruz. Pour faire face aux défis, le gouvernement régional de Santa Cruz implémente plusieurs améliorations, telles que l’embauche de nouveau personnel clinique et administratif, l’augmentation de l’autonomie budgétaire de l’hôpital, l’externalisation des services auxiliaires des hôpitaux, la prise de mesures pour éliminer les listes d’attente et plusieurs nouveaux investissements pour moderniser et équiper les hôpitaux. La Banque mondiale a été interrogée afin d’évaluer la viabilité financière de ces investissements et de conseiller le gouvernement sur les propositions de changement à faire pour améliorer les performances de gestion des hôpitaux. L’article décrit les défis restants dans ces hôpitaux, ainsi que les propositions de l’étude de la Banque mondiale. Dans le domaine de la qualité des soins, le principal défi est d’améliorer la satisfaction des clients et du suivi continu des résultats, selon les normes d’évaluation de la qualité. Dans le domaine du financement, le défi est de savoir comment assurer la durabilité de ces hôpitaux avec le niveau actuel de financement de la santé et les transferts financiers insuffisants du gouvernement National. Dans le domaine de la gouvernance, des réformes visant à rationaliser et simplifier les processus internes doivent être introduites afin d’établir des mécanismes pour accroître la transparence et traçabilité, permettant à l’hôpital avoir une bonne administration et une participation adéquate des acteurs majeurs dans la direction de l’institution.

Solving a Health Information Management Problem. An international success story

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ABSTRACT: The management of health care delivery requires the availability of effective ‘information management’ tools based on e-technologies [eHealth]. In developed economies many of these ‘tools’ are readily available whereas in Low and Middle Income Countries (LMIC) there is limited access to eHealth technologies and this has been defined as the “digital divide”. (1, 2) This paper provides a short introduction to the fundamental understanding of what is meant by information management in health care and how it applies to all social economies. The core of the paper describes the successful implementation of appropriate information management tools in a resource poor environment to manage the HIV/AIDS epidemic and other disease states, in sub-Saharan Africa and how the system has evolved to become the largest open source eHealth project in the world and
become the health information infrastructure for several national eHealth economies. The system is known as OpenMRS [www.openmrs.org]. The continuing successful evolution of the OpenMRS project has permitted its key implementers to define core factors that are the foundations for successful eHealth projects.

Résolution d’un problème de gestion de l’information de la santé. L’histoire d’une réussite internationale
La gestion des soins de santé nécessite la mise à disposition d’outils efficaces de « gestion de l’information » basé sur des e-technologies [e-santé]. Dans les pays développés, beaucoup de ces « outils » sont disponibles, tandis que les pays à bas et moyen revenu (LMIC) ont un accès limité aux technologies de e-santé et ceci a été défini comme « fracture technologique ». Cet article fournit une brève introduction à la compréhension de base de ce que signifie la gestion de l’information dans les soins de santé et de comme elle s’applique aux économies sociales.
Le cœur de l’article décrit l’implémentation avec succès d’outils appropriés de gestion de l’information, dans un environnement pauvre en ressources, pour gérer des situations d’épidémies de VIH/SIDA et d’autres maladies, dans l’Afrique subsaharienne et comment le système a évolué pour devenir le plus grand projet de e-santé open source au monde et devenir l’infrastructure pour l’information de santé de plusieurs pays. Le système est connu sous OpenMRS [www.openmrs.org].

L’évolution permanente réussie du projet OpenMRS a permis à ses fondateurs clés de définir les facteurs principaux qui sont les piliers de la réussite des projets de e-santé.

HIMSS Venture+ Forum and HX360 Provide Industry View of Health Technology Innovation, Startup and Investment Activity; Advancing the New Model of Care

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ABSTRACT: Presented by HIMSS, the Venture+ Forum program and pitch competition provides a 360-degree view on health technology investing and today’s top innovative companies. It features exciting 3-minute pitch presentations from emerging and growth-stage companies, investor panels and a networking reception. Recent Venture+ Forum winners include TowerView Health, Prima-Temp, ActualMeds and M3 Clinician.

