Hybrid imaging led by PET/CT

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The recently published article in ‘Science’ by Johns Hopkins oncologist Bert Vogelstein and his co-author Cristian Tomasetti has resulted in a flurry of erroneous headlines in the popular press. Attempting to elucidate why some types of cancer are common and others are rare, the oncologists correlated the number of stem cell divisions over a lifetime in thirty-one named human tissue types with the incidence of cancer in those tissues, and suggested that random errors in DNA replication during stem cell division were a major contributing factor in cancer development and that “only a third of the variation in cancer risk among tissues is attributable to environmental factors”. Because at best popular journalists merely skimmed the abstract of the article- many others plagiarized from a secondary source- a typical mass media headline was “Two thirds of cancers just bad luck”!

But Vogelstein and Tomasetti didn’t consider breast tissues in their study, and breast carcinoma is the most common cancer in Europe, accounting for more than thirteen percent of all cancers diagnosed. The disease has many modifiable risk factors, such as obesity, high alcohol consumption, not breast-feeding babies and taking combined oestrogen/progesterone HRT post-menopause. Prostate tissue was also not included, but breast and prostate cancer, together with colorectal and lung cancer, account for over half of all cancers diagnosed in Europe. Although no modifiable risk factors for prostate cancer have been elucidated, studies have shown that the risk of colorectal cancer is augmented by obesity as well as diets high in red and processed meats, and exposure to tobacco smoke is a notorious modifiable risk factor for lung cancer. It is patently wrong to spread the message that certain life-style choices have a minimal impact on the risk of getting cancer, while at the same time it must be recognized that cancer- even of the lung- can affect the most prudent individuals. Another insidious message, disseminated by the popular press and many so-called celebrity cancer patients, is that cancer can be “fought and beaten” by a positive attitude and complementary therapies not advocated by mainstream healthcare providers. Thus ‘meditation coordinators’ profit from facilitating patients to picture regular battles between “weak” tumour cells and victorious leucocytes, and there is a lucrative market for such remedies as “electrically charged water”. Yet many robust studies demonstrate that while quality of remaining life might be enhanced by hope (as long as alternative treatments do not become prohibitively expensive), survival time remains unaffected. Isn’t it time for some cancer myth-busting?

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ISSN 0306-7904

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Emergency medicine departments are often the first point of call or ‘gateway’ for acute care - from accidents, sprains and strains to chest pain and psychiatric conditions. As a result, emergency physicians face a major challenge, since patients expect quick and correct diagnosis of their condition and the commencement of appropriate treatment.

A long history
In much of Europe, pre-hospital emergency medical services (EMS) have a long history, represented by several professional bodies. More recently, emergency department (ED) physicians have formed organizations of their own. In certain countries, EMS and ED organizations have been merged. The most recent development consists of academic emergency centres.

The Anglo-American and Franco-German models
Industrialized countries have traditionally followed two models for emergency medicine.
The first is the Anglo-American ‘scoop and run’ system. This is based on in-hospital emergency departments, fed by a pre-hospital ambulance and paramedic-based EMS which transfers patients to the hospital. The second is the so-called Franco-German ‘stay and stabilize’ system, which depends on a sophisticated pre-hospital emergency physician service capable of taking clinical decisions on scene, but possessing “only a basic organization of hospital-based emergency medicine.”

The gap between the two models is, however, “closing fast because of the rapid advancement of hospital-based emergency medicine.” In the meanwhile, countries as diverse as Argentina, China, India, South Korea and Turkey have begun recognizing emergency medicine as a separate speciality, and opting for hybrid models adapted from the two principal systems in Western countries.
The Anglo-American emergency medicine model (in the UK and Ireland) and the Franco-German one have together inspired other countries on the continent.
Meanwhile, Europe has also witnessed transitional models which seek to bridge the two, in the UK and Ireland, in France and Germany - and elsewhere. Europe therefore exemplifies some of the key issues and challenges accompanying the growth of emergency medicine.

As the role of hospital emergency departments grows by leaps and bounds, many analysts believe little thought has been given to its implications in the broader context of healthcare organization, financing and delivery, as well as future demand and capacity.

A full spectrum of specialities
One of the first challenges is that of training. The task of emergency physicians cuts across many medical and surgical specialities.
The International Federation of Emergency Medicine (IFEM) does not attempt to fudge the enormity of the skills “required for the prevention, diagnosis and management of acute and urgent aspects of illness and injury affecting patients of all age groups with a full spectrum of episodic undifferentiated physical and behavioural disorders.”

In Britain, the National Health Service (NHS) lists 25 specialities covered by emergency medicine, ranging from resuscitation, anesthetics and pain relief, through trauma and burns, cardiology, toxicology, diabetes and endocrinology, to hematology, dermatology, rheumatology, neonatology and oncology.

Keeping up-to-date
Emergency physicians are also expected to stay abreast of developments in different speciality areas.
Arvind Venkat, M.D, editor of ‘Challenging and Emerging Conditions in emergency medicine’, describes the scale of the task:
“During a typical clinical shift, an emergency physician may have to manage acute issues in patients whose co-morbidities may include transplantation, congenital heart disease, end-stage renal disease, or cancer. Without awareness of the new treatments and procedures in these areas ... it is easy to understand why emergency physicians may not correctly diagnose and initiate treatment ... — with detriment to the patient.”

The EU Doctors Directive - defining emergency medicine
The so-called European Doctors’ Directive dates to 1993 but was most recently updated in 2006. The Directive recognises 53 different hospital medical specialities, one of which is called ‘Accident and emergency medicine.’ This title was originally used by the UK and Ireland, and though both have since compressed it simply to emergency medicine, the EU (officially) still retains the older heading.
Several EU countries (e.g. Estonia, Italy, Latvia, Slovenia) recognize emergency medicine as a primary speciality. Others recognize it as a supra-speciality (e.g. Finland, France and Sweden). It is important to note that some countries, such as Belgium, consider emergency medicine in both
groups, while major EU members such as Italy and Spain recognized it as a speciality as recently as 2008.

The European Society for Emergency Medicine (ESEM) has added a crucial element to definitions of emergency medicine by observing that this “is a speciality in which time is critical.” ESEM also highlights the procedural interface between the pre-hospital and in-hospital phases of emergency medicine - including “triage, resuscitation, initial assessment and management of undifferentiated urgent and emergency cases until discharge or transfer to the care of another physician or healthcare professional.”

Given the growing convergence between the Anglo-American and Franco-German models, such transitional settings (from pre-hospital to in-hospital) will be of increasing significance in the future.

Growth in patients driven by new knowledge and technology

The number of patients seeking emergency care has been growing rapidly. In January 2015, Britain’s College of emergency medicine estimated that patient numbers were rising by 20,000 a week compared to the previous year. In the US, annual emergency department admissions amount to more than 115 million, corresponding to over 40% of the population.

Growth in patient numbers has been driven by advances in medical knowledge and healthcare technology, alongside an ageing population. Armed with new insights into disease, emergency physicians now routinely treat patients who would simply not have been able to survive in the past.

Procedures such as bariatric surgery, antiretroviral therapy for HIV/AIDS, novel chemotherapies and post-cardiac arrest regimens have increased longevity and quality of life for masses of patients. However, they have also made a hospital’s emergency department “the venue in which acute diagnosis of treatment failures or complications will take place.”

Overcrowding and exit block

The impact of wider emergency medicine availability in the hospital has not always been positive. Two of the principal challenges consist of overcrowding and ‘exit block’.

Overcrowding is a consequence of patients unable to access anything other than a hospital’s Emergency Department. It has been a particular problem in countries following the Anglo-American model. In the UK, moves to halt overcrowding have been attempted for almost two decades but have generally failed. Nevertheless, new initiatives continue. In mid-January 2015, the government decided to experiment with a tripling of the time handlers have available to decide whether to send an ambulance to a caller, from 60 to 180 seconds.

Exit block occurs when a hospital is unable to transfer patients from emergency departments into an inpatient bed. It affects over 500,000 patients in the UK each year. In May 2014, the UK College of emergency medicine estimated that 15% of patients attending Emergency Departments could be treated by GPs and remove the burden on hospitals.

As mentioned previously, there has been convergence of the Anglo-American and Franco-German models. Many continental European countries have allowed patients to walk in to emergency departments “without referral or medical prescription ... or identification documents.” In addition, “payments are usually not demanded, the aim being not to delay or hamper a patient’s access to care for life threatening conditions.” This has resulted in “an exponential increase in the utilization of this service” - and overcrowding. Ironically, the reason for a rush by patients to emergency departments has been the effort by EU Member States to put in place access- and cost-control mechanisms to prevent abuse of primary and secondary healthcare services. These have “often left emergency departments as the only (or the easiest) service that can be accessed by those citizens.”

Care coordination, co-location: new approaches

One of the best approaches to manage overcrowding and exit block consists of improved care coordination. This allows multiple conditions after emergency admission to be managed more efficiently in an outpatient setting - directly reducing the load on hospital Emergency Departments.

Some professional societies in Europe have called for co-location of primary services with Emergency Departments. Co-location aims to route patients to the best place to obtain their care, while providing more staff, with a better distribution of skills, at the front-line. Other benefits of co-location mean the ability to provide out-of-hours primary care staff with immediate access to facilities such as radiology, pathology and ECG, and promote knowledge sharing between primary care and emergency department staff.

The US too has been seeking to bridge the gap between traditional hospital emergency departments versus EMS on site. One recent paper which has attracted considerable attention classifies ED visits into different categories of severity, seeking to focus attention on those with maximum potential for improving outcomes while reducing costs. According to its authors, current attempts to simply divert low-acuity patients to less-costly ambulatory care sites is less efficient than reducing preventable hospital admissions and improving ED care of patients with what they call ‘intermediate’ or complex conditions.

