Managing radiology risks

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Worldwide breast cancer is the most common female cancer; in the West one in eight women eventually develop the disease. However the mortality rate has steadily decreased in recent decades, in large part due to improved screening programmes and earlier detection. The current gold standard screening tool is mammography, but in 2011 the FDA approved the first Digital Breast Tomosynthesis (DBT) system, and this or similar systems are now available in a limited number of Western hospitals, generating studies to compare the effectiveness of the two imaging modalities.

Healthcare professionals are cognizant with the limitations of mammography, particularly for imaging dense breasts. X-rays of each breast from different angles can only provide a 2D image of a 3D structure, and normal breast tissue can thus mask a tumour. In addition false positive results augment both patient anxiety and hospital workload. And patients are well aware (even if many male health professionals are not) that the compression necessary for allowing the whole breast to be adequately viewed during mammography is not merely “uncomfortable” but can be extremely painful, deterring some women from being screened. DBT, however, provides a computer-generated 3D reconstruction of the breast via multiple X-ray images over a range of angles. There is thus no overlap of breast tissue, so even in dense breasts tumours are clearly visible and false positives are minimal. In addition the breasts are positioned for stability using minimal pressure during a procedure that is not even uncomfortable!

A very interesting session on DBT at the annual European Congress of Radiology (ECR) last year concluded that whilst DBT was a promising technology, the jury was still out on whether it could replace mammography for screening and diagnosis until the results of several ongoing clinical trials were available. Now results from a large trial at the Hospital of the University of Philadelphia have recently become available. The study imaged 15,633 women using DBT and 10,753 women using mammography. The former modality increased the rate of cancer detection significantly, as well as significantly decreasing the number of false positives requiring callback (read more about this study on page 27).

To further demonstrate the importance of DBT for optimal breast cancer management, the European Society of Breast Imaging (EUSOBI) is offering a new training course on this imaging modality during the two days preceding this year’s ECR. The course will include an overview of available systems as well as training in image interpretation*. Hopefully an increasing number of hospitals will now take advantage of DBT for the benefit of both patients and healthcare professionals.

* http://www.eusobi.org/cms/website.php

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Molecular pathway linking ICU ventilation to brain damage

At least 30 percent of patients in intensive care units (ICUs) suffer some form of mental dysfunction as reflected in anxiety, depression, and especially delirium. In mechanically-ventilated ICU patients, the incidence of delirium is particularly high, about 80 percent, and may be due in part to damage in the hippocampus, though how ventilation is increasing the risk of damage and mental impairment has remained elusive. A new study found a molecular mechanism that may explain the connection between mechanical ventilation and hippocampal damage in ICU patients.

The investigators, including Adrian González-López, PhD, in the laboratory of Guillermo M. Albaiceta, MD, PhD at the University of Oviedo, and co-authored by Konrad Talbot, PhD, an assistant research professor in Neurobiology in the Department of Psychiatry at Penn Medicine, began by studying the hippocampus in control mice and in mice on low or high-pressure mechanical ventilation for 90 minutes. Compared to the controls, those on either low- or high-pressure ventilation showed evidence of neuronal cell death in the hippocampus, as a result of apoptosis. Searching for the molecular cause of the ventilation-induced apoptosis, the team discovered that a well-known apoptosis trigger had been set off in the hippocampus of the ventilated animals. That trigger is dopamine-induced suppression of a molecule known as Akt, which normally acts to prevent neuronal apoptosis. Akt suppression was clearly evident in the hippocampus of the ventilated mice and was associated with a hyperdopaminergic state (increased levels of dopamine) in that brain area. This was confirmed by showing that pretreatment of mice with type 2 (D2) dopamine receptor blockers injected into the ventricles of the brain significantly reduced ventilation-induced apoptosis in the hippocampus.

How mechanical ventilation manages to affect the hippocampus was answered by experiments on mice in which the vagus cranial nerve connecting the lungs with the brain was severed. In these mice, mechanical ventilation had virtually no effect on levels of the dopamine-synthesising enzyme or on apoptosis in the hippocampus. The investigators then studied the consequences of ventilation and elevated hippocampal dopamine on dysbindin-1, a protein known to affect levels of cell surface D2 dopamine receptors, cognition, and possibly the risk of psychosis. High-pressure ventilation in mice caused an increase in gene expression of dysbindin-1C, and later, in protein levels of dysbindin-1C. Dopamine alone had similar effects on dysbindin-1C in hippocampal slice preparations, effects that were inhibited by D2 receptor blockers.

Since dysbindin-1 can lower cell-surface D2 receptors and protect against apoptosis, the authors speculate that increased dysbindin-1C expression in the ventilated mice may reflect compensatory responses to ventilation-induced hippocampal apoptosis. That possibility applies to ICU cases given the additional finding by the authors that total dysbindin-1 was increased in hippocampal neurons of ventilated compared to non-ventilated humans who died in the ICU.

The findings could lead to new therapeutic uses of established drugs and targets for new drugs that activate a molecular pathway mediating adverse effects of ICU ventilation on brain function.

Penn Medicine
http://tinyurl.com/pwkuv58

Largest study of critical care telemedicine reveals improvements in patient outcomes and reductions in healthcare costs

With critical care costs in the U.S. totalling roughly $80-100 billion per year, new research highlights Intensive Care Unit (ICU) telemedicine as key to enabling hospitals and health systems to improve patient care at lower cost. The study, which examined the impact of Philips’ remote Intensive Care Unit (eICU) program on 118,990 critical care patients, across 56 ICUs, 32 hospitals and 19 health systems over a five-year period, demonstrated reductions in both mortality and length of stay. The results were statistically significant on both an unadjusted and severity-adjusted basis. The key findings were that, compared to patients receiving usual ICU care, patients who received their ICU care from a hospital that utilized the eICU program were:

- 26% more likely to survive the ICU;
- Discharged from the ICU 20% faster;
- 16% more likely to survive hospitalisation and be discharged;
- Discharged from the hospital 15% faster.

“This is the first large-scale study that ties ICU telemedicine to both the improvement of patient outcomes and cost reduction through shorter length of stays in the ICU and hospital, and identifies the processes that achieved greater efficiency,” said Dr. Lilly. “These results point to a significant opportunity to better manage and treat our critical patients in this time of increasing pressure from health-care reform to deliver high quality and cost-effective care.” Hospitals and health systems that saw the largest reduction in length of stay and mortality rates were those that excelled in certain components of the program – involving people, technology and processes. As a result, the study revealed the following program design elements common to the most successful ICU telemedicine programs:

- Having an intensivist physician perform a remote review of the patient and care plan within one hour of ICU admission;
- Frequent collaborative review and use of performance data provided by the ICU telemedicine program;
- Faster response times to technology-based alerts and alarms for physiological and laboratory value instability;
- Increased rates of adherence to ICU best practices for those that are supported by the ICU telemedicine team; Interdisciplinary rounds;
- Institutional ICU committee effectiveness.

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Point-of-care ultrasound for suspected appendicitis in kids proves accurate

Using portable ultrasound as a first-line imaging study in kids with suspected appendicitis helps reduce emergency room length of stay and reduces the need for CT scans, according to a team of Mount Sinai researchers. Bedside ultrasound, often referred to as point-of-care ultrasonography, has a specificity of about 94%, meaning that it misses few cases, the Mt. Sinai researchers add.

“From an institutional perspective, this is the most common surgical problem that we encounter with children in the emergency department,” said the study’s senior author, James W. Tsung, MD, MPH, associate professor of emergency medicine and pediatrics at the Icahn School of Medicine at Mount Sinai. “CT scans have been the best imaging test for diagnosing appendicitis, which cumulatively can prove harmful, as increasing numbers of studies have shown.”

Several studies have reported lifetime risks of cancer from abdominal and pelvis CT in children between one fatal cancer cause for every 500 to 3,000 CT scans ordered, depending on age and sex. Efforts to try to reduce the four million radiation-emitting CT scans obtained in children every year are underway, led by front-line physicians, radiologists, and radiological professional societies. “CT scanning rate was reduced by over 35%, from a 44% scan rate prior to the study to a 27% rate during the study,” commented Ee Tay, MD, assistant professor of emergency medicine and pediatrics, Icahn School of Medicine at Mount Sinai, and the study’s second author.

The study showed that emergency department length of stay declined by 2 hrs and 14 minutes (46% decrease) for those requiring radiology department ultrasound and nearly 6 hours (68% decrease) for those requiring CT scan when point-of-care ultrasound was inconclusive as a first-line imaging study. Importantly, no cases of appendicitis were missed with the point-of-care ultrasound protocol and no unnecessary surgeries were performed for a normal appendix.

With focused ultrasound training, pediatric emergency clinicians were able to evaluate ultrasound exams with the similar accuracy as radiologists (about 94% accuracy). Dr. Tsung noted: “Surgeons are becoming more comfortable using ultrasound for decision-making and that is a big change from reliance on CT scans.” The Mt. Sinai Division of Emergency Ultrasound is involved with an effort to educate providers at Mount Sinai Hospital to use safer ultrasound as a faster first-line study in kids.

Medical Express
http://tinyurl.com/m7me97r

Holographic diagnostics

‘Smart’ holograms, which are currently being tested to monitor diabetes, and could be used to monitor a wide range of medical and environmental conditions in future, have been developed by researchers. Responsive holograms that change colour in the presence of certain compounds are being developed into portable medical tests and devices, which could be used to monitor conditions such as diabetes, cardiac function, infections, electrolyte or hormone imbalance easily and inexpensively.