As an industry catalyst for health IT innovation and business-building resource for growing companies and emerging technology solutions, HIMSS has co-developed with AVIA, a new initiative that addresses how emerging technologies, health system business model changes and investment will transform the delivery of care. HX360 engages senior healthcare leaders, innovation teams, investors and entrepreneurs around the vision of transforming healthcare delivery by leveraging technology, process and structure.

Le Forum Venture+ et HX360 fournissent une vision de l’industrie de l’innovation des technologies de santé, des start-up et de l’activité d’investissement ; Faire progresser le nouveau modèle de soins
Présenté par HIMSS, le programme du Forum Venture+ et le concours de présentations donne une vue à 360 degrés sur l’investissement de la technologie de la santé et de meilleures entreprises innovantes d’aujourd’hui. Il met en scène des présentations passionnantes de 3 minutes des pays émergents et en phase de croissance, des panels d’investisseurs et une réception de réseau. Parmi les récents gagnants du forum Venture+ Forum on trouve TowerView Health, Prima-Temp, ActualMeds et M3 Clinician.

Comme un catalyseur de l’industrie pour l’innovation informatique de la santé et des ressources de renforcement des entreprises et de solutions technologiques émergentes, HIMSS a co-développé avec AVIA, une nouvelle initiative qui traite de la façon dont les technologies émergentes, les systèmes de santé et de modèle d’affaires et de l’investissement transformeront la prestation des soins. HX360 engage les dirigeants des leaders des soins de santé, les équipes d’innovation, les investisseurs et les entrepreneurs autour de la vision de la transformation de la prestation des soins de santé en tenant parti de la technologie, du processus et de la structure.

Facilitating Virtual Health Management Using Medical Device Integration

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ABSTRACT: Data from connected medical devices (CMDs) provides an objective and rich source of information to augment patient care management and clinical decision making. A principal reason is measurements of patient properties made through bedside CMDs are not typically subject to errors associated with misinterpretation, incorrect recording, and incorrect time stamping. Furthermore, data from CMDs can be collected regularly, ensuring a dense and robust data record on a given patient. The ability
to remotely manage and monitor patients is greatly facilitated by access to data, as measurements represent an objective source of information that facilitate clinical decision making.

In my recent book, Connected Medical Devices: Integrating Patient Care Data in Healthcare Systems, I discuss the topic of medical device integration (MDI) in relation to implementing CMDIs in healthcare settings as a guide to assist hospitals in undertaking the following discussion about MDI are the opening paragraphs from this text, followed by a discussion of MDI architectures.

Faciliter la gestion de santé virtuelle grâce à l’intégration de dispositifs médicaux

Les données issues des dispositifs médicaux connectés (DMC) sont une source riche et objective d’informations pour renforcer la gestion des soins au patient et la prise de décisions cliniques. Une raison principale est la mesure des caractéristiques des patients faites au moyen de DMC qui ne sont généralement pas soumis à des erreurs liées à une mauvaise interprétation, à un enregistrement incorrect et à un enregistrement de l’heure incorrect. De plus, les données des DMC peuvent être collectées régulièrement, assurant un enregistrement des données robuste et dense sur un patient donné. Comme les mesures représentent une source objective d’information qui facilite la prise de décisions cliniques, la capacité de gérer et de surveiller les patients à distance est grandement facilitée par l’accès aux données.

Dans mon dernier livre, Connected Medical Devices: Integrating Patient Care Data in Healthcare Systems, j’aborde le sujet de l’intégration de dispositifs médicaux (IDM) en ce qui concerne la mise en œuvre de DMC dans les établissements de soins comme un guide pour aider les hôpitaux dans cette entreprise. La discussion suivante sur la IDM sont les paragraphes d’ouverture de ce texte, suivis d’une discussion des architectures IDM.