Emergency medicine and integrated healthcare

Given the growing convergence between the Anglo-American and Franco-German emergency care systems, it is clear that there is going to be much cross-fertilization in the years to come. Indeed, the US paper discussed above, to build categories of severity, reflects efforts in Europe to set up uniform triage protocols through the whole EMS system - principally as a means to combat the “overcrowding and misuse of EDs.”

This, in turn, loops into an emerging philosophy to provide emergency care within the context of ‘integrated healthcare’, using referral networks between hospital EDs and/or tertiary facilities to increase quality and efficiency, and cost-effectiveness.

These were some of the conclusions of a joint project on emergency medicine in 2008 by the EU Commission’s Directorate General for Health and Consumers and the World Health Organization (WHO).

One priority identified by the EU/WHO participants included “the need to develop performance indicators of an international standard. The application of these indicators to different EU EMS systems could provide the data necessary for benchmarking, comparison and cost-effective optimization of the system.”

Other areas for attention included a common core curriculum across the EU for an emergency medicine (EM) speciality, and interfacing EMS systems across the EU for disaster response. However, participants acknowledged that harmonizing the roles and responsibilities of other medical cadres, such as nurses and paramedics or technicians, was more complicated and unrealistic - “at the present moment.”
Medical radiation - protection and dose monitoring

Technological breakthroughs in diagnostic imaging and interventional radiology have revolutionized patient care. However, these benefits seem to be accompanied by risks. In 2009, a report in the ‘Archives of Internal Medicine’ estimated that CT scans in the US may lead to 29,000 cancers and 14,500 deaths. A ‘New York Times’ feature published in January 2014 suggested that “3 percent to 5 percent of all future cancers may result from exposure to medical imaging.”

No estimate to date has aggregated cancer risks in Europe from CT (or any other medical radiation procedures). For the sake of comparison, however, per capita effective dose from diagnostic medical exposures was 2.2 mSv/year in the US in 2006, a rise of 460% since the early 1980s. In Europe, latest available figures (from 2008) show a massive variation in range (from 0.33 mSv/year in the UK, to 1.52 mSv/year in Germany).

Such differences have, on their own account, provoked considerable debate. Even in the relatively homogeneous Nordic region, the use of X-Rays vary by 50% - from about 0.55 per capita in Denmark and Sweden to 0.8 in Finland and Norway. As one report by the Swedish Radiation Safety Authority observes, “No clear answers (for these differences) have been given.”

CT scans and cancer

CT accounts for 46% to 81% of exposure from the top 20 examinations requiring radiation in Europe, and, as in the US, has come under specific scrutiny, due to its high unit dose levels. In the UK, which has one of Europe’s lowest per capita effective medical radiation doses (0.33 mSv/year), CT accounted for just 7% of all medical and dental radiological examinations, but 68% of the resultant total collective dose; this is similar to the US. A report from University Medical Center Groningen in the Netherlands concluded that recurrent CT scanning added to “a significant increase in cancer risk,” and “may be a serious problem in long term follow-up of non-cancerous patients or patients who survived their (previous) cancer.”

In the US, after the ‘Archives of Internal Medicine’ report in 2009, the debate about CT use has continued to gather momentum. Congressional hearings followed a ‘New York Times’ finding in 2011 that hundreds of hospitals “routinely” performed two chest CT scans on a single patient, needlessly exposing them to double doses of radiation and driving up costs.”

Little clarity in debate

The debate, however, is hardly conclusive - anywhere.

One study in Europe, by Cologne University Hospital, observes that a “major portion of the total dose from diagnostic medical exposures does not constitute an additional cancer risk due to the poorer prognosis of patients compared to non-patients of (the) same gender and age.”

Similar findings were echoed in a survey of 23,359 subjects aged 18-35 by researchers at Massachusetts General Hospital, which concluded that patients “are much more likely to die from a condition that required a CT scan than from radiation exposure from the scan.” Nevertheless, the researchers did acknowledge that “mortality rates were higher in patients who received more CT scans.

This debate - and controversy in the wider scientific community on issues such as excess relative risk from radiation (ERR) - is unlikely to diminish in the near future. However, there is growing agreement that rapid growth of high-dose procedures like CT may be adding to risks, and that guidelines on rational use will help bring some of these risks under control.

The Swedish Radiation Safety Authority explicitly underlines concerns about ‘unjustified examinations’. The reasons it provides include the “remarkable increase in the number of CT examinations in the last 10 years” and “a large potential for averted dose if a substantial part of the examinations is unnecessary.”

Hospitals step up dose monitoring campaigns

In the face of such concerns, hospitals have been developing sophisticated radiation dose-management programmes to track and monitor exposure for patients’ and caregivers. One of the most ambitious efforts is being made in the US, by Utah-based Intermountain Healthcare. Its 22 hospitals and 185 clinics are launching a system that measures and reports collective radiation exposure from CT scans, nuclear medicine scans, and interventional radiology exams. Intermountain will include the exposure data in patients’ electronic health records (EHRs).

European hospitals are also likely to face pressure for similar moves after a new European Union (EU) Directive, released at the end of 2013 (2013/59/EURATOM).
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Minimizing risks

Traditionally, the regulation of medical radiation is (and has been) governed by one cardinal principle: the minimizing of risks through specific controls on exposure. Its legal framework is largely based on the International Commission for Radiation Protection (ICRP), a non-governmental body, whose main recommendations are contained in a 1990 paper called ICRP-60. ICRP-60 lists three overarching principles for the use of medical radiation: Justification (the attaining of “positive net benefit”), Optimization (keeping exposure as low as reasonably achievable as per the so-called ALARA Principle), Dose Limitation (separation of maximum permissible doses for individuals from those of patients).

The concept of minimizing - as opposed to the elimination - of risk, is key to understanding rules about medical radiation. While the generation of nuclear power, in theory, allows for reducing worker (and public) exposure to zero, this can clearly not be the case for patients seeking benefits from diagnostic radiology or radiotherapy.

Justification, Optimization and Dose Limitation: EU tightens up on ICRP


Among other factors, the new Directive seeks to take note of the “important technological and scientific developments” which have occurred since its 1997 predecessor, leading to “a notable increase in the exposure of patients.”

Key topics addressed include “the exposure of asymptomatic individuals,” a strengthening of the requirements on information that must be provided to patients, “the recording and reporting of doses from medical procedures, the use of diagnostic reference levels and the availability of dose-indicating devices.”

It also requires a “high level of competence and a clear definition of responsibilities and tasks among all professionals” in order to ensure adequate protection of patients.

Clinical audits and responsibility for hospitals

Two sections in the Directive have specific regulatory significance for hospital management. These include a ‘clinical audit’ and ‘clinical responsibility’.

The former entails a systematic review of radiological procedures, against latest available standards and best practices. The aim is to improve both the “quality and outcome of patient care.”

On its part, the clinical responsibility clause explicitly specifies the need to give information on radiation risks to patients. It also mentions the need to obtain information (“if appropriate”) on previous examinations, and sharing records with other practitioners and/or the referrer (“as required”).

The above sections are likely to pose very specific challenges for EU hospitals in the years ahead, especially if the US experience is an indicator. The US effort by Intermountain Healthcare to measure (and reduce) patients’ exposure from CT scans notes that “calculating risk to patients is a complex process which “often doesn’t generate any clear answers.”

In April 2013, the ‘Journal of the American Medical Association’ (JAMA) cited studies observing that up to one in 3 imaging tests were ordered in situations where expected benefits did not sufficiently exceed the risks and that clinicians were not well informed about the risks of medical imaging.

JAMA also noted that the impact of current risk communication practices on patient knowledge was not well understood. Less than 1% of patients knew the relative amount of radiation exposure they would receive from the scan—three times the level of an X-ray.

Challenges ahead for dose monitoring

The appropriate use of radiation is evidently an important patient safety and quality issue. Many monitoring programmes have fallen short of meeting the spirit of regulatory requirements.

In Europe, for example, radiological departments are legally obliged to register dose-area-product (DAP) values for every interventional radiology or cardiology patient. However, a major multi-centre review of dose evaluations showed that even centres with similar average DAP-values could still have significantly different average effective dose values.

The role of radiation dose-management programmes is almost certain to be examined more closely in the years ahead. In spite of the challenges, one study notes that at the minimum, hospitals should focus on three goals: to ensure that the test is clinically indicated; avoid duplicate tests; and make sure alternative tests, such as an ultrasound or magnetic resonance imaging, are not viable options.

Encouraging greater awareness of radiation risks

A related priority is education and training. In an interview with Hospitals & Health Networks (H&HN), Keith White, MD, the medical director of imaging for Intermountain Healthcare, says: “Physicians don’t necessarily, as a body, believe the risks associated with radiation dose are as written... There’s a lack of understanding and knowledge in the medical community in general.” These comments echo a 2003 survey in Britain of 130 physicians, including 40 consultants and some radiologists. Almost no one knew the dose quantity (or the unit in which it is expressed) for a chest X-ray, and almost all underestimated risk.

Efforts to inform physicians about radiation risks and benefits is the subject of major campaigns by professional societies. The European Coordination Committee of the Radiological, Electromedical and Healthcare IT Industry (COCIR) has endorsed EuroSafe Imaging, a campaign to promote awareness about radiological imaging and the need for measures to protect patients from unnecessary exposure to radiation. CT manufacturers in COCIR have been working with HERCA (Heads of Europe’s Radiation Protection Control Authorities) and other professional societies to standardize dose reduction claims and dose estimation through phantom development and dose metrics such as size-specific dose estimate (SSDE).