The ‘smart’ holograms can be used to test blood, breath, urine, saliva or tear fluid for a wide range of compounds, such as glucose, alcohol, hormones, drugs, or

LITERATURE ALERT
Implementing delirium screening in the ICU

Objective:
To review delirium screening tools available for use in the adult ICU and PICU, to review evidence-based delirium screening implementation, and to discuss common pitfalls encountered during delirium screening in the ICU.

Data Sources:
Review of delirium screening literature and expert opinion

Results:
Over the past decade, tools specifically designed for use in critically ill adults and children have been developed and validated. Delirium screening has been effectively implemented across many ICU settings. Keys to effective implementation include addressing barriers to routine screening, multifaceted training such as lectures, case-based scenarios, one-on-one teaching, and real-time feedback of delirium screening, and interdisciplinary communication through discussion of a patient’s delirium status during bedside rounds and through documentation systems. If delirium is present, clinicians should search for reversible or treatable causes because it is often multifactorial.

Conclusion:
Implementation of effective delirium screening is feasible but requires attention to implementation methods, including a change in the current ICU culture that believes delirium is inevitable or a normal part of a critical illness, to a future culture that views delirium as a dangerous syndrome which portends poor clinical outcomes and which is potentially modifiable depending on the individual patient’s circumstances.

References
Nathan E. Brummel, MD, MSCI, Eduard E. Vasilevskis, MD, MPH, Jin Ho Han, MD, MSc, Leanne Boehm, MSN, RN, ACNS-BC, Brenda T. Pun, MSN, RN, ACNP, E. Wesley Ely, MD, MPH, FCCM

Medscape
http://tinyurl.com/osvtnjz
bacteria. When one of these compounds is present, the hologram changes colour, potentially making the monitoring of various conditions as simple as checking the colour of the hologram against a colour gradient. Clinical trials of the holographic sensors to monitor glucose levels and urinary tract infections in diabetic patients are currently underway at Addenbrooke’s Hospital, part of Cambridge University Hospitals.

The interdisciplinary project by researchers from the University of Cambridge uses a highly absorbent material known as a hydrogel, similar to contact lenses, impregnated with tiny particles of silver. Using a single laser pulse, the silver nanoparticles are formed into three-dimensional holograms of predetermined shapes in a fraction of a second.

When in the presence of certain compounds, the hydrogels either shrink or swell, causing the colour of the hologram to change to any other colour in the entire visible spectrum, the first time that this has been achieved in any hydrogel-based sensor.

A major advantage of the technology is that the holograms can be constructed in a fraction of a second, making the technology highly suitable for mass production.

“When currently a lot of medical testing is performed on large, expensive equipment,” said Ali Yetisen, a PhD student in the Department of Chemical Engineering & Biotechnology, who led the research. “While these sorts of inexpensive, portable tests aren’t meant to replace a doctor, holograms could enable people to easily monitor their own health, and could be useful for early diagnosis, which is critical for so many conditions.”

The holographic sensors produced by the Cambridge team are much faster, easier and cheaper to produce than current technologies – it is estimated that a single sensor would cost just ten pence (0.12€) to make, which would make it particularly useful in the developing world, where the costs of current glucose tests can be prohibitive. The entire sensing process is reversible, and the same sensor may be reused many times, after which it may be easily disposed of.

In addition to the clinical tests currently underway at Addenbrooke’s against current state-of-the-art glucose monitoring technology, the researchers are developing a prototype smartphone-based test suitable for both clinical and home testing of diabetes and clinically relevant conditions.

“In addition to medical applications, the holographic technology also has potential uses in security applications, such as the detection of counterfeit medicine, which is thought to cause hundreds of thousands of deaths each year,” said Dr Fernando da Cruz Vasconellos, Post-Doctoral Researcher in Professor Chris Lowe’s group and a co-author of this study.

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How SCHILLER is redefining heart rate variability (HRV) analysis

The prognostic value of heart rate variability (HRV) was already established at the beginning of our era in China. Physiological research and technological developments then provided the means for using HRV in experimental and clinical settings.

SCHILLER is now offering a unique tool for the diagnosis of autonomic dysfunctions, based on an uncompressed graphical representation of the heart rate. Autonomic nervous system disruptions go hand in hand with reduced HRV, the heart being a central target organ of the autonomic nervous system. The heart rate is also an important control parameter for many regulatory processes in the human body and provides a large amount of information on the functioning and status of these regulatory systems.

In order to identify the relevant information, a statistical analysis of the heart rate is performed. This includes a spectral analysis. The difficulty lies in processing the data, in part highly compressed, resulting in loss of valuable information. An attempt is thus made at describing the status of an extremely complex system (i.e. the autonomic nervous system) with only a few parameters. One should however bear in mind that the whole information is actually just contained in the 120’000 RR intervals over 24 hours.

The Fire of Life
SCHILLER has developed the “Fire of Life”, an uncompressed graphical representation of the entire information contained in a 24-hour heart rate signal. This approach enables a highly differentiated representation of the functions of the autonomic nervous system, paving the way for a wide range of clinical applications:

- Assessment of autonomic balance: ratio of sympathetic to parasympathetic activation/24-hour rhythm
- Analysis of sleep architecture/sleep quality/respiratory events
- Generation of a baroreceptor graph/status of blood pressure regulation
- Stress and recovery management (burn-out prevention)
- Quantification of an autonomic dysfunction, e.g. diabetes mellitus

A wide variety of applications
Many different clinics and prominent physicians already use SCHILLER’s HRV analysis program. One of them is Dr. med. René Hefti, specialist for internal medicine, psychosomatic outpatient clinic. According to Dr. Hefti, in addition to its high resolution and innovative technology, a major benefit of SCHILLER’s tool is that it enables a differentiated evaluation of the regulatory capacity of the autonomic nervous system, and thus of the whole body. This HRV analysis can thus be applied to such different medical specialties as internal medicine, cardiology, occupational medicine, psychiatry and psychosomatics, as well as sleep medicine. The patient’s ability to recover at night is a crucial indicator of healthy regulatory processes. In the daytime, the analysis focuses on the body’s regulatory capacity under everyday stress.

Thanks to the clear data representation in the spectrogram, even patients with no medical knowledge are able to read the results and identify signs of progress.

The following HRV case study, courtesy of Dr. med. Albrecht Seiler M.Sc. (specialist FMH for internal medicine, senior physician of psychosomatic outpatient clinic), illustrates the benefits mentioned above: 43-year-old woman with chronic fatigue syndrome and depression, under psycho-social stress, probably post-traumatic stress, eating disorder, etc.

HRV reference values

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<th>10 months later</th>
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<td>verge HR</td>
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<td>diurnal HR</td>
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<tr>
<td>nocturnal HR</td>
<td>85/min</td>
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<tr>
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<td>PNN50</td>
<td>1.5 %</td>
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<tr>
<td>RMSSD</td>
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</tbody>
</table>
Initial findings

Progression 10 months after clinical stabilization

www.ihe-online.com & search 46546
Medical imaging: evolution and quality standards

Although many patients still associate the imaging department of a hospital with the frontiers of medicine, the discipline is nearly 120 years old.

The effort to set quality standards for modern CT and MRI systems are inspired by experience with older imaging technologies, especially X-rays. In general, safety issues remain the focus for lawmakers, while recognized professional organisations ensure that quality control efforts remain up to date with ever-changing technologies. Top professional bodies usually function in such capacities under a legislative umbrella. For example, the American College of Radiology (ACR) has a mandate from the US Medicare Improvements for Patients and Providers Act (MIPPA); it also seeks to ensure implementation of both safety and quality programs at the imaging facilities of accredited healthcare providers.

Roots in the 1890s
Medical imaging was born after the discovery of X-rays by German physicist Wilhelm Röntgen in 1895, and the first X-ray image ever taken was of his own wife’s hand. Röntgen’s efforts won him the Nobel Prize in 1901. X-rays went on to play a key role in the detection and fight against tuberculosis, a scourge of the times, while early fluoroscopy techniques were used to locate bullets in wounded soldiers during the First World War.
Over the years, a blizzard of technological advances have added to the imaging arsenal.

1920s-1950s: Electron microscopy to radiopharmaceuticals
In the 1920s, scientists focused on enhancing the efficiency of X-rays, with more powerful tubes and superior contrast media. The years between the two World Wars witnessed the arrival of certain niche imaging techniques, such as transmission electron microscopy (TEM) and coronary artery imaging. This was followed just after the Second World War, by X-ray image intensifiers and closed circuit TV cameras, which revolutionized fluoroscopy.
The birth of radiopharmaceutical techniques in the 1950s permitted imaging of vital organs such as the heart, liver and kidneys, and for the first time, identify disease processes rather than anatomical changes in tissue; this, in turn allowed for diagnosis of certain medical problems at an earlier stage than was possible via other available tests.

CT, MRI and PET make their debut
Three new imaging technologies made their debut in the 1960s (ultrasound imaging) and 1970s (computed tomography and magnetic resonance imaging). The next major breakthrough was the launch of the first positron emission tomography (PET) scanner inn 1985. Along with X-Rays and ultrasound, CT and MRI are the most widely used imaging techniques today.
In the 1990s, developments were more incremental and based on core CT, MRI and PET systems. Examples include spiral CT, MR angiography and echo planar MR imaging (EPI) as well as SPECT (single photon emission CT).
The latest additions to the imaging arsenal include biomarker-based molecular imaging and digital tomosynthesis; both date to the mid-2000s.

Digital technologies, IT boost imaging development
The digital revolution has fuelled the gamut of imaging technologies over the past 35 years. Already by the late-1970s, digital radiography had made it possible for analogue TV signals from an X-ray to be enhanced and stored. In the mid-1980s, digital techniques allowed for 3-D processing of CT and MRI data.