Hospitals will send an integrated nurse home with each discharge

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ABSTRACT: Hospitals must adapt to the rapidly changing environment of risk by changing the health behavior of their population. There is only one way to do this efficiently and at scale: send a nurse home with every patient at the time of discharge. That nurse can ensure adherence to medication and slowly, over time, transform personal behavior to evidence based levels... basically taking their medication as prescribed, changing eating habits, increasing exercise, getting people to throw away their cigarettes, teaching them how to cope, improving their sleep and reducing their stress. But, this approach will require a nurse to basically “live” with the patient for prolonged periods of time, as bad health behaviors are quick to start but slow to change or end. The rapid developments in artificial intelligence and natural language understanding paired with cloud based computing and integrated with a variety of data sources has led to a new marketplace comprised of cognitive technologies that can emulate even the most creative, knowledgeable and effective nurse. Termed the Virtual Health Assistant, your patients can literally talk to these agents using normal conversational language. The possibility to send a nurse home with each patient to maintain adherence and prevent readmissions has arrived. The technology is available. Who will step forward to reap the rewards first?

Les hôpitaux devront envoyer une infirmière intégrée au domicile à chaque décharge

Les hôpitaux doivent s’adapter à l’environnement en mutation rapide du risque en modifiant le comportement de santé de leurs populations. Il y a une seule façon de le faire efficacement et à l’échelle : envoyer une infirmière à la maison avec tous les patients au moment de leur retour au domicile. Cette infirmière peut assurer l’adhésion aux médicaments et l’entêtement, au fil du temps, transformer un comportement personnel à la preuve fondée sur des niveaux... fondamentalement en respectant leurs ordonnances, en modifiant les habitudes alimentaires, en augmentant l’activité physique, en améliorant les gens à arrêter de fumer, et leur apprenant à faire face, en améliorant leur sommeil et en réduisant leur stress. Mais cette approche nécessitera une infirmière qui vit « essentiellement » avec le patient pour des périodes prolongées, car les comportements de mauvaise santé s’instaurent rapidement, mais mettent longtemps à changer ou à terminer.

L’évolution rapide en intelligence artificielle et dans la compréhension du langage naturel va de pair avec l’infomatique basée sur le cloud et intégrée à une variété de sources de données a conduit à un nouveau marché, composé de technologies cognitives qui peuvent émuler même l’infirmière la plus créative, compétente et efficace.

Appelé l’Assistant virtuel de santé, vos patients peuvent littéralement parler à ces agents à l’aide d’un langage conversationnel normal. La possibilité d’envoyer une infirmière à domicile pour chaque patient afin de maintenir le respect des ordonnances et d’éviter les ré hospitalisations est arrivée.

La technologie est disponible. Qui récoltera d’abord les fruits de ces avancées ?

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World Hospitals and Health Services Vol 51 No.2
Point-of-care testing in the BRICS

In spite of clusters of world class hospitals in high-end districts of major cities, the BRICS group of large emerging markets (Brazil, Russia, India, China and South Africa) are handicapped by rudimentary healthcare infrastructure in outlying regions and in their countrysides. In addition, even in central urban areas, the growth of new lifestyle diseases threatens to swamp existing facilities.

‘Emerging’ is still ‘developing’

Overall mortality rates from communicable disease in the BRICS countries place them squarely in the ‘developing’ world. For example, WHO data show death from one of the biggest killer diseases, tuberculosis, at 38 per 100,000 inhabitants in South Africa, 26 in India, 15 in China and 14 in Russia. By comparison, the figure in Equatorial Guinea, a sub-Saharan African nation, was 7 per 100,000, while Honduras in central America had a rate of 3.5. Both were lower than the BRICS and indeed closer to Belgium, an advanced western European country, where the figure is about 1 per 100,000.

Growth in lifestyle diseases

On the other side, the BRICS seem to be in a race to catch up with western world lifestyle diseases, seemingly due to increased urbanization, smoking, obesity and pollution.