Efforts are also under way in the US, where the American College of Radiology has sponsored a national radiation campaign called the “Dose Index Registry,” which will allow providers to compare their facilities’ CT doses against national benchmarks.

Nevertheless, dose reduction is not a stand-alone target. There is a shift in emphasis “towards higher levels of information from an examination that has occurred over the past several years, based upon volume CT scanning methods.” New forms of 3D imaging also offer potential for lowering doses whilst improving information content, while computer aided diagnostic (CAD) techniques provide ways to measure and compare diagnostic outcomes. Together, these “may lead to greater consistency and improved performance” and are “important optimization considerations.”
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Hybrid imaging is the fusion of medical images, most commonly from CT (computed tomography), PET (positron emission tomography) and MRI (magnetic resonance imaging), in order to enhance visualisation. It addresses both anatomical detail and functional processes, thereby providing superior accuracy for diagnosis and the monitoring of interventional procedures. In several cases, it is also accompanied by lower radiation exposure for patients.

Hybrid imaging is now being used to combine structural and molecular imaging - revealing molecular processes in vivo while depicting their anatomic location. Some proponents believe the technique marks the dawn of the era of personal medicine.

Medical Invention of the Year
The age of hybrid imaging could be considered to have begun in the year 2000, after PET/CT was heralded as the ‘Medical Invention of the Year’.

CT has also been combined with MRI and with SPECT (Single Photon Emission Computed Tomography), while other combinations include MRI/PET, MRI/SPECT and MRI-plus-ultrasound. Nevertheless, PET/CT remains the most widely used combination.

Functional and anatomical information
Traditionally, medical devices imaged either anatomy or function. Clinicians tend to employ different imaging techniques for diagnosis and during the course of treatment. In other words, both functional and anatomical information are essential for state-of-the-art patient management. Although the advantages of combining the two into ‘correlative imaging’ was known since the early 1960s, another three decades were to pass before the process was mastered.

Anatomo-metabolic imaging
The biggest driver for this was the need to interpret nuclear medicine studies, which began as a non-imaging speciality and lacked in-depth anatomical information. When overlaid on similar, unmagnified X-rays, the life-size results from nuclear medicine probes were found to aid diagnosis, in a process which came to be known in the early 1990s as ‘anatomo-metabolic’ imaging. A major advantage of anatomo-metabolic imaging was a reduction in the number of imaging examinations required for patients. Another collateral effect was an increase in collaboration between radiology and nuclear medicine, which has in turn led to new insights into disease.

Digital technologies, new algorithms aid image manipulation, fusion
The development of CT, MRI and SPECT in the 1980s and 1990s, with their higher degree of spatial resolution, served to accelerate interest in image fusion. These new digital imaging techniques lent themselves more easily to software manipulation such as rotation, rescaling and deformation. Given the absence of deformation in brain structures, a key area of interest in correlative imaging or ‘image co-registration’ was by neurologists.

Nevertheless, problems such as differences in the geometries of the imaging machines and in the positioning of patients, continued to pose major barriers for retrospectively co-registering structure and function. Tackling such challenges was left to the related and fast-developing field of digital image processing, by which sophisticated algorithms perform tasks such as feature extraction, components analysis, linear filtering, pattern recognition and multi-scale signal analysis - as well as fusion.

Major algorithms dedicated to digital image processing included HARDI (High Angular Resolution Diffusion Imaging) and DSI (Diffusion Spectrum Imaging). These were among the first to permit multi-modal rendering, especially for image fusion. Iterative reconstruction and accelerated convergence methods for nuclear medicine imaging are generally based on the early-1990s OSEM (ordered subset expectation maximization) algorithm.

Hardware fusion
‘Hardware fusion’ has since emerged as a complement to post-imaging software. This combines two different imaging modalities within a single gantry. The resulting PET/CT or SPECT/CT tomograph acquires co-registered structural and functional information within one study, with CT localizing functional abnormalities and PET or SPECT highlighting areas of abnormal metabolism.

Hybrid revolution led by PET/CT
The launch of the first hybrid device marked a wholly new paradigm in imaging technology. As mentioned, PET and CT remain the most widely used combination. Highlighting its success is the fact that no major medical imaging manufacturer offers stand-alone PET scanners anymore. Apart from intrinsic image alignment, the PET/CT hardware combination uses CT imagery to derive PET attenuation correction factors. The duration of an examination is also reduced by using rapidly acquired, low-noise CT data in place of a lengthy conventional PET transmission. As a result, a
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single session provides a full diagnostic anatomical and functional whole-body survey. By 2006, data indicated that PET/CT was “more sensitive and specific than either of its constituent imaging methods alone and probably more so than images obtained separately from PET and CT and viewed side by side.” In 2007, claims of 10-15% improvements over PET or CT alone, alongside “convenience for patients and clinicians,” made PET/CT the “most important cancer imaging modality,” allowing radiation oncologists to use the functional information provided by PET for planning radiation treatment. Studies also indicated the promise of PET/CT in the staging of several cancers (non–small cell lung cancer, recurrent colorectal cancer, and malignant lymphoma) and monitoring therapy response. Developments in PET/CT have since continued, beginning in the late 2000s with 64-slice MDCT (multi-detector arrays), new detector technologies and time-of-flight scanners. Follow-on areas for application include intensity-modulated radiation therapy (IMRT) and radiation therapy devices to treat tumours with surgical precision using robotic techniques. In 2011, an expert review concluded that “after a decade of clinical evaluation, PET/CT will continue to have a significant impact on patient management, mainly in the area of oncological diseases.” Further innovation is expected to focus on data acquisition schemes and data processing/fusion, as well as dose-efficiency.

**Growth in radiologist demand**

Guidelines on PET/CT data are evolving. As stated earlier, hybrid imaging has led to cross-fertilization of radiology and nuclear medicine. PET/CT images are generally interpreted by nuclear medicine physicians. However, an increasing number of radiologists are acquiring additional training in PET image interpretation or additional board certification in nuclear medicine. Indeed, in some parts of Europe (such as Switzerland), radiologists cannot independently interpret PET/CT images unless they are fully credentialed in nuclear medicine.

**Molecular imaging and personalized medicine**

PET/CT is also on the frontlines of molecular imaging and personalized medicine. In the words of a global panel of experts convened by the Radiological Society of North America, the application of PET/CT will grow due to the introduction of “an armamentarium of new radiotracers that will enable disclosure of previously hidden properties of human diseases and offer ‘road maps’ for patient therapy and disease management.” These range from metabolic substrates, hypoxia agents and neurotransporters to monoclonal antibodies, peptides, and molecules “that have exquisite specificity for detecting surface and subsurface molecules expressed in disease processes.”

**SPECT/CT likely to remain niche**

SPECT/CT was introduced commercially in 2004. SPECT traditionally had access to a much larger range of clinically established biomarkers and radiopharmaceuticals than clinical PET. Although (as mentioned above), the gap is expected to narrow in the coming years, there are some diseases where SPECT/CT has shown considerable promise - among other reasons, due to attenuation correction via integration of CT data. These include the imaging of benign and malignant bone disease, diagnosing prostate cancer (where the value of PET alone has been questionable), and distinguishing between osteomyelitis, aseptic necrosis and metastatic disease.

One of the most important (and accurate) diagnostic applications of SPECT so far has been in myocardial perfusion scintigraphy for ischemic heart disease. Hybrid SPECT/CT has proven itself invaluable in providing data on lesions and coronary anatomy, and for making decisions on interventional cardiology. Although there have been occasional hypotheses about disease-specific SPECT/CT imaging, SPECT/CT is unlikely to replace all, or even most SPECT. “When compared to PET/CT most technical and methodological advances of SPECT, however, are not only available to SPECT/CT users but also to SPECT-only users.” Indeed, one European study in 2010 found that workflow and economic analysis does not support the use of SPECT/CT with a state-of-the-art multisector CT scanner. As a result, unlike PET/CT, SPECT/CT instrumentation is marketed with less expensive CT options to keep down total hybrid instrument costs.

**Other SPECT hybrids**

Meanwhile, the opportunities in combining SPECT and PET too have been demonstrated by US physicians, who reported that the two can jointly “play a significant role” in epilepsy patients by noninvasively localizing epileptogenic brain regions before surgery.” Combinations such as SPECT/MRI may also be anticipated, but will again need to firstly demonstrate viability in clinical prototyping.

**PET/MRI**

PET detectors have also recently been adapted to operate within the strong magnetic fields of MRI scanners. Hybrid PET/MRI, which has its roots in small-animal imaging technology, provides the “anatomical and structural description of MRI simultaneously with the quantitative capabilities of PET.” Although still experimental, it addresses the inability of PET/CT to provide high soft-tissue contrast, and thus “bridges the gap between molecular and systems diagnosis.” PET/MRI also promises to become “clinically useful in improved therapy planning for neurodegenerative diseases and subsequent response assessment, as well as in complementary loco-regional oncology imaging.”

**Ultrasound and hybrid imaging**

Efforts are also under way to bring ultrasound (US) into hybrid imaging, coupled with MRI. A core target application is focused ultrasound surgery (FUS), a non-invasive but extremely precise procedure for ablating pathogenic tissue. FUS therapy is usually combined with MRI, since the latter offers excellent target identification and allows continuous monitoring of FUS-induced temperature changes. Since the late 2000s, some manufacturers have found the US/MRI combination an optimal launch pad for precision robotic support in surgery. One of the first applications of US/MRI hybrids was breast biopsy, with ultrasound providing real-time display of the needle trajectory while MRI confirms needle placement. Similar complementarity has also been demonstrated for high-intensity ultrasound therapy in the upper abdomen. MRI-guided focused ultrasound has also been used in thermal ablation for brain surgery, with the hybrid system providing guidance for targeted drug delivery via blood-brain barrier disruption.