Information technology, in the form of increasingly sophisticated signal acquisition and data processing algorithms, have been enhancing both the quality and reach of imaging technologies. Typically, viewing rates as recently as the late 1990s, from state-of-the-art imaging systems, were just 4 to 5 FPS (frames per second). They are now about 6-8 times higher, and continue to rise.

The DICOM standard
IT has also enabled the efficient use of acquired imaging data, which is both larger in terms of the number of patient imaging procedures and much bulkier in terms of the file size of records.
The key technology here is PACS (Picture Archiving and Communication System), to provide on-screen enhancement/manipulation of images as well as storage, retrieval, distribution and presentation across different locations.
One of the first standards to emerge in the field of imaging is an IT-related one known as DICOM (Digital Imag-
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ing and Communications in Medicine). The DICOM standard, which includes a file format definition and communications protocol, covers storage and transmission of medical imaging data via a PACS system.

**Regulatory focus on safety, increasing attention to MRIs**

Safety has typically been the greatest concern with imaging systems, since most are based on radiation (the key exception is ultrasound). It was some time before the dangers associated with X-Rays became known, as also with fluoroscopy and nuclear medicine. Due to this, most regulatory attention on imaging is inspired by a legacy of safety concerns. The latter, in turn, spill over into efforts by professional associations to set imaging quality control regimes.

Above all, laws generally seek to minimize risks from radioactivity. Their goal is to keep radiation doses to patients as low as reasonably achievable (ALARA), but still consistent with clinical requirements. In recent decades, regulatory attention to safety has been aimed at CTs. However, there is increasing interest in bringing MRIs too under controls. This is especially pronounced in the US, where there has been an increase in MRI-related accidents, prompting some to call for federal government intervention. More recently, privacy too has become a major area of attention, especially after the sharp growth in distribution of medical images, driven largely by PACS.

**Quality: From acceptance to maintenance**

Due to the rapid pace of development in imaging technology, users first of all seek to ensure that imaging equipment performance (including quality of operation and output) is in conformity with manufacturer specifications. These form part of acceptance tests of all new equipment. Professional associations have taken centre stage in the provision of guidelines for the maintenance of imaging equipment, procedures and records, and the accreditation of personnel. These are usually accompanied by quality assurance (QA) and quality control (QC) programs, although the two terms are sometimes used interchangeably. It is, however, important to note that the ensuring of patient safety is closely coupled to most quality programs.

QA programs essentially involve a portfolio of tests to measure scanner performance and ensure that it operates at an acceptable level. QC programs aim to correct shortcomings before they become problematic and pose a safety risk to patients. QA programs on imaging equipment must clearly be implemented routinely. Some tests are required daily, others on a monthly or yearly basis. Test results are also required to be interpreted as rapidly as possible, compared to acceptance date, and followed by corrective action if required. Yet another key quality requirement concerns the accuracy of records and bookkeeping.

**Automating tests**

Given that imaging systems face heavy user demand, minimizing the frequency and duration of quality tests has also been a priority. Several QA tests are therefore automated by so-called phantoms. There are two categories of QA test phantoms, for equipment calibration and for imaging. A calibration phantom tests scanners and corrects quantitative information obtained from digital images. Imaging phantoms assess image quality and are sometimes broken down further, for example based on the region of the body covered.

**Quality regimes for CT, MRI and PET**

The imaging systems for which quality issues are a high priority include CTs, MRI and PET. X-ray machines have a far longer pedigree, with much less debate about quality approaches. Indeed, EU rules on X-rays date back to the mid-1990s, and were developed over a decade via two continent-wide trials.

Ultrasound is generally considered a lower-risk alternative due to the fact that it does not use ionizing radiation. Quality controls on ultrasound systems are also relatively standardized in the US and Europe, with accessible, checklist-based protocols.

**CT quality tests**

CT quality tests generally measure image quality (using a water phantom test tool to determine CT numbers) and noise levels (stated as a percentage of image contrast), spatial resolution (measuring high-resolution patterns in a phantom image, based on modulation transfer function or MTF), low-resolution contrast, slice thickness (to profile sensitivity), as well as achievement of a minimum level of variation from a conventional X-ray image. Typically, annual tests assess general radiation safety, the computed tomography dose index (CTDI), slice width, the absolute CT number, noise and resolution, while a daily or weekly test is designed to ensure that it gives the correct value for water with consistent noise levels.

**Trend to group CT and PET**

In the US, the quality of CT images must comply with Federal Regulation 21 CFR 1020.33(C), while the Food and Drug Administration (FDA) has established specific CT dose indices.

European Guidelines On Quality Criteria For Computed Tomography also specify benchmarks on radiation dose for patients. However, recommendations on quality are exploratory and dated; instead the focus is largely on imaging techniques and performance, based on the anatomical area under investigation. Follow-up efforts on this front have, more recently, drawn the attention of the European Association of Nuclear Medicine (EANM). The EANM has a section on ‘Quality assurance and quality control’ which groups CT and PET systems, with considerable attention paid to the latter. Such convergence is also witnessed in an effort by the International Atomic Energy Agency (IAEA), which like the EANM, cross-references with the PET-specific NEMA-2 standard from the US National Electrical Manufacturers Association. However, the IAEA makes a bigger effort to separate CT and PET and focuses as much on QA issues in the former as on PET.

**QA for MRI**

As of now, quality assurance (QA) for MRI is not harmonized, and manufacturers specify their own systems as part of service agreements. However, QA regimes for MRI generally cover the following: geometric accuracy, high-contrast resolution, slice thickness accuracy, slice position accuracy, image intensity uniformity, percent signal ghosting, and low-contrast object detectability. The earliest QA efforts on MRI scanners date to the 1980s. They were focused on signal quality and the measurement of signal-to-noise ratios (SNR). However, such parameters were considered insufficient to determine image quality. In the early 1990s, the American College of Radiology (ACR), the American Association of Physicists in Medicine (AAPM) and the EU proposed independent QA protocols based on a series of specially designed MR phantoms.
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Managing radiology risks

Risk management is an everyday part of a radiologist’s job. Broadly speaking, risk management systems are meant to ensure that medical images are acquired and reported in accordance with agreed protocols, by competent staff working within a defined scope of practice, with advance identification and addressing of potential problems.

Risk management methodologies aim to activate appropriate procedures to minimize, and ideally, eliminate lapses in the standards of care. Key examples of the latter include unexpected errors which harm a patient, or lead over time to sub-optimal outcomes. Human factors are also part of the radiology risk spectrum, and include early identification of practitioners who lack the necessary knowledge and skills, or have psychological and other medical problems. One recent area for attention is machine error, for example allocating a radiological study to the wrong patient in the RIS-PACS system.

Individual judgement, heuristics and rules-of-thumb

A key driver for risk management in radiology is the lack of oversight in terms of the interpretation of imaging data and recommendations for clinical management; this is left wholly to the judgement of radiologists.

As a result, differences in opinion remain a major concern. One study found “significant disagreement” between “experienced radiologists” in the interpretation of radiographs, ranging between 5% and 9%, with an average incidence of 5.6%. Variations in opinion were more likely to occur about the presence of an abnormality rather than its significance. Indeed, one study concludes that “much of radiological practice” is based not on quantitative image analysis, “but on ‘heuristics’ to guide physicians through rules-of-thumb. Such heuristics are prone to fail when combinations of diagnostic features do not fit expected patterns, and practitioners fail to recognize their impact.

Public concern about radiology risk

Apart from diagnostic accuracy, risk management is also driven by general public sensitivity about radiology, due to its association with radioactivity.

In Europe, for example, the 1997 Medical Exposure Directive, which laid down the general principles of radiation protection in a medical context, was issued by Euratom, the European Atomic Energy Community. The Directive, in turn, led to the release of a set of guidelines for radiologists in 2000.

In the US, medical imaging is estimated to account for about 50% of total ionizing radiation exposure. New techniques such as magnetic resonance imaging (MRI) transmit radio waves up to 30,000 times stronger than that created by the earth’s magnetic field through a patient’s body.

Meanwhile, the number of radiological procedures continues to grow unremittingly. Over 5 billion medical imaging studies had been conducted across the world by 2010.

Referral guidelines in Europe

One of the key tools for reducing radiological risk, proactively, consist of referral guidelines. In Europe, the EU released a set of ‘Referral Guidelines for Imaging’ in 2000. The EU guidelines are based on those from Britain’s Royal College of Radiology (RCR). However, they are not binding on Member States. To remedy this, the European Association of Radiology (EAR) has urged the European Commission to directly recognize the RCR guidelines as a standard for all EU countries.

Britain: Europe’s model for radiology guidelines

The British referral guidelines, known as iRefer, seek to assist referring GPs, radiographers and other healthcare professionals to determine the most appropriate and informed imaging investigation or intervention and ensure that patients obtain timely and accurate diagnoses.
iRefer contains about 300 guidelines and provides practical advice based on best available evidence, together with expert medical and radiological opinion. These are drawn from over 20 years of case studies, systematic literature review, critical appraisal and consensus. iRefer is part of a series of publications from the RCR, covering a host of topics from radiologist training, data protection and patient care to standards for imaging equipment, reporting and interpreting imaging data, simulation and safety. Specific attention is paid to subjects such as permissible radiation levels, children and pregnant women, severely injured trauma patients, the management of diseases requiring repeat imaging as well as the role of IT and teleradiology.

One title, BFCR(11)2, covers a controversial but frequently used practice, the reporting and interpretation of imaging investigations by medical practitioners who are not qualified radiologists.