One of the fastest growing threats is diabetes. In 2010, India had the dubious credit of being home to the largest number of diabetic patients in the world, over 41 million. According to a 2007 report from PwC, the number of Indian diabetics is projected to reach 73.5 million by 2025. Other BRICS countries do not fare better. In China, the rate of diabetes diagnosis “is outrunning every country in the world.” In Brazil, 37% of adults report metabolic diseases – a figure which includes 2.7 million diabetics, while the proportion in Russia is 44%.

Cancer mortality in the BRICS too is clearly a major concern. WHO data show age-adjusted deaths from cancer per 100,000 population at 133 in Brazil, 143 in China, 100 in India, 142 in Russia and 151 in South Africa. These correspond to OECD averages.

Meanwhile, according to WHO data, mortality from cardiovascular diseases (CVD) is already higher in the BRICS than much of the western world. For example, CVD deaths per 100,000 is 286 in Brazil, 279 in China, 382 in India, 645 in Russia and 389 in South Africa. By comparison, the rate in Belgium is 175.

The role of diagnostics

One of the major, cost-effective enablers of a robust response to disease consists of diagnostics. According to some estimates, although “more than 50% of treatment decision-making is based on some diagnostics, it still accounts for less than 3% of the cost of healthcare.”

As is the case in smaller or poorer developing countries, the inability of the BRICS countries to rapidly diagnose disease is a key reason for differences in death rate from disease versus the developed world. This applies to both communicable and non-communicable diseases.

Diagnostic choices

Advanced diagnostics technologies such as PCR (polymerase chain reaction) and ELISA (enzyme-linked immunosorbent assay) are available only in major, urban laboratories in the BRICS countries. High equipment costs, the inadequacy of sophisticated infrastructure and a lack of trained personnel have militated against their presence outside metropolitan cities.

A response to this challenge by BRICS countries has been to emphasize new, paper-based technologies, which are seen to have the greatest potential to deliver point-of-care (PoC) diagnostics. These tests, consisting largely of “dipstick assays, lateral flow assays (LFAs), and microfluidic paper-based analytical devices,” are seen to be “affordable, user-friendly, rapid, robust, and scalable for manufacturing.”

For some, the future of PoC testing technologies in developing countries will be almost wholly dependent on microfluidics, “which allows miniaturization and integration of complex functions that facilitate their usage in limited resource settings.” The advantages of such systems includes “low cost, ruggedness and the capacity to generate accurate and reliable results rapidly.” In other words, they are well suited to the clinical and social settings of the developing world.

Local industry responds

Given growing demand, the healthcare industry in the BRICS has also sought to position itself aggressively. This is especially true for India and China, with their relatively large and sophisticated medical-industrial bases.

China has been witness to some of the heaviest activity, both in terms of outbound investments by domestic firms and the establishment of facilities in the country by international vendors. Some of this activity has been cross-directional, for example involving China-US entities selling in Europe and Euro-Chinese entities doing the same in the US.

Sino-American diagnostics in Europe

Shenzhen-based Micropoint, which has facilities in both China and the US, is a case in point. The company is focused on a proprietary microfluidic/immunoassay platform with three cardiac markers, which it is marketing - apart from China - in Europe.

China encourages partners in development

Another growing model consists of alliances for co-development, once again with multi-regional entities. For instance, Qiaogen - a global provider of sample and assay...
China’s Jinjing (a glass and building materials firm) to acquire in China is the entry by non-medical businesses. Recently, Wales-based another trend marking the growing attraction of PoC diagnostics for Disease Control and Prevention (ICDC). Newer, Enigma is collaborating with the Chinese government’s Center for Disease Control and Prevention (ICDC). Another trend marking the growing attraction of PoC diagnostics in China is the entry by non-medical businesses. Recently, Wales-based EKF Diagnostics confirmed that it received a proposal from China’s Jinjing (a glass and building materials firm) to acquire the former’s PoC testing division. EKF is also involved in clinical chemistry and molecular diagnostics.