**The future**

It is clear that multi-modal imaging systems will become standard part of clinical routine. Indeed, in 2007, researchers published a study on an interactive, high-resolution combination of data from CT and MRI as well as from fMRI (functional MRI), PET and DSA (digital subtraction angiography); together, the data was used successfully for a neurosurgical intervention. However, there will be some questions too, such as when to use hybrid imaging, and in what combination; how to ensure quality imaging and clinically relevant interpretation, and how best to train hybrid imaging professionals for the future.
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The heterogeneous state of medical imaging in Europe

Medical imaging is confronted with heterogeneities in many areas, including education and training, research, and quality of equipment and practice, which calls for a pan-European approach.

by Prof. Guy FRIJA, Past-President of the European Society of Radiology (ESR)

In 2014, the European Commissions Expert Panel advising the European Commission on effective ways of investing in health recently adopted an opinion\(^1\) recommending specific actions to improve quality of care and patient safety. The actions proposed in the expert panel’s opinion paper correspond with the key issues addressed by the ESR as follows:

• The use of a comprehensive conceptual framework in relation to quality and safety
• Development of guidelines and the inter-professional sharing of good practices
• Funding research on quality and safety
• Economic issues related to the defined quality dimensions
• Education and training for the new roles of both patients and health professionals
• Information technology and information systems significant for health quality and safety
• Quality and safety aspects of the burden of chronic diseases and inequalities in health
• The HTA network, and increasing attention to Health System Impact Assessment

The ESR fully subscribes to this document and the proposed actions and has developed a ‘European Action Plan for Medical Imaging’ to improve quality of care and patient safety\(^2\), targeting harmonization in regard to quality and safety, education and training, as well as research and technology, in order to significantly improve European healthcare systems, and to ensure better quality and safety for patients in Europe.

A change in paradigm and increased collaboration would strengthen the EU Agenda on quality of healthcare and patient safety put forward by DG Health and Food Safety and would facilitate the implementation of the opinion and actions recommended in October 2014 by the independent expert panel advising the European Commission on effective ways of investing in health in order to improve quality of care and patient safety.

Moreover, following the successful launch of the ESR Call for a European Action Plan for Medical Imaging at the European Parliament in November 2014, ESR experts were invited to share their expertise during a conference on promoting patient safety and quality of care, held by the former Italian Council Presidency and the European Commission in Rome in December. The conference focused mainly on the Council Conclusions\(^3\) on patient safety and quality of care, adopted in December by the Employment, Social Policy, Health and Consumer Affairs Council (EPSCO). Although the Council’s conclusions focus on the prevention of ‘hospital acquired infections’ the core aims defined in the paper reflect the key issues addressed in the ESR’s call for a European Action Plan for Medical Imaging. The Council, inter alia, calls on the Member States and the European Commission to foster patient safety and quality of care through the promotion of research and the development of guidelines as well as to finalize by December 2016 a framework for a sustainable EU collaboration on patient safety and quality of care.

Medical imaging heterogeneities

With the launch of the ESR Action Plan the ESR calls on the European Commission and the other EU institutions to focus on the reforms necessary to overcome the current heterogeneities in EU Member States with regard to quality of care and patient safety. Medical imaging is confronted with these heterogeneities in many areas, including education and training, research, and quality of equipment and practice, which calls for a pan-European approach. The European Commission would have all the means to implement such an approach; however the rigid division of responsibilities between the various directorates seems to impede reforms and the much needed harmonization.

Practical examples of existing heterogeneities in the field of medical imaging include the need for modernising imaging equipment across Europe, which would bring about an immediate decrease of patients’ radiation exposure, as well as the importance of developing and politically supporting key quality and safety indicators.

Since 1996 the European Coordination Committee of the Radiological, Electromedical and healthcare IT Industry (COCIR) has closely monitored the ageing of medical imaging equipment throughout the European Union and developed a set of ‘Golden Rules’\(^4\) to support the evaluation of the medical equipment installed base and to aid procurement decisions. These Golden Rules are the following:

1. At least 60% of the installed equipment base should be younger than 5 years; medical technology life-cycle averages suggest equipment that is up to 5 years old adequately reflects the current state of technology and offers opportunities for economically reasonable upgrade measures.
2. Not more than 30% should be between 6-10 years old; medical technology which is between 6 - 10 years old is still fit for use, but already

Overall total frequencies per 1000 of population for different countries. The relative contributions of the four main groups (plain radiography including dental, fluoroscopy, computed tomography and interventional radiology) are also shown. Plain radiography includes dental procedures. (Source: EC Radiation Protection doc. No 180)
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requires replacement strategies to be developed in order for systems to benefit from efficiency gains afforded by current technologies.

3. Not more than 10% of the age profile should be older than 10 years; medical technology older than 10 years is outdated, difficult to maintain and repair, and may be considered obsolete and inadequate for conducting some procedures when compared with current medical guidelines and best practices; replacement is essential.

It is understood that more targeted and more efficient use of medical imaging techniques will not only reduce unnecessary exposure to radiation, and thereby help prevent harmful effects, but will also improve health outcomes through better diagnosis and more effective treatment. To ensure this is achieved consistently across EU member states, common quality indicators and parameters should be developed at the European level in order to allow benchmarking.

**Education and training**

Another field to be considered essential for the improvement of patient safety and quality of care is education and training.

Patient safety and quality of care can only improve throughout Europe if Europe invests in education and training. The ESR developed a European Training Curriculum for Radiology and the European Diploma in Radiology in order to support harmonization efforts and calls upon the European institutions to endorse these and to introduce mandatory continuing medical education throughout Europe.

**Heterogeneities in research and technologies**

Unimpeded access to research and technologies depend on several key factors, one of the most important factors is the heterogeneity of healthcare systems within the European Union often caused by the lack of financial resources. With the principle of subsidiarity enshrined in the Rome Treaties of the European Communities, health policy is primarily a matter of national competence.

However, some competence was given to the European Union in the health area. In 2014, the European Commission has put the development and support of ‘personalized medicine’ high up on the agenda.

The ESR follows this issue with great interest and has learned that policy makers often undervalue the crucial role medical imaging plays in the field of personalized medicine. From clinical trial design to individualized cancer treatments, the ESR calls on decision makers to fully recognize the important role of imaging in the development of personalized medicine and to fully integrate medical imaging into policy making processes in this area.

Moreover, the era of personalized medicine and biobanking has led to diverse heterogeneity of data, and the integration of imaging and ‘omics’ data has become essential. There is a strong need for a structured repository for imaging data in order to facilitate personalized medicine, clinical trials, and the evaluation of new drugs.

The ESR, thus, calls on the European institutions to support the standardization, as well as the technical and clinical validation of imaging biomarkers and the support of the development of European biobanks in medical imaging to simplify access to knowledge, improve interoperability and data management.

Furthermore, advances in information technology (IT) have revolutionized healthcare in general and radiology in particular, but have also created new challenges regarding data volume, standardization, data protection, etc., which require harmonization efforts on a European scale.

The ESR is concerned about the current European legislative framework for teleradiology and encourages the European Commission to revisit its approach. Since teleradiology is, however, still on the European political agenda, there is consequently a need to develop European standards regarding quality, safety and liability issues.

In order to address the current heterogeneities in medical imaging an extensive collaboration between the various Directorates General (DGs) of the European Commission in charge of the development of respective legislative proposals is needed in order to ensure the creation of synergies to the maximum benefit of Europe’s patients.

The ESR is currently organizing a contact programme with representatives from the European Commission, European Parliament and Council in order to implement concrete measures addressed in the ESR Call for a European Action Plan for Medical Imaging and to continue raising awareness regarding patient safety and quality of care for the benefit of Europe’s patients.

**References**

3. COCIR website: http://cocir.org/uploads/media/14008_COC_Age_Profile_web_01.pdf

Number of MR and CT scanners per country in Europe
(Source: OECD Health at a Glance: Europe 2014 report)
Detecting cancer earlier is goal of new medical imaging technology

A new medical imaging method being developed at Rutgers University could help physicians detect cancer and other diseases earlier than before, speeding treatment and reducing the need for invasive, time-consuming biopsies. The potentially lifesaving technique uses nanotechnology to reveal small cancerous tumours and cardiovascular lesions deep inside the body. It is showing promise in early tests by Rutgers researchers in the schools of engineering and pharmacy.

“Our new mode of fluorescent imaging aims not only to reveal diseases earlier, but also to learn more about the diseases before performing surgery,” said Prabhas Moghe, the lead researcher on the project and distinguished professor of biomedical engineering and chemical and biochemical engineering. “I like to think of it as an optical biopsy.”

“This technique could eventually be used to accurately determine whether a newly detected cancer has spread to nearby lymph nodes, which should help a surgeon deal with the full extent of disease during a single surgery,” said Shridar Ganesan, associate director for Translational Science at Rutgers Cancer Institute of New Jersey and clinical advisor for the project. Currently a surgeon who can’t tell how far a cancer has spread may do lymph node biopsies and wait a day for results and then perform a second surgery if needed, with its attendant trauma, risks and costs.

The Rutgers technology, co-developed by Richard Rimai, distinguished professor of Materials Science and Engineering, uses a different type of infrared light than is used for imaging today. Called shortwave infrared, it penetrates skin and other tissue more deeply than visible light or the near-infrared light used in current imaging methods. This light stimulates dyes made with nanocrystals of rare earth elements – a family of 17 similar metals that are not scarce but are difficult to mine. Rare earths are in growing demand for electronic products such as smart phones, video screens and electric car motors and batteries.