The US case

The US, too, has non-binding rules. The American College of Radiology (ACR), for instance, has published a set of practice guidelines covering diagnostic reference levels and achievable doses across the entire range of imaging technologies, from X-Rays and ultrasound to CT, MRI and PET.

Each of these guidelines specify that they are “an educational tool designed to assist practitioners in providing appropriate radiologic care for patients. They are not inflexible rules or requirements of practice and are not intended, nor should they be used, to establish a legal standard of care.” The ACR explicitly specifies that the “ultimate judgement regarding the propriety of any specific procedure or course of action must be made by the physician or medical physicist in light of all the circumstances presented. Thus, an approach that differs from the guidelines, standing alone, does not necessarily imply that the approach was below the standard of care.”

Differences in US and European approach

The key goal of the European ‘Referral Guidelines for Imaging’ is to optimiZe radiological intervention, so as “to obtain maximum information with the minimum of radiation”. Significantly, the Guidelines (which as mentioned previously are non-binding), note that their key target group consist of “newly qualified doctors” and those auditing referral patterns and workload.

Unlike the US ACR, whose guidelines focus separately on different imaging techniques, the European Referral Guidelines jointly group X-Rays, CT, MRI, nuclear medicine and ultrasound (as well as interventional radiology). They propose departmental protocols for ‘common’ clinical situations to determine when imaging is done, and by which imaging technique. The clinical approach is anchored by an anatomical classification: Head (including ENT), Neck, Spine, Musculoskeletal system, Cardiovascular system, Thoracic system, Gastrointestinal system, Urological, adrenal and genito-urinary systems, Obstetrics and gynecology, Breast disease, Trauma, Cancer and Pediatrics.

The departmental protocols of the European Guidelines are broken down into four categories: the clinical situation, choice of imaging techniques, a recommendation on the appropriateness of an investigation, alongside explanatory notes.

The recommendations, in turn, are split into five groups: Indicated, Requiring Specialized Involvement by physicians with adequate clinical expertise, Not Indicated Initially (with deferral for 3-6 weeks), Not Indicated Routinely (where the final decision is left to the clinician) and Not Indicated (e.g. intravenous urograms for hypertension).

Non-binding guidelines drive risk management systems

Given the above circumstances, considerable attention has been paid to evolving, evidence-based risk management systems, which involve the sharing of experience, a mature means to learn from mistakes - above all, critical clinical incidents and close-calls.

Risk management systems also seek to recognize the inherent limits of radiological diagnosis as well as identify and systematically reduce or eliminate complications in radiological examinations via protocols and safety systems. Finally, they also seek to harmoniZe the referral guidelines and use them to build a best practices culture for radiology risk management.

The ESR Initiative

In 2004, the European Society of Radiology (ESR) published a 13-page “advisory document” called ‘Risk Management in Radiology in Europe’. Its aim is to take a “proactive approach” to risk management, which it defines as “a structured way of reducing risk to patients and staff to the lowest achievable level.”

The ESR report lists and analyses the most common incidents, their key targets consist of “radiologists and their key target group consist of “newly qualified doctors” and those auditing referral patterns and workload.

The ESR report concludes that errors are “intrinsic and inevitable” and proposes that “the essence of risk management is to review all potential reasons for an inaccurate report in advance so that an evaluation can be made as to whether procedures can be put in place to avoid them and whether such procedures are clinically significant or cost-effective.” It also suggests formalizing a format for “errors meetings” openly to discuss mistakes so that all radiologists can learn and modify their practice, if required.

The Patient Care theme is broken up into two categories: Radiology Reporting and Interventional Radiology. In the former, the report lists and analyses the most common errors: false positives, incorrect diagnosis, poor quality of examination, the failure to consult previous reports, inadequate clinical information, the presence of multiple lesions, poor viewing conditions, repeated interruptions, fatigue and poor training. This detailed analysis is followed by a concise set of recommendations for risk management.

The Interventional Radiology category provides more of a bird’s eye view than Radiology Reporting, with an analysis of typical complications and issues of consent. This is again followed by risk management recommendations.

The Communication theme is, once again, broken into two categories, on the Information Needs of Radiologists and Communication of Reports, with each followed by specific risk management recommendations.

Although the section on Dealing with Errors is brief, it is a masterly attempt to get to the crux of risk management challenges in radiology. The section list specific procedures to deal with errors and proposes a format for conferences on discrepancy and difficult diagnosis as well as for the reporting of critical incidents. Given the sensitivity of this issue, it is clearly an area for attention by top management at hospitals.

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Pattern recognition: unlocking the secrets of data

Pattern recognition consists of labelling data inputs and interpreting them according to a broad range of criteria, from classification and sequencing to regression and parsing. At the most fundamental level, pattern recognition may be a basic definition of ‘intelligence’, as opposed to pure instinct. Animals use pattern recognition to determine threats and opportunities, a grazing deer, for example, fleeing from a blurred sequence of spots that is an attacking cheetah. Indeed, predator-prey models have been used to determine complex particle swarm optimization algorithms in image and signal processing.

Patterns and the Information Age

Pattern recognition is one of the key outcomes of the explosion of data in the Information Age. It is closely linked to the growth of computing power in recent decades and the development of ever-more sophisticated algorithms. There also is an interesting connection from an earlier era between patterns and computers.

In the 1960s, Bell Labs developed a computer programming language called SNOBOL (String Oriented Symbolic Language), which was based on the use of patterns as a first-class data type. Pattern matching was one of SNOBOL’s core applications. Pattern recognition is nevertheless a more complex variant of pattern matching. Unlike the latter which seek an exact matching of inputs to a model, pattern recognition targets all possible inputs and provides most likely matches for the inputs.

Wide range of users

The applications of pattern recognition are vast, from traffic management to cognitive psychology. However, interest is especially focused on two areas: medicine and the military.

One of the best-known military applications of pattern recognition is for reconnaissance via unmanned aerial vehicles (UAVs) or drones. Future UAV systems are targeted to not only identify the face of a person but also read his or her intentions. In the field of medicine, pattern matching is an integral part of medical image computing (MIC), especially of the detailed and complex data obtained from computed tomography (CT) and magnetic resonance (MR).

As a recent book explains: “Computer vision can exploit texture, shape, contour and prior knowledge along with contextual information from image sequence and provide 3D and 4D information that helps with better human understanding.”

Medical Image Computing (MIC)

MIC is used to develop mathematical models to manipulate and interpret images for research and clinical care. Its core purpose is to extract and analyse clinically relevant information from medical images via several methodologies. Some of the key steps in the latter include segmentation, registration, visualization and image analysis.

Segmentation

Segmentation, which is integral to contouring imaging data for diagnosis and radiotherapy, breaks up and partitions (segments of) a digital image into individual pixels. These are then assigned with labels. Pixels are given the same label if they share certain computer-recognizable features, such as colour, intensity or texture, and can demarcate shapes and edges. Interpolation algorithms are then used to create 3D reconstructions from the segments, which correspond to different tissue classes, organs and other regions of interest, to identify any anomalies or abnormalities. In effect, segmentation aims to extract the most meaningful and relevant components of a medical image, and assess the patterns therein.

Key segmentation approaches fall into four categories, namely c-means, maximum likelihood, neural networks, and nearest neighbour rules. Commonplace techniques include edge detection and clustering, histogram- and tree-based models, region-splitting and region-growing, model-based segmentation, neural networks, watershed transformation, graph partitioning and multi-scale segmentation as well as probabilistic and Bayesian approaches.

In general, patterns within a cluster are more similar to each other than patterns belonging to different clusters. In almost all cases, human intervention is required to obtain clinically useful results in imaging. With the increasing availability of high-speed computing, there is now growing attention to automating segmentation in
order to achieve rapid results and handle an ever-growing number of cases with equivalent accuracy as by expert radiologists.

**Image registration and visualization**

Image registration simply seeks to align images. At the foundational level, this involves one source image and a second target image, with the source image transformed to match the target. The degree of matching is assigned a numerical value, and the process iterated until an optimum is reached.

Visualization is used for exploration and to determine the results of algorithmic processing and analysis. During visualization, visual queries are performed on raw data alongside the control of light rendering and contrast. This step also involves the annotation of images.

The above efforts are supported by so-called shape analysis, which measures the geometrical properties of imaging structures: contours, volumetric images, triangle meshes and point sets. Shape analysis seeks to locate morphological correspondence (anatomical, functional, spatial) between different populations: male and female; pediatric, adult and elderly; healthy and sick, etc., and measures structural change at correspondent locations.

**The role of patterns in image analysis**

It may well appear that patterns are relatively less important in registration and visualization than image coherence. However, pattern matching algorithms play a significant role in both steps. Behind the typical ‘images’ which appear on a CT or MRI screen, lie vast masses of digital data sets which require extraction and interpretation.

Such factors also apply in another context. Image-based classifications do not always translate into clear-cut quantitative data on the effects and progression of a disease. Patient populations are highly heterogeneous for a range of medical conditions. Some neurological diseases such as schizophrenia, moreover, are characterized by a continuous spectra of pathological changes. Image-based analysis in these contexts extend to clustering and regression of patterns in order to break a given population group into homogeneous sub-populations.

**CT and pattern recognition**

Pattern recognition is now advancing as a speciality area of MIC in its own right. Coupled to CT, its utility has recently been demonstrated in areas ranging from craniofacial reconstruction to the identification of chronic obstructive pulmonary disease and beyond. Indeed, pattern recognition is showing promise in some of clinical medicine’s most challenging areas. For example, as a recent report suggests, the use of CT allows for 90% survival rates in lung cancer patients over a 10-year period, far ahead of conventional X-rays. On the other hand, CT produces a huge number of images. Each of these must be studied by radiologists, although only a handful may be clinically relevant. This tends to be exhausting and ironically, in some cases, may even lead to an incorrect diagnosis. Automated systems have been developed from those already in use for segmentation, as discussed earlier, but still tend to produce a relatively high number of false positives. Coping with this - both from the opportunity and challenge sides - shows promise using “advanced techniques of pattern recognition.”