Big companies upgrade presence

Big international players, too, are in the fray. Swiss giant Roche Holdings announced at the end of 2014 that it would invest CHF 450 million to set up a new diagnostics equipment manufacturing facility in China, which will focus on developing equipment and kits for clinical laboratory testing. The plant is due to be fully operational by 2018.

Diagnostics as international aggregator

Nevertheless, the clearest example of the ‘global’ nature of the PoC business in China is Ativa Medical, a US-developer of what is being billed as “the world’s first diagnostic micro lab designed to assist physicians by enabling faster treatment decisions.” Investors in Ativa, which is seeking to obtain US Food and Drug Administration for its micro lab, include Chinese VC fund Ping An Ventures and laboratory vendor Dian Diagnostics, Hermed Capital, a partnership between China’s Fosun Pharma and South Korea’s SK Group, US giant Laboratory Corporation of America and Diamond BioFund, Taiwan’s largest healthcare fund.

Similar patterns of investment can also be found in Russia, where the four-year old State-owned nanotechnology aggregator Rusnano is investing in Magnisense SE, a Franco-American developer of in vitro bioassays for PoC diagnostic testing. Magnisense is establishing a Russian subsidiary to produce MIAstrip, PoC testing strips that detect known markers for a range of conditions - cardiac arrest, bacterial infections such as tetanus, viral infections such as avian flu, and parasitic and fungal infections. The technology is based on magnetic bead markers instead of fluorescent labels or changes in optical density, as is common in enzymatic and fluorescent technologies. The Russian manufacturing facility is expected to sell products domestically and exported to Europe, the US, and Japan.

Indian firms target innovation, cost-effectiveness

In India, developments in the PoC diagnostics industry are driven as much by growing demand as by trade barriers. Currently, most quality devices and consumables are imported and face duties of up to 29 percent. To cope with this, local manufacturers are seeking to find new cost-effective solutions - some of which are both innovative and imaginative.

For example, Yethi Medical Systems, a Bangalore-based start-up, has developed devices which can “measure ECG, SPO2, pulse, non-invasive blood pressure, blood sugar, temperature and weight.” In the pipeline are systems for hemoglobin, creatinine and other assay diagnostics. Yethi claims to be the only portable multi-parameter measurement device with cloud connectivity. Another Indian company, Bigtec, has launched TrueLab - a battery-operated, hand-held, real time quantitative mini PCR. TrueLab can be lifted in one hand, and detects disease by a polymerase chain reaction (PCR) on a chip designed using micro-electromechanical systems (MEMS) technology. The chips, which are disease specific, have been developed with the support of the Indian Council of Medical Research.

Indian IT firms see opportunity in PoC tests

India’s giant IT firms have also launched products aimed at PoC testing. Tata Elxsi, a unit of the giant Tata conglomerate, has developed a device to monitor blood glucose levels, targeted at diabetic patients. Typically, users have needed to carry three separate devices - a glucose monitoring device, an insulin delivery device and a lancet. Tata Elxsi has integrated the three into one compact and convenient device which it claims is an easy-to-use lifestyle accessory. Another Indian IT firm, Wipro (with a market value of £31 billion), is developing a remote fetal monitoring solution for high risk pregnancies. The Wipro solution is a wireless cardiotogograph (CTG) for antenatal care and labour or delivery that uses a small wearable wireless fetal-maternal monitoring device, which needs minimal user intervention. Accurate surveillance of fetal heart rate, maternal heart rate and uterine activities is additionally supported by electronic storage of clinical data and decision support software that acts as aid to the doctors. Two pilot studies are currently underway in India.
SCHILLER Americas Inc. now serves the whole American continent

As of the 1st of October 2015, SCHILLER Latin America merged with SCHILLER America to form the subsidiary SCHILLER Americas. This entity has responsibility over the entire American continent, with cardiologist Francesco Iacona, former General Manager of SCHILLER Latin America, in the role of CEO. Consolidation of both territories comes with many advantages: all processes are being optimized, reaction time is further reduced. Customers will benefit from increased efficiency thanks to resource sharing, from office space to personnel and services, including inventory management, purchasing and logistics. This merger is the starting point for an even stronger representation of SCHILLER in America.