While scientists and physicians have long recognized the potential value of shortwave infrared light, fluorescent dyes that react to this light have either been too toxic to use safely or could not deliver sharp images. The dyes that Moghe and his team are developing encapsulate rare-earth nanocrystals in a shell of human serum albumin. They are well tolerated, distribute quickly through the body and accumulate at the disease sites; The researchers can employ different types rare-earth elements, which glow under slightly different colours of shortwave infrared light, to create a family of probes that are sensitive to a variety of cancers.

Rutgers University
http://tinyurl.com/oxnjlez

Healthcare costs could be cut by more appropriate use of cardiac stress imaging

In new research, investigators concluded that overuse of cardiac stress testing using advanced imaging technology has led to increasing healthcare costs in the United States and unnecessary radiation exposure to patients. Researchers from the New York University Langone Medical Center in what is believed to be the first comprehensive examination of trends in cardiac stress testing utilizing imaging, also revealed that there are no significant racial or ethnic health disparities in its use. They also made US estimates of the cost of unnecessary cardiac stress testing with imaging and the health burden of this testing, in relation to cancer risk due to radiation exposure.

Cardiac stress testing, especially with imaging, has been at the forefront of debate about rising healthcare costs, inappropriate use, and patient safety in the context of radiation exposure. Joseph Ladapo, MD, PhD, assistant professor in the departments of medicine and population health at NYU Langone, and the lead author of the study, and colleagues wanted to determine whether US trends in cardiac stress testing with imaging may be attributable to population shifts in demographics, risk factors, and provider characteristics, and to assess whether racial/ethnic discrepancies exist in physician decision making.

The investigators designed their study utilizing data from the US National Ambulatory Medical Care Survey and US National Hospital Ambulatory Medical Care Survey from 1993 to 2010. Patients chosen for the study were adults without coronary heart disease who were referred for cardiac stress tests. Between 1993–1995 and 2008–2010, the yearly number of ambulatory visits in the United States in which a cardiac stress test was prescribed or performed increased by more than 50%. Cardiac stress tests with imaging comprised a rising percentage of all of these tests—increasing from 59% in 1993–1995 to 87% in 2008–2010. At least 34.6% (one million tests) were probably inappropriate, the researchers concluded, with associated annual costs of USD 501 million (€ 441 mil) and 491 future cases of cancer.

“Cardiac stress testing is an important clinical tool,” said Dr. Ladapo, “but we are overusing imaging for reasons unrelated to clinical need. This is causing preventable harm and increasing healthcare costs. “Reducing unnecessary testing also will concomitantly reduce the incidence of radiation-related cancer. We estimate that about 500 people get cancer each year in the US from radiation received during a cardiac stress test when, in fact, they most probably didn’t need any radiological imaging in the first place. While this number might seem relatively small, we must remember that “first, do no harm” is one of the guiding principles in medicine.”

New York University Langone Medical Center
http://tinyurl.com/ng7wlkr

MRI probe technology shows brain toxins in living animals for first time

No methods currently exist for the early detection of Alzheimer’s disease, which affects one out of nine people over the age of 65. Now, an interdisciplinary team of Northwestern University scientists and engineers has developed a non-invasive MRI approach that can detect the disease in a living animal. And it can do so at the earliest stages of the disease, well before typical Alzheimer’s symptoms appear.

Led by neuroscientist William L. Klein and materials scientist Vinayak P. Dravid, the research team developed an MRI probe that pairs a magnetic nanostructure (MNS) with an antibody that seeks out the amyloid beta brain toxins responsible for onset of the disease. The accumulated toxins, because of the associated magnetic nanostructures, show up as dark areas in MRI scans of the brain.

This ability to detect the molecular toxins may one day enable scientists to both spot trouble early and better design drugs or therapies to combat and monitor the disease. And, while not the focus of the study, early evidence suggests the MRI probe improves memory, too, by binding to the toxins to render them “handcuffed” to do further damage.

Northwestern University
http://tinyurl.com/pw2povb
Optimizing patient dose with the latest technology and tools

The ALARA principle (As Low As Reasonably Achievable) will remain the key method used to determine the proper exposure technique for a given examination. However, the technology and the methods used to achieve the lowest reasonably achievable dose will continue to evolve.

New, more efficient technology can have a significant impact on required dose levels. To confirm this, Agfa HealthCare conducted both a technical assessment and an image quality evaluation with radiologists. The goal of this evaluation was to determine by how much patient exposure (and dose) could be reduced while providing the same or similar image quality, comparing conventional BaFBr plate CR systems to CsBr needle plate CR systems and CsI needle scintillator DR detectors using Agfa HealthCare’s MUSICA image processing.

Cesium detector
High absorption of the X-ray quanta in the phosphor layer of CR and DR detectors is a prerequisite for good image quality.

The thickness of the powder phosphor layer is limited to less than 300 μm, because of light scattering. This limit to the thickness also imposes a limit to X-ray absorption.

Higher X-ray absorption is possible with the CsBr and CsI needle crystalline radiography detectors, due to the low light scattering, therefore a thicker phosphor layer can be used without jeopardizing the sharpness of the imaging system.

MUSICA image processing
Due to the strong focus on dose reduction in radiographic imaging, increasing numbers of radiographic images are taken at a lower dose, resulting in higher noise content.

Agfa HealthCare’s MUSICA processing is based on a new mathematical multiscale framework: Fractional Multiscale Processing (FMP). It is used to achieve active noise reduction, which results in much more efficient image denoising with preservation of the fine and subtle image structures.

Clinical image quality study
Both the CsI DR detector and CsBr CR detectors with MUSICA image processing showed a substantial reduction in dose when compared to conventional BaFBr CR systems.

In clinical practice, the improved performance available with cesium phosphors can be used to significantly reduce dose for various types of radiographic examinations.

The study outcome shows that substantial dose reductions of up to 60% can be achieved with cesium halide based detectors in either CR or DR systems, combined with the Agfa HealthCare MUSICA Fractional Multiscale image processing software.

Higher image quality with needle phosphor technology translates to equivalent image quality at lower exposure levels:

- DQE of cesium-based detectors is more than double that of powder phosphor-based CR detectors.
- Needle phosphor detectors are used in Agfa HealthCare’s CR (CsBr doped with Eu) and DR systems (CsI doped with Ti).

Higher image quality with needle phosphor technology translates to equivalent image quality at lower exposure levels!

≥

Image processing and noise reduction can also play a key role.

Up to 60% dose reduction is possible with cesium-based detectors and MUSICA image processing:

- Both the CsI DR detector and CsBr CR detectors with MUSICA image processing showed a substantial reduction of between 50 to 60% in dose when compared to conventional BaFBr CR systems.

Fig. 1 Electron microscope images with powder (top) and needle (bottom) phosphors.

Fig. 2 DQE measured according to the IEC62220-1 standard for three Agfa HealthCare imaging systems: BaFBr CR (MD4.0R), CsBr CR (HD5.0), CsI DR (DX-D 35C, DX-D 30C). DQE at RQA3 beam quality at ~0.7 μGy.
where lower dose is critical; for example neonatal imaging.

**IEC exposure index & dose monitoring**

Agfa HealthCare was the first manufacturer to fully implement the IEC exposure index standard in 2009. When this index is coupled with Agfa HealthCare’s colour-coded exposure indicator, the technologist receives immediate visual feedback.

Agfa HealthCare’s extended dose monitoring software tools enable QC supervisors and physicists to quickly and easily monitor the exposure and dose history of an individual technologist or of any CR or DR system in the department. They can also produce exposure outlier reports, scatter plots and exposure histograms.

**Innovative and market-leading solutions**

Agfa HealthCare’s digital radiography systems have been implemented and used worldwide since 1993. The huge installed base of more than 50,000 units clearly illustrates the confidence customers have in Agfa HealthCare products throughout medical communities worldwide. Innovative and market-leading solutions keep systems and technology up-to-date, and make a significant change in required dose. Whenever possible, cesium halide-based detectors in combination with MUSICA should be used to minimize dose and achieve optimum image quality.

**References**

1. Testing with board certified radiologists has determined that cesium bromide (CR) and cesium iodide (DR) detectors when used with MUSICA processing can provide dose reductions of between 50 to 60% when compared to traditional barium fluor bromide CR systems. Contact Agfa HealthCare for more details.

2. White paper: Optimizing Patient Dose. Agfa HealthCare provides technology and tools for patient X-ray dose reduction. Authors: Dirk Vandenbroucke, Bruce Apgar, Tom Bertens; Date: October 2014.
The CBCT technique is normally used in head and neck area for dento-maxillofacial, sinonasal and cervical spine imaging. Until recently, temporal bone imaging has typically been done with multi-detector CT (MDCT). An issue related to CBCT in this anatomical area is the thick bony mass that surrounds the small details of the middle and inner ear. When the narrow cone shaped beam is localized to the small field-of-view (FOV), this bony mass, which is outside of the target area, significantly attenuates the X-rays before and after they pass the region of interest and therefore pose challenges to the image formation. The MDCT technique covers axially the whole head and hence does not have this problem, but at the expense of a considerably higher radiation dose. The usefulness and diagnostic capability of the CBCT technique in the temporal bone area is demonstrated in the following three case reports.