**Magnetic resonance fingerprinting**

Pattern recognition with MRI data, meanwhile, has been deployed in identifying late-onset depression, accurately diagnosing cardiac myopathies, and is being transformed into a wholly new field, known as ‘magnetic resonance fingerprinting’ (MRF).

MRF permits the simultaneous non-invasive quantification of multiple properties of tissue, and to “increase the sensitivity, specificity and speed” of traditional MR techniques and potentially lead to new diagnostic testing methodologies.

**Content-based medical image retrieval (CBIR)**

Apart from automation, another area of attention consists of high-speed and accurate content-based medical image retrieval (CBIR), as opposed to exhaustive nearest-neighbour searching over a full set of available feature vectors. The benefits of CBIR range from research to clinical decision support. There are scores of CBIR systems under development, but many are dedicated to areas like earth mapping, astronomy, traffic management etc. Nevertheless, in spite of this, the role for CBIR in medical imaging applications remains “potentially very powerful”. Apart from enabling similarity-based indexing, it promises to “provide computer-aided diagnostic support based on image content as well as on other metadata associated with medical images.”

**Patterns and CBIR**

CBIR systems have been developed since several years for a variety of medical conditions. e.g. breast cancer biopsy, spine radiographs and mammography. One promising medical CBIR initiative was a European EU-funded effort in the early 2000s, known as PANDA (PAtterns for Next generation Database systems). PANDA used low-level feature extraction from image regions, followed by clustering the feature space to form higher-level patterns.

Accompanying this was a metric to assess the quality of content representation achieved by a particular set of patterns. Correspondence between two or more patterns was established as a function of the similarity between both the structure and the measured components of the patterns. PANDA also kept higher-level patterns in a unified format, to facilitate follow-on analysis by mining or visualization algorithms. This, indeed, remains one of its most promising aspects: the higher-level patterns are semantically designed to be in a machine-processible format. Traditionally, most data mining algorithms have tended to focus on rules extraction from low-level data, while first-generation feature-based pattern recognition algorithms were limited to drawing a formal analogy only between the structural pattern and the syntax of language.

Although the PANDA project has not been followed up, its results conclusively demonstrated the promise of pattern recognition as a tool to intelligently manage and exploit the continuing explosion in medical image data.
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AZ Imelda puts its radiology data to work for the hospital, staff, GPs and patients

The Impax Business Intelligence platform supports the department to run smoothly, optimize resources and improve the patient experience

What can you do with your data? That’s a question Dr. Dirk Perdieus, Head of the Radiology Department of the AZ Imelda hospital in Bonheiden, Belgium, answers every day. Like all professional enterprises, hospitals must find ways to satisfy their customers, efficiently use their resources, and make decisions for their future evolution. As a pilot site for the second-generation IMPAX Business Intelligence (BI) solution, AZ Imelda works closely with Agfa HealthCare to explore possibilities, questions and ideas. Together, they have uncovered quite a few real advantages for the hospital, and they know there is still more potential to develop.

A long-term relationship opens up new opportunities

AZ Imelda and Agfa HealthCare have worked together for many years, with a close relationship that supports their joint commitment to improving patient care. AZ Imelda first implemented Agfa HealthCare’s Radiology Information System (RIS) in 2000, followed by an IMPAX Picture Archiving and Communication System (PACS), an IMPAX Cardiovascular solution, an IMPAX Data Center vendor-neutral archive and the zero-footprint ICIS viewer technology. These solutions help to keep the hospital and its workflow moving smoothly.

The department had earlier implemented Agfa HealthCare’s first-generation Business Intelligence solution to help it exploit the rich information available in its IMPAX RIS/PACS. But Dr. Perdieus had lots of ideas for what he wanted to accomplish using BI. This open, forward-looking mentality, combined with the hospital’s commitment to using state-of-the-art technology to improve healthcare, made AZ Imelda an ideal candidate to pilot Agfa HealthCare’s second-generation BI solution.

More information supports decision-making, day-to-day and long-term

IMPAX BI, built on Agfa HealthCare’s advanced, integrated RIS/PACS workflow system, allows hospitals to intelligently combine clinical and quality data with financial and administrative data. They can thus make operations more transparent, enhance the patient experience, improve decision-making and identify potential cost savings.

The IMPAX BI pilot at AZ Imelda began in 2010, building on three main cornerstones: a live dashboard, analysis of department data and incident reporting. “The dashboard provides a live overview of what is happening in the department. For example, we can see how many patients are in the waiting room and how long each has been there,” explains Dr. Perdieus. “That way, if a patient has been waiting too long, we can find out why, or add an additional radiologist or technologist to the modalities to clear up the backlog. We can also give our patients better information on what is going on: informed patients are more satisfied, and patient loyalty is important to us.”

“IMPAX BI helps us in both day-to-day tasks and for longer-term projects,” agrees Kathleen François, who uses IMPAX BI within her role in the Quality Team. “When we see that certain modalities get backed up at specific times, we can spread appointments more evenly. We can also show graphs to our colleagues to explain why it would be better to do something a certain way. And the data is very easy to extract for projects like the annual report.”

AZ Imelda can evaluate departmental statistics back to 2005, for productivity, workflow, patient population and more. Dr. Perdieus explains, “We can analyse the busiest time of the day or week per modality; breakdown our patients by age or referring GP; study ‘no-show’ statistics, etc. Based on this data, we can optimize our resources, organize appointments to avoid peak times, adapt our strategy to our evolving patient base (such as geriatrics), send appointment reminders, and even make investment decisions.”

Greater satisfaction inside and outside the hospital

Contacts with referring GPs are enhanced as well, he says. “We can track the GPs that send us the most patients, and if we see a drop in referrals we can contact them directly to find out if there is a problem, and address it. And by determining which GPs tend to prescribe which exams, we can target our communication about clinical evolutions to them more effectively.”

Dr. Perdieus has also been won over by the IMPAX BI incident reporting. “All incidents are reported, from a patient’s allergic reaction, to a problem with placing a drip,” he explains. “Frankly, at first, it was disconcerting to read the reports! But incidents do happen, and by tracing them we can uncover the root problem and solve it. Sometimes it is a little thing, like a staff member needing additional training in placing drips. But it all helps us improve our performance, and that is what counts.”

Both Dr. Dirk Perdieus and Kathleen François agree that training is key to the successful adoption of IMPAX BI and to accessing its full potential. “IMPAX BI provides many standard reports that are very useful. But you can turn it into an even more powerful tool using custom queries. Having a few people trained in the in-depth functionalities allows you to really build up valuable data. But I think that it is also important to have a wide range of people within the hospital who are able to use and understand the solution: nursing staff, radiologists, maybe clinicians later on. Everyone has to understand the need for inputting accurate data, and be motivated to provide it.”

“Agfa HealthCare has been very supportive for our team,” comments Kathleen François. “We have definitely found that the more you use the system, the more possibilities open up!”

Dr. Perdieus agrees, concluding: “IMPAX BI is a very valuable tool for our department: we couldn’t do without it anymore! Ensure that input data is correct, train people to use its powerful customization capabilities, optimize how you use the reports – and you will really see the benefits.”

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Can data and analytics help lower radiation dose?

Monitoring the exposure of hospital patients to ionizing radiation from medical imaging procedures is becoming a huge focus for Professor Casselman, Chairman of Radiology in St John’s Hospital, Bruges, Belgium.

“For me it’s about ethics. If we are giving patients a higher dose than is needed we are not doing our jobs properly” says Professor Casselman, who has held his current role since 2004 at St John’s Hospital, which two months ago began using ‘DoseWatch,’ GE’s dose management system.

“We have 930 beds in the main hospital and another 410 at two other sites— that’s a lot of patients. Controlling dose levels for those patients undergoing X-ray or CT exams is a huge responsibility, not least because they are increasingly asking us – just how much risk is there to me from radiation from this scan? In addition, the official Belgian radiation safety regulator is more and more specific with the information it needs.”

Why is dose necessary?

X-rays, a form of ionizing radiation, allowed physicians to see inside the human body without invasive surgery for the first time. CT scans – essentially a series of X-rays, reconstructed into detailed images of the anatomy, are commonplace procedures in hospitals all over the world. Both though, expose patients to low levels of radiation.

Radiation dose becomes part of a trade-off for physicians with regard to image quality. Higher radiation should lead to a clearer image, which can lead to a more confident diagnosis. A very low dose, meanwhile, may provide insufficient image quality to make a diagnosis, so striking the right balance between dose and image quality is important.

How dangerous is dose from medical imaging?

The question of risk from radiation exposure is much debated. Most of the existing data regarding cancer risk from radiation is based on exceptionally high doses, in atomic bomb survivors for example, where research has shown with some certainty that high doses of radiation do lead to increased risks of cancer.

Some scientists believe that if this information is extrapolated down to the much lower doses given in a typical diagnostic X-ray exam, there is still a small risk. Of course, any discussion of potential risks needs to be balanced against the benefits of diagnostics, in terms of the value of medical imaging to inform clinical diagnoses and treatment, the benefit to patients of enabling choices about long term health, and the sense of patient satisfaction generated by a clinical diagnosis.

Professor Casselman points out “With medical imaging we’re talking about very low levels of radiation, but no amount of radiation exposure is considered to be without risk. Imagine if a patient needs numerous diagnostic tests over a period of time, for example, for a cancer patient, particularly a young one, the cumulative exposure may raise the level of risk.