MEDICA Hall 09 / E05
www.schiller.ch

Sphere Medical releases a white paper exploring the issues of anemia, transfusions and blood conservation in critical care

Since up to 90% of patients develop hospital-acquired anemia by their third day in the ICU (Intensive Care Unit) with many requiring subsequent transfusions, blood conservation strategies can be of significant benefit to patients and will help reduce costs of care. The new paper observes that within the ICU setting, the total amount of diagnostic (iatrogenic) blood loss is a significant predictor of anemia and subsequent allo-geneic transfusion. Notably, iatrogenic blood loss is the factor most easily controlled by the intensivist - the paper discusses the main methods of reducing the contribution of blood tests to the incidence of iatrogenic anemia. Entitled “Blood conservation with a patient dedicated arterial blood gas analyser”, the new white paper is available for download from Sphere’s online clinical resource centre.

www.spheremedical.com/content/clinical-resources

Telemed presents enhanced version of pocket-sized ultrasound imaging device

Telemed’s next step towards the “stethoscope of the future”, based on the smartphone-sized MicrUs originally launched at the end of last year and offering ultrasound screening in B, M and B/M modes together with Speckle Reduction Processing and spatial compound imaging, makes its debut at Medica 2015 in Düsseldorf. Under the name “MicrUs DUO,” this enhanced version is capable of providing real-time imaging from two transducers simultaneously. This opens up new horizons for researchers and clinical specialists.

MEDICA Hall 9 / D58
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**JOEY BIBER**
MEDICA Hall 03 / D45-2

**Ultrasound microvascular imaging**

AngioPLUS is a significant advancement in colour doppler imaging. Conventional doppler is limited in its ability to show microvascular slow flow. AngioPLUS significantly improves colour sensitivity and spatial resolution, resulting in the next level of microvascular imaging to visualize flows that couldn't be seen before. Soon available on Aixplorer, this new imaging tool will provide highly detailed real-time information to physicians, which is key in diagnosing cancerous lesions. Lesion microvascularization and vessel flow are important indicators of a potential malignancy in areas such as breast, lymph nodes, thyroid and liver. This technique is also valuable for musculoskeletal assessments to help identify low-grade tendon inflammation.

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With its high-productivity, innovative features and ZeroForce Technology offering high speed, precision and comfort, Agfa HealthCare's fully automated DR 600 streamlines workflow, increases throughput and enhances the experience of patients and operators alike, even in the busiest imaging environment. The ceiling-suspended DR 600's individual features and capabilities come together in a complete and integrated solution that provides high quality images, while maximizing productivity, versatility and ease of use. Robotization, in combination with the pre-programmed MUSICA workstation examination tree, the automated MUSICA image processing, and seamless integration with RIS and PACS, all work in concert to give the right images, quickly and efficiently, with maximum ease of use for the operator and comfort for the patient.
3.0T MRI system