**Case reports**

The CBCT unit used in this study is SCANORA® 3D (SOREDEX, Tuusula, Finland) with the technical factors of 90 kV, 75 mAs. The patient was stabilized in seated position in order to minimize movement artifacts. With the used device, the FOV size can be selected according to the volume to be imaged. The small FOV of 75x100 cm was used as it can be accurately located to the temporal bone region. The voxel size was 133 μm. The effective dose was approximately 0.03 μSv, 0.06 mSv for both sides of temporal bone imaging. The effective dose of a 16 slices MDCT is approximately 1 mSv.

**Case 1**

A) The coronal reformatted CBCT image shows the presence of a diffuse soft mass in the area of the epi-tympanum of the middle ear medial to the incudo-malleolar bony joint, which does not show any signs of bony destruction suspicious of otitis media and soft tissue complications. B) The axial reformatted CBCT image shows the presence of tympanosclerosis leading to thickening of the tympanic membrane without perforation (tympanosclerosis). Also the presence of a former atticomastoidecctomy is well seen with the presence of a soft tissue graft. A part of the aerated Eustachian tube is seen. C) A sagittal reformatted CBCT image of the right temporal bone shows the presence of a non-specific inflammatory soft tissue mass in the epitympanum without any bony destruction. D) The sagittal reformatted CBCT image shows that the incudo-malleolar joint is intact. The longitudinal area of the facial canal is visualized.

**Case 2**

A) and B) The sagittal and coronal reformatted CBCT images show the presence of a mild amount of fluid in the mastoid bone in the area of the antrum. The scutum appears normal and the presence of mild soft tissue thickening is seen in the external auditory meatus. C) and D) Axial images show the presence of fluid in the mastoid cavity. Also the presence of soft tissue thickening in the anterior and posterior walls of the external auditory meatus is seen. The posterior part of the Eustachian tube is well aerated. The aditus ad antrum is clearly visible.

**Case 3**

A) The Coronal CBCT image of the right temporal bone shows the rounding of the scutum due to disintegrated cholesteatoma and a small bony defect in the area lateral to the tympanic membrane. B) MDCT reformatted image, which is identical in identification. C) CBCT image D) Axial MDCT of the same right temporal bone showing that the bony details are seen as much more homogenous than in the CBCT image (C).

**Conclusion**

Although it has been known that the bony details of the temporal bone area are well seen on CBCT, the major difference in comparison with MDCT is the homogenous bony disposition of the bone seen on a MDCT image. However, the use of CBCT can be recommended in cases of soft tissue changes, like in otitis media and larger cholesteatoma masses, which affect the destruction of the temporal bone regardless of the fact that the quality of the soft tissue mass on a CBCT image is non-specific. This recommendation is based on two clear advantages pro-
duced by the CBCT technique; firstly, the amount of radiation is 16 or even 32 times less in CBCT, and, secondly, the margins of the soft tissue masses and the bony details are visualized much better on CBCT than on MDCT. The amount of radiation by MDCT can naturally also be reduced by using iterative reconstruction techniques, but while considering the correct imaging modality for the temporal bone area, it is worthwhile to keep in mind that CBCT is a cost-efficient, low dose alternative available.

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-2015-China_International_Medical_Equip ment_Fair.html

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Deadline for pre-registration: 26th April 2015
iPad screenings effective for detecting early signs of glaucoma in underserved, high-risk populations

Using a tablet screening app could prove to be an effective method to aid in the effort to reduce the incidence of avoidable blindness in populations at high-risk for glaucoma with limited access to healthcare, according to a study released today at AAO 2014, the 118th annual meeting of the American Academy of Ophthalmology. In this study, researchers from the University of Iowa, the University of Maryland, Johns Hopkins University, the University of Michigan, and the Tilganga Eye Institute in Nepal used a free peripheral vision assessment app to screen approximately 200 patients in Nepal for glaucoma using an iPad. The results show promise for screening populations that have limited or no access to traditional eye care and certain ethnic groups that have a high risk of developing the disease.

Glaucoma is the second leading cause of blindness worldwide, affecting more than 60.5 million people. The disease can be effectively treated; however, it generally does not present symptoms in its early stages, resulting in many patients being unaware that they suffer from the condition until it progresses to later stages. Early diagnosis can easily be achieved through a routine examination from an ophthalmologist or an optometrist.

In order to determine if a screening test using mobile technology could be effectively administered to communities outside of a traditional clinical setting, the research team used the Visual Fields Easy app, which simulates a visual field test on an iPad (1st Generation), to screen more than 400 eyes for glaucoma.

Approximately half of the eyes screened were healthy “control” eyes and the other half were eyes with glaucoma. The researchers compared the screening results to those from the traditional industry standard visual field test, known as the Humphrey SITA Standard 24-2, and found that the two tests agreed between 51-79 percent of the time. The best agreement was in patients with moderate and advanced visual field loss, while there was less agreement in patients with mild visual field loss. The researchers believe this was due to a high false positive rate for normal controls. While the agreement rate and cost-benefit ratio of the results were not strong enough to support using the method for screening general populations, the researchers believe that conducting screenings using a tablet can be an effective initial screening tool for high-risk groups, such as people of African or Hispanic ancestry, the elderly and people with limited or no access to traditional eye and healthcare.

In addition, the screenings lasted an average of 3 minutes and 18 seconds – less than half the average time needed for the Humphrey SITA Standard test.

“Visual field testing equipment is neither portable nor affordable to some populations around the world, limiting entire regions from accessing health and eye care,” said lead researcher Chris A. Johnson, Ph.D., director of the Visual Field Reading Center at the University of Iowa.

“Although not perfect, the tablet glaucoma screening method could make a significant difference in remote locations where populations would not otherwise receive screening at all.”

American Academy of Ophthalmology
http://tinyurl.com/t5elaq

MRI machine provides in-depth analysis of strokes

New research conducted at the National High Magnetic Field Laboratory has revealed a new, innovative way to classify the severity of a stroke, aid in diagnosis and evaluate potential treatments.

“Stroke affects millions of adults and children worldwide,” said Sam Grant, MagLab researcher and associate professor of chemical and biomedical engineering at the FAMU-FSU College of Engineering. “This research offers a new technique for the chemical analysis of metabolites during stroke and a means of evaluating dynamic changes in cell processes and size in living tissue.”

The new technique is a way of narrowly applying energy to the metabolites of a specimen exposed to a very high magnetic field. Metabolites are the biological compounds used in the chemical process of breaking down food or other chemicals into energy and producing new materials. By selectively “exciting” these metabolites and analysing their distribution and confinement in brain tissue, the research team can investigate the metabolic microenvironment and tell whether cells were shrinking or expanding, a critical tool to understanding the severity of stroke, Grant said.

That information could help medical professionals better treat patients. The MagLab’s flagship 900 MHz Ultra Widebore NMR magnet system was a critical component to the research. Utilizing this powerful magnet, the research team, which included scientists from the Champalimaud Center in Portugal and the Weizmann Institute of Science in Israel, were able to acquire localized chemical signatures of metabolites from 125-microliter volumes within the brain with high sensitivity and fidelity in six seconds.

The National High Magnetic Field Laboratory
http://tinyurl.com/p53oo6v

‘Dead’ heart transplant ‘huge breakthrough’

In a world first, Australian surgeons have successfully transplanted “dead” hearts into patients at Sydney’s St Vincent’s Hospital. The procedure, using hearts that had stopped beating, has been described as a “paradigm shift” that will herald a major increase in the pool of hearts available for transplantation.

Until now, transplant units have relied solely on still-beating donor hearts from brain-dead patients. But the team at St Vincent’s Hospital Heart Lung Transplant Unit announced on Friday they had transplanted three heart failure patients using donor hearts that had stopped beating for 20 minutes.

Two of them have recovered well, while the third, who recently undertook the procedure, is still in intensive care. Cardioangiologist Prof Peter MacDonald said the donor hearts were housed in a portable console coined a “heart in a box”. Here they were submerged in a ground-breaking preservation solution jointly developed by the hospital and the Victor Chang Cardiac Research Institute.

The hearts were then connected to a sterile circuit where they were kept beating and warm.

Cardiothoracic surgeon Assoc Prof Kumud Dhital, who performed the transplants with hearts donated after circulatory death (DCD), said ‘The incredible development of the preservation solution with this technology of being able to preserve the heart, resuscitate it and to assess the function of the heart has made this possible. In many respects this breakthrough represents a major inroad to reducing the shortage of donor organs.'

TransMedics
http://tinyurl.com/k5v8zgk
Breast centre certification in Europe

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ABSTRACT: Certification procedures help to improve the quality process by modifying organizational and clinical attitudes to the benefits of increased quality in the standards of care. It provides a critical attitude towards daily work and requests to dedicate sufficient time to multidisciplinary analysis on breast centre organization activity and performance. Breast Centres Certification (BCCERT) is a nonprofit association, operating in compliance with international standards on certification, which carries out voluntary certification of breast centres based on the requirements of the European Society of Breast Cancer Specialists (EUSOMA) and aims to improve and standardize the level of patient care throughout Europe.

Certification des centres de médecine mammaire en Europe

La procédure de certification participe au processus de qualité en améliorant les comportements administratifs et cliniques, et donc les critères de soins. Elle nécessite une attitude critique vis-à-vis du travail quotidien et oblige à consacrer le temps requis à l'analyse multidisciplinaire sur les activités et les performances des centres de médecine mammaire.

Breast Centres Certification (BCCERT), Certification des centres de médecine mammaire est une association sans but lucratif qui fonctionne dans le respect des normes internationales de certifications, et gère la certification volontaire des centres de soins mammaires conformément aux exigences de l'European Society of Breast Cancer Specialists (EUSOMA, société européenne des spécialistes du cancer mammaire), dans le but d'améliorer et de standardiser le niveau de soins des patients dans toute l'Europe.