“Many physicians are taught to follow the ALARA principle – as low a dose as reasonably achievable – but up to now there has not been an effective hospital wide system to keep dose under control. DoseWatch is changing all that for us.”

What is DoseWatch?

DoseWatch retrieves, tracks, and reports the radiation dose administered to patients during medical exams and automatically organizes the data for hospital leaders so they can easily and effectively monitor dose provision in their institution.

The system collects data in different ways – by imaging device, by the individual operator or by protocol, so it can compare and contrast the dose being administered in one exam to another from the past.

For Professor Casselman: “This means we can manage dose levels much more carefully than ever before. The system will email me when the dose exceeds a defined threshold for a specific exam, which means we know when there’s an ‘outlier’ – for example if unnecessary dose has been administered – so we can find out why, and make sure it’s corrected moving forward.

“Imagine maybe if an X-ray is looking at two different parts of the body. Is the radiographer keeping his/her finger on the button as the X-ray tube moves from one part of the anatomy to the other? If so the patient is being exposed unnecessarily. This system will alert us to that, and we can put a stop to it.”

Indeed this system allows healthcare providers to improve dose management holistically and over time by tracking and archiving their dosimetric data. Ultimately they can use the data to improve patient care by determining potential behavioural or systemic changes to how dose is managed at their institution.

Professor Casselman concludes: “This is leagues ahead of other dose management solutions. It’s automatic, it doesn’t rely on our nurses having to manually record dose levels for each exam, it means we can help reduce errors and it allows us to constantly improve dose management for patients at St John’s.”

The integration of complex physical machinery with networked sensors and software characterizes the Industrial Internet as it draws together fields such as machine learning, big data, the Internet of things and machine-to-machine communication to ingest data from machines, analyse it (often in real-time), and use it to adjust operations.
A new feasibility study shows that equipping head and neck cancer patients with home-based sensors to identify potential risks of dehydration during radiation treatment is attainable and acceptable to patients as well as their physicians.

“We used sensor-based technology to monitor and evaluate potential signs for dehydration in the patients’ home environment,” said Susan Peterson, Ph.D., M.P.H., lead investigator on the study and behavioural scientist at The University of Texas MD Anderson Cancer Center. The study monitored head and neck cancer patients to determine if they would be willing to use sensors daily to record their blood pressure, weight, pulse and symptoms at home while undergoing radiation treatment – an effective treatment that often triggers inflammation and sores in the mouth and throat.

During the study, physicians reviewed their patients’ information daily to identify early indicators of possible dehydration – another side effect of radiation for head and neck cancers – using CYCORE (CYberinfrastructure for COmparative Effectiveness REsearch) – a novel software-based platform to collect and manage data from multiple systems through a suite of home-based and mobile sensors.

Although radiation treatment is common and typically successful for this type of cancer, treatment can last up to six or seven weeks.

“Radiation treatment often damages some of the muscles and other tissues in that area and can result in decreased saliva production and mucusitis – inflammation of mucus membranes,” said Peterson. “This can make it difficult for patients to swallow, so eating and drinking even small amounts can be painful, which can put patients at risk for dehydration.”

Peterson says the onset of dehydration during radiation treatment can be fairly rapid and life-threatening, resulting in hospitalization which can cause interruptions in treatment and recovery.

Researchers followed 48 patients during two five-day periods. Sensors were used to monitor weight and blood pressure fluctuations daily because changes might indicate a patient’s risk for becoming dehydrated. Patients also reported daily food and drink servings, degree of pain with swallowing and other side effects using a smartphone. Patients’ sensor readings and symptom information were automatically transmitted to the CYCORE system. Their doctors viewed this information daily to determine if any steps were needed to reduce the risk of dehydration in their patients.

More than 90 percent of patients in this study rated CYCORE as extremely easy to use during a challenging treatment regimen. Clinicians working with these patients were highly satisfied with the ease of monitoring their patient’s progress using CYCORE.

Based on patients’ information transmitted using CYCORE, 60 percent of patients had at least one event that would suggest risk for dehydration and would warrant clinical intervention, and 35 percent had two or more events.

“There are a number of critical changes that can occur during that time,” said Peterson. “Our study showed that it is feasible to use sensor technology to monitor patients during their treatment, and that both patients and their doctors find it easy and valuable to do so. We were able to collect important data for our research while possibly helping with clinical decision-making as well.”

M D Anderson Cancer Center
http://tinyurl.com/khldlqe

Credit card-sized device could analyse biopsy, help diagnose pancreatic cancer in minutes

Pancreatic cancer is a particularly devastating disease. At least 94 percent of patients will die within five years, and in 2013 it was ranked as one of the top 10 deadliest cancers.

This prototype of a microfluidic device has both curved and straight channels for transporting tissue biopsies. The silicon material is lightweight, flexible and transparent.

Routine screenings for breast, colon and lung cancers have improved treatment and outcomes for patients with these diseases, largely because the cancer can be detected early. But because little is known about how pancreatic cancer behaves, patients often receive a diagnosis when it’s already too late.

University of Washington scientists and engineers are developing a low-cost device that could help pathologists diagnose pancreatic cancer earlier and faster. The prototype can perform the basic steps for processing a biopsy, relying on fluid transport instead of human hands to process the tissue.

“This new process is expected to help the pathologist make a more rapid diagnosis and be able to determine more accurately how invasive the cancer has become, leading to improved prognosis,” said Eric Seibel, a UW research professor of mechanical engineering and director of the department’s Human Photonics Laboratory.

The new instrumentation would essentially automate and streamline the manual, time-consuming process a pathology lab goes through to diagnose cancer. Currently, a pathologist takes a biopsy tissue sample, then sends it to the lab where it’s cut into thin slices, stained and put on slides, then analysed optically in 2-D for abnormalities.

The UW’s technology would process and analyse whole tissue biopsies for 3-D imaging, which offers a more complete picture of the cellular makeup of a tumour, said Ronnie Das, a UW postdoctoral researcher in bioengineering who is the lead author on a related paper.

“As soon as you cut a piece of tissue, you lose information about it. If you can keep the original tissue biopsy intact, you can see the whole story of abnormal cell growth. You can also see connections, cell morphology and structure as it looks in the body,” Das said.

In this prototype, tissue biopsies first move through the transparent channels of a microfluidic device. In a second stage, an optical clearing fluid illuminates the original channels. Moving whole tissue samples through such a device is unprecedented. The research team is building a thick, credit card-sized, flexible device out of silicon that allows a piece of tissue to pass through tiny channels and undergo a series of steps that replicate what happens on a much larger scale in a pathology lab. The device harnesses the properties of microfluidics, which allows tissue to move and stop with ease through small channels without needing to apply a lot of external force. It also keeps clinicians from having to handle the tissue; instead, a tissue biopsy taken with a syringe needle could be deposited directly into the device to begin processing.

University of Washington
http://tinyurl.com/kmhr9s9
3D mammography increases cancer detection and reduces call-back rates

Conventional digital mammography is the most widely-used screening modality for breast cancer, but may yield suspicious findings that turn out not to be cancer, known as false-positives. Such findings are associated with a higher recall rate, or the rate at which women are called back for additional imaging or biopsy that may be deemed unnecessary.

Tomosynthesis, however, allows for 3-D reconstruction of the breast tissue, giving radiologists a clearer view of the overlapping slices of breast tissue. And though a relatively new technology, it has shown promise at reducing recall rates in all groups of patients, including younger women and those with dense breast tissue. This study, presented by Emily F. Conant, MD, chief of Breast Imaging at the Perelman School of Medicine at the University of Pennsylvania, is one of the largest prospective trials in tomosynthesis to date.

For the study, the research team compared imaging results from 15,633 women who underwent tomosynthesis at HUP beginning in 2011 to those of 10,753 patients imaged with digital mammography the prior year. Six radiologists trained in tomosynthesis interpretation reviewed the images.

Researchers found that, compared to conventional mammography, the average recall rate using tomosynthesis decreased from 10.40 percent to 8.78 percent, and the cancer detection rate increased from 4.28 to 5.24 per 1,000 patients, a 22 percent increase.

“Our study showed that we reduced our callback rate and increased our cancer detection rate,” said Dr. Conant, the study’s lead author. “The degree to which these rates were affected varied by radiologist. But importantly, the ratio of callback to cancer detection rate improved significantly for our radiologists.”

The overall positive predictive value—the proportion of positive screening mammograms from which cancer was diagnosed—increased from 4.1 percent to 6.0 percent with tomosynthesis, a 46% increase.

Perelman School of Medicine
http://tinyurl.com/pynlph4

Prototype chip makes possible fully implantable cochlear implant

Researchers from Massachusetts Eye and Ear, Harvard Medical School, and Massachusetts Institute of Technology (MIT) have designed a prototype system-on-chip (SoC) that could make possible a fully implanted cochlear implant.

A cochlear implant is a device that electronically stimulates the auditory nerve to restore hearing in people with profound hearing loss. Conventional cochlear implants are made up of an external unit with a microphone and sound processor to pick up and encode sound, and an internal unit that is seated in the skull and connected to an electrode array inserted into the cochlea. The external unit raises concerns in some individuals with social stigma and has limited use in the shower or during water sports.

“In addition to the cosmetic aspect of an invisible cochlear implant, a potential major functional benefit is that it can facilitate sound localization. Our system relies on a sound sensor located in the middle ear so that the user can benefit from directional cues provided by the auricle and ear canal. Conventional cochlear implants detect sound by a microphone located outside of the ear so that important directional cues are lost,” said Konstantina Stankovic, M.D., Ph.D., Mass. Eye and Ear otologist who co-led the study with Anantha Chandrakasan, Ph.D., MIT head of Electrical Engineering and Computer Science. “Our long-term goal is to develop a fully implantable cochlear implant. To facilitate that development, we have developed the SoC and tested it in ears of human cadavers.”