With up to twice higher signal levels than 1.5T systems, 3.0T MR systems improve spatial resolution and therefore provide more information on very fine anatomical structures. Typically, 3.0T MRIs are common in academic and research hospitals. Now the SIGNA Pioneer brings the power of 3.0T for clinical use and it is designed for accessibility to a broader range of healthcare providers. The SIGNA Pioneer 3.0T MRI delivers the ease-of-use and flexibility of a 1.5T system, with improved image homogeneity and reproducibility for oncology and spine imaging for example. In addition, ultra-high efficiency gradient technology enables high performance, even during demanding clinical applications such as cardiology or oncology. Using equivalent imaging parameters, physicians can use the signal gain to shorten patients’ breath-holds for liver exploration; SIGNA Pioneer also enables free-breathing body imaging for a much improved patient experience but also image quality in very challenging situations. The new MAGiC sequence is a major innovation in neuroimaging enabling clinicians to generate six contrasts in a single scan and in as little as one-third of the total time taken to acquire each contrast separately using conventional techniques. After an acquisition of only approximately 5 minutes, it is now possible to adjust the image contrast in real time, even after completing the scan, by simply moving a dynamic cursor to change conventional MRI acquisition parameters (TE, TR and TI) depending on the disease or the age of the patient. MAGiC also provides quantitative information (maps T1, T2, and proton density) that opens new perspectives for the characterization and monitoring of lesions. This has the potential to provide physicians the ability to detect and characterize earlier and more precisely small or secondary lesions, improving the diagnosis and monitoring of patients with neurodegenerative disorders, and enabling the adjustment of the treatment of cancer patients. Patients with neurodegenerative disease, who cannot remain still during the examinations, can also now benefit from MR. With new advanced 3D motion correction software, SIGNA Pioneer will compensate patient movement to provide the same image quality and comfort for diagnosis despite involuntary movements. An enhanced SilentScan package also dramatically reduces scan noise from excess of 110 decibels (dBA) for conventional MRI scans to just three dBA above ambient noise for most head exams, a major differentiator for patient comfort and to minimize the risk of deteriorating image quality in anxious patients.

GE HEALTHCARE
MEDICA Hall 10 / A42
RSNA Hall A / Stand 1929
www.ihe-online.com & search 46952

Patient monitoring system

The design of the BeneVision N22/N19 patient monitoring system combines original technology innovations with attractive and interesting features for optimal patient monitoring experience. Novel details such as rotatable landscape and portrait layout are included. BeneVision N22/N19 is setting further future-oriented standards, with innovative clinical decision support tools like HemoSight. In addition, state-of-art parameter modules such as rSO2 are available in BeneVision for the first time. The system also enhances the iView user Apps platform which becomes an upgradable module. Monitoring and informatics are combined into one workstation at the point of care. The BeneLink feature further connects BeneVision with real clinical settings.

MINDRAY
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RSNA Hall B / Stand 6129
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- Image and Model Guided Therapy
- Personalized Medicine
- Surgical Navigation
- Surgical Robotics and Instrumentation
- Surgical Simulation and Education
- Computer Assisted Orthopaedic and Spinal Surgery
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- Minimally Invasive Cardiovascular and Thoracoabdominal Surgery
- Digital Operating Room

Deadline for abstract/paper submission: 12th January 2016

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Digital imaging system

The CARESTREAM DRX-Evolution Plus includes new capabilities to further enhance workflow and offer improved visualization of anatomy. The new system offers a sleek new design with LED lighting for enhanced functionality and esthetics; greater flexibility in high-ceiling rooms via an extended tube column; a new high-performance generator; an optional table to accommodate patients up to 320 Kg and forward-looking design specifications to embrace new advanced imaging applications as they become available. An innovative wall stand Bucky-angulation feature expedites cross table and other complex X-ray exams, while a tube touch screen allows a radiographer to change techniques and view images from the tube. Pediatric capabilities include automatic technique and image processing for seven pediatric body size categories. The system is also equipped with bone suppression software for optimized viewing of soft tissue and a fast, secure log-in process using RFID badges. A transbay option enables fast tube movement across multiple trauma bays, which helps expedite treatment while minimizing movement of critically ill or injured patients. Other features include automatic acquisition and stitching for long-length and supine imaging exams and IHE Dose Reporting to facilitate data sharing with a facility’s dose management system. The DRX-Evolution Plus offers modular components and configurations. For maximum productivity, the system can be configured with a fixed detector in the wall stand and one or two additional wireless detectors that can be used for table Bucky and tabletop exams. Like other members of the company’s portfolio of DRX systems, the DRX-Evolution Plus enables each DRX detector to work with all other DRX systems within a provider’s environment.

CARESTREAM HEALTH
MEDICA Hall 10 / E65
RSNA Hall A / Stand 4706
i www.ihe-online.com & search 46951

Flat panel detectors for digital radiography

Pixium 4343 C-E and Pixium 4343 G-E are the latest generation of Digital Radiography flat panel detectors. They are intended for general radiography applications and offer high image quality at low dose thanks to their excellent signal to noise ratio. Easy to integrate, compatible with Pixium 4x43 settings, and using the PixRad pre-processing software platform, Pixium 4343 C-E and Pixium 4343 G-E feature respectively state-of-the-art CdI and GOS scintillators. They are a quality and cost-efficient solution for all radiography applications.