The rehaVital Stroke Network: An integrated, post-discharge, patient care model initiated by durable medical equipment specialists

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ABSTRACT: ABSTRACT: Outpatient care for patients with chronic illnesses in Germany (e.g., stroke patients) is currently fragmented, with little interconnectivity among the different care providers. After being cared for in a highly structured inpatient environment, patients are often discharged alone with limited supportive care at home. With the goal of accompanying patients on their way back to autonomous mobility and social participation, rehaVital members developed an integrated care model. In this model, patients’ perspectives and needs are recognized as central determinants in their post-discharge care.
The willingness of and barriers to Korean health care providers participating in a humanitarian assistance field hospital responding to an urgent global health crisis

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ABSTRACT: Purpose: As the number of disaster and humanitarian crisis increases, there is an emphasis on the prompt dispatching of humanitarian assistance field hospitals (HAFHs) in order to relieve a disaster-stricken society as soon as possible. The participants’ individual motivation constitutes one of the most important factors in achieving successful HAFH activities. The aims of this study are to evaluate health care providers’ willingness to participate in HAFHs when there is an urgent global health need and to examine their motives, perceived barriers, and concerns using a simulated global disaster scenario. Results: Seventy health care providers completed a survey which asked about their willingness to join a HAFH that was being dispatched immediately. Forty-five of the 70 respondents (64.3%) answered that they were willing to join an HAFH, which departed within 24 hours of a hypothetical earthquake. The major perceived barriers to participation in an HAFH included “pre-scheduled work commitments in home institutions,” “insufficient support from home institutions,” and “insufficient field safety and security.” Conclusion: Policy-makers need to proactively establish support from the institutions that employ disaster-related health care providers, in order to secure their participation in HAFHs and to ensure optimal preparedness for global disaster relief.

Volonté des prestataires de soins de santé des urgentes mondiales de santé

Objectif : A mesure qu'augmente le nombre de catastrophes et de crises humanitaires, il importe d'axer les efforts sur la mise en place d'hôpitaux de campagne d'assistance humanitaire (humanitarian assistance field hospital, HAFHs) pour parer le plus rapidement possible aux besoins des populations prises de panique. L'un des facteurs les plus importants pour la réussite des activités des HAFH est la motivation personnelle des participants. Les objectifs de cette étude sont d'évaluer si les agents de santé sont disposés à travailler dans les HAFH lors d'urgences sanitaires mondiales et d'examiner leurs motifs, les obstacles qu'ils redoutent et leurs préoccupations grâce à un scénario de simulation de crise mondiale.

Résultats: Soixante-dix prestataires de soins ont mené à bien une étude leur demandant s'ils accepteraient de travailler aux répartitions d'urgence au moyen des HAFH. Quarante-cinq des soixante-dix répondants (64,3%) ont répondu qu'ils accepteraient de travailler avec les HAFH, qui partent dans les 24 heures qui suivent un hypothétique tremblement de terre. Les principaux obstacles perçus à la participation aux HAFH étaient "des engagements de travail déjà pris avec leurs..."
The well-being and mental health of male and female hospital doctors in Germany

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Abstract: This study focuses on the associations between subjective well-being and mental health. In addition, gender differences are evaluated. The research was conducted as a cross-sectional online survey using a standardized questionnaire to assess physicians’ mental health and well-being. Results have shown moderate scores for mental health and well-being in physicians. In general, male physicians perceive a better well-being and higher mental health score than female physicians. Well-being and mental health should be improved to increase physicians' work ability and subsequently, the quality of treatment and patient satisfaction. Mental health prevention should be more widely implemented in hospitals, and its awareness and early treatment should be encouraged. Mental health interventions might include modifying physicians' daily work schedules, providing curricula on mental health and offering training on the awareness of distress and well-being.

Bien-être et santé mentale des médecins hospitaliers des deux sexes en Allemagne

Cet article porte sur le bien-être subjectif et la santé mentale et leurs relations. Les différences entre les sexes sont également évaluées.

L'enquête a été menée par une étude transversale en ligne en utilisant un questionnaire standardisé pour évaluer la santé mentale et le bien-être de médecins. Les résultats montrent des scores modérés de ces paramètres. En général, les médecins hommes donnent des scores plus élevés de bien-être et de santé mentale que les médecins femmes. Un bon niveau de bien-être et de santé mentale devrait améliorer la capacité de travail des médecins et par conséquent, la qualité des traitements et la satisfaction des patients. Il problème est qu'un traitement précoce. Les interventions de santé mentale pourraient inclure la modification des horaires de travail des médecins et des programmes de formation en santé mentale et de prise de conscience du bien-être et de la dépression.

The effects of hospital reforms on the management of public hospitals in Tanzania: Challenges and lessons learnt

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Abstract: Although hospital reforms are being advocated internationally as part of a solution to hospital management problems in developing countries, studies have shown that they do give rise to some challenges. A study was undertaken that used in-depth interviews, focus group discussion and document review to examine hospital reforms. The article examines the effects of reforms on the management of Level II public hospitals in Tanzania and documents the related challenges and lessons learnt. It is shown that hospital reforms have mixed effects in resource-strained hospitals, and that hospital reform actions may have replaced the bureaucratic inefficiencies associated with hospitals being managed from the central level (MoHSW) with the equally bureaucratic inefficiencies that characterize the management of these hospitals from a supposedly local level, the office of the Regional Administrative Secretary (RAS). Managing hospitals from this level seems to cause many hospital management problems to be left unattended.

Effets des réformes hospitalières sur la gestion des hôpitaux publics en Tanzanie: Défis et leçons

Bien que l'on ait préconisé une réforme des hôpitaux à l'échelle internationale pour essayer de résoudre les problèmes de gestion hospitalière dans les pays en développement, des études ont montré que sa mise en œuvre se heurte à certaines difficultés. Une enquête a été menée pour évaluer des réformes hospitalières. Elle était basée sur des entretiens en profondeur, des discussions thématiques de groupe et l'examen de documents. Cet article examine les effets des réformes sur les hôpitaux.
publiés de niveau II de Tanzanie et rapportent les difficultés rencontrées et les leçons apprises. Il montre que les réformes hospitalières ont des effets mitigés sur les hôpitaux dont les ressources sont limitées, et que les opérations de réformes peuvent être remplacées l’inefficacité bureaucratique inhérente aux hôpitaux gérés au niveau centralisé (MOHSW) par une inefficacité bureaucratique comparable qui caractérise la gestion d’ces hôpitaux au niveau soi-disant local, le bureau du secrétaire administratif régional (Regional Administrative Secretary, RAS). La gestion des hôpitaux à ce niveau semble laisser beaucoup de problèmes non résolus de gestion hospitalière.
Personal dosimetry system monitors radiation exposure in real time in the interventional suite

Each year approximately 3.6 billion x-ray examinations are performed worldwide, leading to earlier and more accurate diagnosis of medical diseases. However, concern has been raised regarding the stochastic and even deterministic impact on both patients and medical staff. Authorized bodies have emphasized the importance of ensuring the proper performance of X-ray equipment and of keeping the dose to medical staff and patients as low as reasonably achievable (ALARA). Unfors RaySafe has developed comprehensive solutions to monitor and reduce radiation in the X-ray room.

Personal dosimetry
The most significant personnel doses in the hospital environment often occur in the interventional suite where fluoroscopy is performed. Recent studies have shown hospital workers who are routinely exposed to ionizing radiation are at an increased risk to cancer, cataracts and other health problems. These findings have forced radiation safety professionals to look at more effective methods to reduce personnel exposures.

In the past, health and medical physicists relied primarily on training and the use of shielding to reduce personnel exposures. They would then review passive dosimeter results months later in hopes of seeing a dose reduction. However, as interventional techniques grow longer and more complicated, this delayed method has become less effective. Some hospitals have tried to use electronic dosimeters to monitor staff exposures during interventional procedures to obtain more accurate dose measurements. However, this method is only minimally accurate. Some electronic dosimeters are not capable of accurately monitoring cumulative exposure in a pulsed radiation field as found in the fluoroscopy suite. Additionally, some are too heavy and are uncomfortable to wear, and all electronic dosimeters require the user to retrieve and view the LED display, which can occasionally be difficult to read. As a result, efforts to achieve ALARA for staff in the interventional suite have been challenging and largely unsuccessful.

Unfors RaySafe, a Fluke Biomedical company, recognized the need for a more accurate dosimeter, and developed the RaySafe i2 system to overcome the limitations of passive and conventional electronic dosimeters. In 2012, RaySafe introduced the i2, an active dosimetry system that gives real-time insight about personal radiation exposure, as well as access to time stamped dose date. The i2 wirelessly transmits exposure rate data to a large display monitor at the centre of every interventional suite. Displaying exposure rate and cumulative data allows each individual to make real-time adjustments such as shielding to immediately see the results of their efforts to achieve ALARA during interventional procedures. A study by the University of Rochester showed a 50 percent reduction in staff dose over a nine month period as the result of using these real-time personal dosimeters.