In addition, the SoC was designed to require lower power sound processing and auditory nerve stimulation to enable operation from an implantable battery that is wirelessly recharged once daily.

Massachusetts Eye and Ear Infirmary
http://tinyurl.com/ovpez4o
The 71st China International Medical Equipment Fair (CMEF Spring 2014)
The 18th International Component Manufacturing & Design Show (ICMD Spring 2014)

2014 April 17–20
Shenzhen Convention & Exhibition Center
www.cmef.com.cn
Fluke Biomedical acquires Unfors RaySafe

Fluke Biomedical, the world’s leading manufacturer of biomedical test instruments, announced in early February the acquisition of Unfors RaySafe.

With this acquisition Fluke Biomedical adds industry leading quality assurance devices for diagnostic x-ray from Unfors RaySafe. With an enhanced portfolio especially in the fields of diagnostic X-ray, real-time dose monitoring systems for medical personnel and patient dose tracking software solutions, the Unfors RaySafe product line will broaden the Fluke Biomedical customer base and answer market demands with innovative and state-of-the-art solutions. Fluke Biomedical’s goal is to provide healthcare providers, institutions and medical device manufacturers with a complete portfolio of test equipment.

Both companies see the user friendliness of their products, combined with advanced technology and maximum measurement accuracy as their major assets. “The fact that our companies share a similar culture is an ideal basis for continuing our excellent relationships with our employees, customers and partners,” says Magnus Kristoferson, CEO of Unfors RaySafe. “We have experience in highly specialized markets all over the world, we know our business and we can now maximize our competencies. In the past, Unfors RaySafe has attracted the attention of the market not just for the functionality and measurement accuracy of its products, but also for the attractive design and intuitive user interface.”

Fluke Biomedical leads the world in the manufacture of biomedical test and simulation products, including electrical safety testers, patient simulators, performance analysers, and fully-integrated and automated performance testing and documentation systems. Fluke Biomedical General Manager, Eric Conley says, “The acquisition of Unfors RaySafe brings to Fluke Biomedical a strong team that has delivered leading innovation to the radiation test and safety markets. The combination of Unfors RaySafe and Fluke Biomedical accelerates our ability to provide a broad portfolio of world class test equipment to our customers.” With worldwide sales and distribution channels, Fluke Biomedical anticipates growth through innovative design and creative solutions for their customers. Fresh perspectives and product enhancements, coupled with the commitment to customer satisfaction, remain the hallmark of the organization.

Fluke Biomedical is part of Fluke Corporation, the world leader in the manufacture, distribution and service of electronic test tools and software.

Unfors RaySafe was founded in 1994 in Billdal, Sweden, where the company headquarters is still located today. With offices in the US, UK, Germany, Singapore, India, Japan and China as well as with a closely connected sales network, Unfors RaySafe serves a global customer base that includes leading manufacturers of X-ray machines and university hospitals around the world.


East Kent Hospitals adopt fully connected glucose solution to enhance patient safety at the point of care

East Kent Hospitals University NHS Foundation Trust, serving a local population of over 750,000, recently installed 224 wireless-enabled Roche Accu-Chek Inform II blood glucose meters in 130 point of care (POC) locations across seven hospital sites. Linked to the cobas IT 1000 POC data management package, this fully connected glucose testing solution from Roche enhances patient safety by helping to ensure appropriate use of the meters and by providing a full audit trail for every test performed.

“With over 3,000 users across seven sites, implementation was challenging from a scale point of view but, thanks to the support we had from Roche, everything went smoothly,” comments POCT Coordinator, Phil Bates. “Roche worked closely with our IT team to satisfy our wireless network requirements and the support from our Roche Training Specialist has been invaluable.” Training of staff is vital for ensuring safe and appropriate use of equipment. The content of the training delivered by the Roche Training Specialist at East Kent Hospitals was agreed with the POCT Coordinator, providing assurance of appropriate, site-specific and consistent training for all staff. Following training, user identifications and barcodes are activated and only then can users access the Accu-Chek Inform II meters to test patient samples.

“cobas IT 1000 allows me to monitor safe and appropriate use of the equipment,” Phil says. “I can see at a glance who is trained and who is coming up for recertification, and I can target areas within the Trust where additional training might be required, with evidence to back this up. I couldn’t do this before.”

“Connectivity to cobas IT 1000 provides a full audit trail in far greater detail than has been possible before. It also helps us to ensure quality control is being performed on every instrument on a daily basis. If QC is not performed, the meter is locked and it cannot be used. This ensures the meters are in good working order and is particularly reassuring from a patient safety perspective. The system also generates a warning when there is an abnormal result, which prompts the user to take action. This means that, no matter who performs the test, they are prompted to communicate the result to someone who can make a decision about patient management. This is another important feature for ensuring patient safety,” Phil concludes.

“The recently published National Diabetes Inpatient Audit1, reported that out-of-target glucose levels (high and low) are not being recognized or addressed, leading to serious complications”, said Peter Jones, Marketing Manager Hospital IVD, Roche. “Through our fully connected blood glucose solution, the point of care team at East Kent is able to monitor such out-of-target results via cobas IT 1000 and, in the near future, they hope to be able to flag this vital information directly to clinicians by linking to the Hospital Information System, ensuring that patients are treated appropriately to avoid potentially serious complications.”

www.roche.com
PACS integrates images with reports

A new generation of the Vue PACS platform (shown as a work in progress) is designed to create productivity-enhancing capabilities for radiologists and referring physicians. These include embedding access to key image data using links within the report, which merges images into the reporting workflow and an innovative teleradiology module that gives remote radiologists access to prior exams and automatically sends radiology reports to the requesting facility—all without requiring significant investment by healthcare facilities or radiology/teleradiology groups. The new PACS will also offer an optional Vue for Teleradiology module (also a work in progress) designed to enable efficient off-site reading and reporting by remote radiologists for multiple healthcare facilities. The new module will employ Carestream’s Vue Connect platform, which will enable radiologists to access worklists from unaffiliated healthcare providers and automatically deliver reports back to each facility. Carestream’s Vue Motion zero footprint image viewer will be used to transfer the imaging studies. Vue Motion currently enables access to imaging studies and radiology reports on mobile devices such as an iPad.

Enhancements to Vue PACS digital breast tomosynthesis module

This new module is scheduled to include the display of DICOM-compliant 2D synthetic views, which are calculated from the 3D dataset. The use of synthetic views is being considered as an alternate approach to reducing dosage to patients while allowing full advantage of the benefits of digital breast tomosynthesis. Other additions to the DBT module include a DBT image map and improved workflow settings. Synthetic 2D views have the potential to help reduce patient dose and some radiologists believe the image quality is superior to traditional 2D mammography views. Carestream is showing a new generation of Vue PACS as a work in progress that is designed to include 64-bit architecture. One of the primary benefits of 64-bit architecture is its enhanced ability to handle larger datasets, including DBT and other 3D exams. So this architecture will greatly improve access speeds and reading convenience for users of 3D imaging studies. Designed with specialized tools to enhance reading, the DBT module can enhance workflow by allowing healthcare providers to store, route, display and query/retrieve DBT exams from DICOM-compliant acquisition devices. Comparison tools enable radiologists to use personalized hanging protocols for DBT exams along with other procedures.

CARESTREAM HEALTH
ECR Booth 210
i www.ihe-online.com & search 46560
www.carestream.com/ecr
X-ray QA multifunction meter

The new RTI Black Piranha multifunction meter brings speed and power to the X-ray QA workflow. Connection to various accessories, tablet and PC is automatic – just plug and play. The Quick Check feature identifies the probes inserted and selects the optimum Piranha settings for the measurements. It is even possible to easily program a personalized default start-up screen. The Black Piranha can measure on Rad, Fluoro, Dent, Mammo, and CT.

The Black Piranha is complemented by the Ocean 2014 software which makes workflow more intuitive and speeds up work. Ocean 2014 can perform instant real-time analysis during the measurements. Ocean also prepares a report in the background. So when the work is done, a complete report is available at the touch of a button. A tablet/laptop can be used as both an interactive display during the measurements and as a powerful analysis tool back at the office. No unnecessary, time-consuming data-transfer at the end of the day. Measurements and data are stored – allowing for analysis, trending and printed reports – even months after completion of the measurements.

Ocean 2014 also features Quick Check mode. This Ocean 2014 feature provides a quick and easy way to start measurements. Simple and accurate measurements along with data and waveforms are instantly displayed. Templates are provided. It can be used with a Windows PC or Windows 8 Pro tablet.

RTI ELECTRONICS
ECR Booth 407
i www.ihe-online.com & search 46559

Ambulatory EEG, EMG and ECG recording device

The new Mobita, a 32 channel wireless and wearable electrophysiological amplifier, can measure up to 32 channels of EEG or up to 16 channels of EMG. The system can send the measured signals directly to a PC via Wi-Fi or save it on the on-board memory. With its integrated 3D-accelerometer the Mobita also records the movement of the subject together with for example an EEG. The Conicap-design allows for quick switching between different electrode-configurations, thus enabling easy changeover from EEG to EMG-measurement. Special technology and electrode cables eliminate mains interference or cable movement artifacts. No hardware filters are included, so it is also possible to measure EEG, EMG and ECG simultaneously.