THALES
MEDICA Hall 10 / B39
RSNA Hall A / Stand 1920
i www.ihe-online.com & search 46955

Cardiovascular imaging information system

Siemens has refined its Syngo Dynamics cardiovascular information system (CVIS) to not only help diagnose cardiovascular diseases but also to reduce the administrative load on medical staff and provide the best possible support in outcome-focused management decisions. The main focuses for improvement are on reading and reporting capabilities as well as interoperability and integration into other systems, such as the electronic health record (EHR) system. Data exchange between disparate systems makes improved efficiency and care outcomes possible. This interoperability gives various departments within a hospital – and multiple hospitals within an enterprise – a single point of access to relevant cardiovascular information. For example, specific echocardiography data such as ejection fraction heart failure measurements can now be included more easily and at earlier stages for therapy or medication planning. While an examination is in progress or during interventions, multi-modality clinical images and measurement data can be transferred directly into Syngo Dynamics, which reduces the risk of error compared with manual data input. Unusual results are now automatically highlighted, too, to direct attention to potential pathologies. When results or reports are being drawn up, the system also automatically reviews data plausibility as a means of drawing attention to any potential missing or erroneous entries. This speeds up the accurate documentation of patient flow within the hospital, which in turn saves time and reduces costs.

SIEMENS HEALTHCARE
MEDICA Hall 10 / A20
RSNA Hall Hall A / Stand 4136
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i www.ihe-online.com & search 46931
Optimized C-arm DR system

Designed for delivering efficient workflow and outstanding image quality at the lowest possible X-ray dose, the ddRFormula Plus is a multifunctional DR system that meets the most demanding requirements of the modern radiology department. Equipped with the unique Single Focus Stitching Software, the device enables the automatic acquisition of distortion-free images of scoliosis and whole lower limb while providing an easy to use and seamlessly integrated user interface. Further innovations are to be unveiled at RSNA 2015.

SWISSRAY
RSNA Hall A / Stand 1914
www.ihe-online.com & search 46953

-- PRODUCT NEWS --

Shocked wave therapy system for erectile dysfunction

The EDX is designed as a unique and user friendly shock wave therapy system for erectile dysfunction solutions. The device induces capillary vessel regeneration (angiogenesis) in corpus cavernosum and crus of penis through a special wave focusing technique and high performance applicator which is producing low density shock waves. It offers a short, painless, drug-free and lasting treatment. Low intensity ESWT is very effective with a lasting success rate of up to 80% for patients who have erection disorders related to cardiovascular disease and sensitivity or insensitivity to PDE5.

INFINIUM
MEDICA Hall 16 / C05
www.ihe-online.com & search 46945

(-- CALENDAR OF EVENTS --)

November 16-19, 2015
Medica
Dusseldorf, Germany
www.medica.de

November 29-December 4, 2015
RSNA
Chicago, IL, USA
www.rsna.org

January 25-28, 2016
Arab Health
Dubai, UAE
www.arabhealthonline.com

February 24 to 26, 2016
Medical Japan 2016
Osaka, Japan
www.medical-jpn.jp/en

March 2-6, 2016
ECR
Vienna, Austria
www.myest.org

April 17-20, 2016
CMEF Spring 2016
Shanghai, China

April 19-21, 2016
ConhIT
Berlin, Germany
http://www.conhit.de/en/

May 28-30, 2016
ESA – Euroanaesthesia 2016
London, UK
www.esahq.org/congresses/
euroanaesthesia-2016

June 8-10, 2016
eHealth Week
Amsterdam, The Netherlands
http://www.ehealthweek.org

More Information
www.abcex.com

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November 16-19, 2015
Medica
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