A primary challenge of real-time dose monitoring is in pricing to compete with passive dosimetry. However, as any radiation safety officer knows, the more significant cost of a dosimetry programme lies not in the cost of the dosimeters, but in the time and resources needed to collect and distribute dosimeters on a monthly and quarterly basis, and in the unpopular task of chasing after unreturned badges. Anything which can reduce or remove this administrative burden will be welcomed. The move from passive dosimeters being used only “to demonstrate compliance” to the use of real-time dosimeters to “demonstrate compliance AND achieve ALARA” is fast approaching.
CT system enables scanning of most challenging patients

With the convergence of whole organ coverage, image quality, and speed found in GE Healthcare’s Revolution CT scanner, physicians are now able to diagnose even the most challenging patients. This innovative technology can help clinicians to diagnose more patients with erratic or high heart beats and also provide pediatric patients with sedation-free and low-dose scanning capabilities, among other clinical advances. The wide coverage of Revolution CT allows healthcare providers to scan entire organs such as the brain, heart, liver and pancreas, in a single 0.28 sec rotation reducing breath hold times for patients. Also, the speed of this new technology allows providers to gather information about function as well as anatomy, enabling a comprehensive stroke assessment of the brain in a single exam. Revolution CT comes equipped with ASiR-V, GE’s next generation of low dose technology which routinely reduces dose up to 82% with the same image quality. Furthermore, patient anxiety can be reduced as the scanner is 50% quieter than previous generation CTs while providing soft ambient lighting and personalized gantry displays. It can comfortably accommodate more patients with a larger 80 cm bore size. Patients may not be required to take special medication to slow their heart rate for a diagnostic cardiac exam due to Revolution CT’s fast imaging speed. Revolution CT delivers high definition imaging across the entire body, across all applications, including cardiac exams in a single heart beat; whole brain imaging in less than a second; low dose, whole organ diagnosis and follow-up for oncology patients; detailed boned imaging, even for patients with metal implants; and sedation-free and low dose scans for pediatric patients.

Anesthesia workstation

The latest ADSII features the same sturdy construction as previous models but now offers the latest advancements in anesthesia delivery and patient ventilation. The ADSII provides extremely accurate fresh gas delivery via electronic flowmeters. The ADSII ventilator has been upgraded with a larger 10.1 inch colour screen with more ventilation modes and a user-friendly software interface. Many advanced patient monitoring options are available with the ADSII, particularly auto ID anesthetic agent measurement, EtCO2, 12 lead ECG, invasive blood pressures, and cardiac output.

MINDRAY

www.ihe-online.com & search 46779
Adjustable nebulizer

The next generation A3 Complete Nebulizer provides the complete nebulization solution for asthma and other respiratory conditions. A single device allows fast relief for upper, mid and lower airways, by simply selecting the correct nebulization position. Most nebulizers have only one position, delivering a single average range of particle sizes (normally 4-5 microns) and therefore they are not fully effective in the entire range of respiratory conditions, targeting mainly conditions in the lungs. 80% of asthma patients also suffer from upper airways diseases like rhinitis and sinusitis. The Omron A3 complete adjustable nebulizer is specially designed for the treatment of the upper, middle and lower airways. The easy nebulization control features three positions: position 1 delivers a particle size of over 7.5 microns and is used for nebulization treatment of patients who suffer from disorders of the upper airways (e.g. rhinitis, sinusitis, pharyngitis, tonsillitis, laryngitis); position 2 generates a particle size of 4.5 to 7.5 microns, suitable for nebulization treatment of patients who suffer from disorders of the middle airways (e.g. tracheitis and tracheobronchitis); position 3 covers the 2-4.5 micron particle size range for nebulization treatment of patients who suffer from disorders of the lower airways (e.g. asthma, bronchitis, bronchiolitis, bronchiecstasy, bronchopneumonia).
Enterprise imaging system

Agfa Healthcare’s Enterprise Imaging for Radiology system now offers new features and options that include enhanced functionalities for collaboration, reporting and viewing, and off-site-hosted deployment. This unified imaging management platform offers a powerful task-based workflow designed to achieve gains in clinical productivity and optimizes total cost of ownership. New features enhance the ease of use and diagnostic value of radiology reports. Sectional, structured, standardized reporting lets tables and measurements be directly imported into the report, saving the radiologist time and improving accuracy. Key images are also automatically inserted into the report, for greater diagnostic value for the clinician. Advanced visualization tools can be embedded into the diagnostic and review workflows without starting a separate application. This includes 3D segmentation tools, 3D registration for improved synchronized navigation for multi-modality and follow-up examinations, PET-SPECT fusion support and full multi-modality women’s imaging support, including digital breast tomosynthesis. Increasingly, hospitals are looking for new deployment models for implementing solutions that better meet their financial strategies and goals.

AGFA HEALTHCARE
ECR 2015 Stand 103, Expo A
i www.ihe-online.com & search 46785

Enhanced digital mobile X-ray system

The MobileDaRt Evolution, EFX version digital mobile X-ray system can be moved to any location where radiography is required. It is equipped with a wireless flat panel detector (FPD) and broadens its applications from clinical rounds in hospitals to critical care and applications at disaster sites, as well as operating rooms and neonatal intensive care units. New features improve safety, processing speed, and save energy. Instead of a traditional hard disk drive, the new vibration resistant DR unit uses a high speed vibration resistant solid-state drive (SSD), thereby reducing the risk of data loss. In addition, the conventional system startup time has been reduced to +/- 1 min, allowing rapid radiography in an emergency. The new energy saving collimator with bright irradiation field uses LEDs as the light source to indicate the irradiation field, increasing the brightness and contributing to improved operability for the technologist. This reduces power consumption to approximately one half of conventional levels while ensuring a long operating life, reducing periodic maintenance requirements. The LCD monitor has a wide viewing angle, displaying high quality images that can be viewed from a wide range of positions around the unit. The addition of a new FPD increases the speed of internal processing, shortening the preview image display time to 2 secs, contributing to improved procedural efficiency. The 17 x 17” FPD (CXDI-401 Wireless) design provides an IPX4 level of splash protection, so the unit is resistant to liquid penetration, making it suitable for operating rooms and emergency rooms.

SHIMADZU
ECR 2015 Stand 325, Expo C
i www.ihe-online.com & search 46786
Two-in-one critical care ventilator

The V680 ventilator for hospital respiratory care, offering both invasive and non-invasive ventilation, is designed for smoother transition from ventilation to natural breathing and helps enhance patient care and minimize ventilator-associated infection rates. It has been developed in partnership with physicians, leading to customized technology that can be simply and quickly adjusted to respond to patient needs. The goal is to speed the time to non-invasive ventilation, ultimately reducing hospital stays and the associated cost burden. Non-invasive ventilation (NIV) has become a standard of care for the management of acute respiratory failure, but there is a risk of leaks around the mask that may interfere with ventilator performance. As a result, patient-ventilator asynchrony, defined as a mismatch between the patient’s inspiratory time and the ventilator insufflation time, occurs in nearly 25 per cent of intubated patients. These high rates of asynchrony are associated with a higher incidence of weaning failure and tracheostomy, prolonged mechanical ventilation, fatigue, increased sedation needs and longer hospital stays. A recent study to compare patient-ventilator synchrony during NIV between ICU, transport and dedicated NIV ventilators, found the use of a NIV ventilator on critically ill patients led to a significant decrease in the incidence of patient-ventilator asynchrony. Moreover, dedicated NIV ventilators exhibited more standardized behaviour during the investigation, with an ability to avoid auto-triggering or delayed cycling while keeping a short triggering delay despite the presence of leaks. The Philips V680 Ventilator is launched in several European markets. US launch is pending 510(k) clearance.

PHILIPS HEALTHCARE

Thales is presenting the expansion of their portable detectors range, innovative solutions for digital mobile X-ray, surgical solutions as well as the new generation GigE camera for conventional image chain. The new products include the Pixium Portable 3543 EZ which is now available with a Gadox scintillator. A new detector, Pixium Portable 3543 EZh-C with integrated handle mechanics, will also complete the range. In addition, Pixium 2121S-A is the new flat panel for surgical C-arms and a true alternative to conventional image chains. Its new generation CsI and innovative pixel design brings unrivalled image quality at low dose. Compact design and new software features provide critical advantages for simplified integration. Finally, TH 8770, the new generation GigE Vision CCD camera based on Thales experience in conventional X-ray imaging, is designed for a perfect match with X-ray image intensifiers.

THALES ELECTRON DEVICES

Cobia users can now benefit from the advantages offered by the Ocean 2014 software – the possibility to use a tablet or a PC, saving data to a computer, printing reports, using analyses and more. Ocean 2014 exhibits the Cobia’s capabilities and makes workflow more practical and simple. With Ocean 2014 and a PC or tablet, it is now possible to control the Cobia Flex more easily and save time. Ocean allows the user to perform remote X-ray QA measurements by simply connecting to the Cobia Flex instrument via Bluetooth or with a USB cable to a PC or tablet. With the addition of Ocean Professional, QA work is simplified – sensitivity, kV-ranges or waveform types can be set automatically. Supported Cobia models include all Cobia Flex models as well as Cobia Sense with PC communication. The software requires Windows 8, Windows 7 or Vista.

RTI ELECTRONICS
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Your smallest patients are a big priority at Agfa HealthCare as children are more sensitive to radiation and its cumulative effects. Therefore, we design our dedicated pediatric and neonatal digital radiography solutions to deliver the optimum balance between low radiation dose and high image quality. Our dose-efficient Cesium detectors are available with both direct radiography (DR) and computed radiography (CR) systems. They can help you reduce dose for pediatric and neonatal applications up to 60%, depending on the examination and conditions. And our patented MUSICA image processing software plays a role, too, providing excellent image quality and greater diagnostic confidence with low-dose pediatric images.

Learn about Agfa HealthCare at www.agfahealthcare.com

* Testing with board certified Radiologists has determined that Cesium Bromide (CR) and Cesium Iodine (DR) Detectors when used with MUSICA processing can provide dose reductions of between 50 to 60% when compared to traditional Barium Floro Bromide CR systems. Contact Agfa HealthCare for more details.