TWENTE MEDICAL SYSTEMS
i www.ihe-online.com & search 46562

Troponin I point-of-care test has obtained CE marking

The ESC, ACCF, AHA and WHF stipulate that Troponin assays should demonstrate a coefficient of variation (CV) of 10% or less at the 99th percentile of the normal population, which no prior POC device could do. The high sensitivity Meritas test achieves a CV of 10% at 36pg/ml which is the 99th percentile. Results are available patient-side within 15 minutes and the Meritas analyser uses only a single drop of whole blood in a one-step process. This test will, for the first time, allow doctors to evaluate potential MI patients quickly and accurately. With CE marking achieved, Trinity Biotech now intends to release the product for sale in Europe and other carefully selected markets through its specialist cardiology distributor network.

TRINITY BIOTECH
i www.ihe-online.com & search 46564
High performance electrocardiography system

The CS-200 Excellence offers professional diagnostic solutions and sets new standards in electrocardiography thanks to an array of high-performance analysis and diagnostic tools as well as more efficient and simple applications and innovative network solutions. Key features include a 24-inch LCD monitor; Intel 3rd Generation Core i7 CPU which speeds up the whole system; very high sampling rate of 8000 Hz per channel; 24-bit resolution of the ECG signal; 16-channel resting and exercise ECG; coronary artery disease screening using HyperQ technology; QTC calculation (user-defined); autonomous emergency ECG (unique feature); automatic measurement and interpretation; repeated analysis of the 10-second ECG. The latest hardware allows for accurate recording of even the slightest changes in the ECG. The multifunctional diagnostic system is fitted with very powerful hardware as well as a high quality analysis tool for the detection of coronary artery disease. The innovative HyperQ technology is very accurate and enables the detection and evaluation of coronary artery disease (CAD) and acute coronary syndrome (ACS). The combination of the CS-200 Excellence and HyperQ makes it possible for the first time to detect depolarization changes in resting and exercise ECGs by means of automated analysis of the high-frequency QRS components.

SCHILLER
i www.ihe-online.com & search 46506

Disposable EEG electrode set

Brainstatus is a new type of EEG electrode set providing a solution to the diagnostic problems in field use and emergency room applications. The EEG electrode set is disposable and, unlike traditional headbands, it is placed on the hairless areas of the patient's head, which makes proper placement easier and faster. Because of these advantages, it is particularly well-suited for use in emergency care, in ambulances and even in field conditions. Thanks to the material of the electrode set, there is no need to remove it for MRI and
CT scans. With an additional adapter cable, the BrainStatus electrode set can be connected to most EEG systems found in the market.

MEGA ELECTRONICS
i www.ihe-online.com & search 46556

Imaging management system

IMPAX Agility is a next generation imaging management platform that truly combines workflow, image management, reporting and clinical applications into one seamless solution. IMPAX Agility is designed to achieve clinical productivity and optimize total cost of ownership. The sophisticated yet uncluttered and intuitive user interface, as well as the native diagnostic capabilities streamline navigation and workflow, for greater clinical productivity. Its modern IT platform helps hospitals to maximize performance and control costs by reducing overhead as well as to upgrade time and IT infrastructure investments. Sectional reporting increases consistency and decreases report turnaround time. Text entry, digital dictation, transcription and speech capabilities are fully embedded for a seamless workflow that provides users with unbridged access to images and fast turn-around of structured, easy-to-read reports.

AGFA HEALTHCARE
ECR Booth 103 Hall Expo A
i www.ihe-online.com & search 46555

FRONT COVER PRODUCT

Point-of-care ultrasound

Addressing the most critical issues faced within ultrasound scanning, the new M9 hand-carried ultrasound system by Mindray is developed with a prime focus on difficult patients. There is no need to sacrifice performance for portability. Combining advanced features only to be found in heavy cart-based systems into a compact portable system, M9 is a premium level laptop-style colour Doppler offering easy handling and mobility. Incorporating technology such as the 3T transducer with single crystal, UWN+ contrast imaging and natural touch elastography, the M9 has the additional advantage of being able to utilize all features at the bedside, therefore offering a shared-service solution suitable for use in multiple clinical settings. The ergonomic solutions offered by M9 are complete in all aspects, improving procedural efficiency while reducing repetitive actions. A user-centric interface enables logical and efficient workflow, ensuring the most convenient operation.

MINDRAY
ECR Booth 203 Expo B
i www.ihe-online.com & search 46568

CALENDAR OF EVENTS

March 6-10, 2014
ECR 2014
Vienna, Austria

March 13-16, 2014
KIMES 2014
Seoul, Korea
www.kimes.kr/eng

March 18-21, 2014
34th International Symposium on Intensive Care and Emergency Medicine (ISICEM)
Brussels, Belgium
Tel +32 (0)2 555 3631
email: sympicu@ulb.ac.be
www.intensive.org

March 18-21, 2014
KIMES 2014
Seoul, Korea
www.kimes.kr/eng

March 18-21, 2014
34th International Symposium on Intensive Care and Emergency Medicine (ISICEM)
Brussels, Belgium
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www.intensive.org

April 3-4, 2014
WalHIT 2014
Nice, France
http://worldofhealth.com/2014/

April 9-11, 2014
Med-e-Tel 2014
Luxembourg
Tel +352 2 269 84 36
email: info@medetel.lu
www.medetel.lu

April 17-20, 2014
CMEF Spring
Shenzhen, China

May 6-8, 2014
conHIT 2014
Berlin, Germany
www.conhit.de/en/

May 12-14, 2014
eHealth 2014
Athens, Greece
http://ehealth2014.org

May 31-June 3, 2014
Euroanaesthesia 2014
Stockholm, Sweden
www.euroanaesthesia.org

June 18-21, 2014
CardioAsia 2014
Nice, France
www.cardioasia.com

June 3-4, 2014
WoHIT 2014
Nice, France
http://worldofhealth.com/2014/

April 9-11, 2014
Med-e-Tel 2014
Luxembourg
Tel +352 2 269 84 36
email: info@medetel.lu
www.medetel.lu

April 17-20, 2014
CMEF Spring
Shenzhen, China

May 6-8, 2014
conHIT 2014
Berlin, Germany
www.conhit.de/en/

May 12-14, 2014
eHealth 2014
Athens, Greece
http://ehealth2014.org

May 31-June 3, 2014
Euroanaesthesia 2014
Stockholm, Sweden
www.euroanaesthesia.org

June 18-21, 2014
CardioAsia 2014
Nice, France
www.cardioasia.com

For more events see
www.ihe-online.com/events/

Dates and descriptions of future events have been obtained from usually reliable official industrial sources. IHE cannot be held responsible for errors, changes or cancellations.

Registration is open on www.cardiostim.com

Deadline early fees
April 8, 2014

World congress on cardiac electrophysiology
Angiography system for universal use

Optimized for a broad clinical utilization, Artis one is designed for routine interventions, which represent the majority of angiographic procedures. Energy consumption with the new system is up to 20% lower than with Artis zee floor. Thousands of angiographic procedures are performed each day worldwide. On the one hand, these include treatment of highly complex cases requiring a high degree of tailoring of the angiography lab’s configuration. On the other hand, there are many routine interventions, which represent the clear majority of cases. These include, for example, revascularizations of peripheral arterial or venous occlusions, functional tests of dialysis shunts in patients with kidney failure or of implanted ports in tumour patients. Diagnostic angiographies of coronary stenosis and their treatment or pacemaker implantations are also established routine procedures. Artis one has been developed to support all of these interventions. Despite being floor-mounted, the new angiography system is similar in positioning flexibility to ceiling-mounted systems and requires substantially less space: Artis one occupies only 25 square meters, compared to the usual 45 square meters required by ceiling-mounted systems. The system features several axes which can be moved independently of each other. This allows physicians and hospital staff to easily position the system where needed – regardless of where the physician is standing. The system covers body heights of up to 2.1 meters without the need to reposition the patient, even for the imaging of peripheral vessels. When necessary, the system allows free access to the patient’s head in order to provide optimal care during the procedure. Buttons on the table side console are tactile so that they can be easily operated even under the sterile covering. The on-screen menu allows the physician to navigate directly using the heads-up display. All information about the procedure is thus kept right in front of the operator’s eyes. The comfortable 30-inch display size delivers images up to 90% larger than conventional 19-inch monitors.

With Clearstent Live, Artis one offers a feature which until now was only available with the premium family Artis Q and Artis Q.zen. This application for interventional cardiology allows the physician to mask out the movement of the beating heart in order to place the stent in precisely the right position. Furthermore, the new system is equipped with the proven “Megalix” X-ray tube of the Artis zee system family featuring flat emitter technology. Using a tube current of up to 250 mA, the system generates images with outstanding quality and high contrast resolution. In order to keep radiation exposure for the physician and patient as low as possible, Artis one offers the most extensive feature set for dose reduction of any angiography system on the market. The system is available in different configurations tailored to fit a broad range of clinical requirements.

SIEMENS HEALTHCARE
ECR Booth 11 Expo A
i www.ihe-online.com & search 46573
For a Confident Access

Launching its latest ultrasound system M9, Mindray has delivered yet another breakthrough within the field of ultrasound imaging. M9 is a new generation hand-carried ultrasound system that provides premium class performance, proving to be an optimum solution for scanning technically difficult patients. Based on a new technological platform and single crystal transducer, M9 will provide you with a confident access.

www.mindray.com

mindray
healthcare within reach
The diagnosis is in the details.

Addressing the radiology department’s need for high-quality, high-productivity image capture systems, we offer a rich portfolio of DR solutions empowered by MUSICA image processing software, from mobile to affordable and fully automated, high-performance DR rooms.

Insight. Delivered.

Learn about Agfa HealthCare at www.agfahealthcare.com